ESSENTIAL SKILLS FOR Struggling Learners

A FRAMEWORK FOR Student Support Teams

Erik von Hahn
Sheldon H. Horowitz
Caroline Linse

Essential Skills for Struggling Learners

A Framework for Student Support Teams

by

Erik von Hahn, M.D.
Developmental-Behavioral Pediatrician
Center for Children with Special Needs, Floating Hospital for Children
Associate Clinical Professor of Pediatrics
Tufts University School of Medicine
Boston, Massachusetts

with

Sheldon H. Horowitz, Ed.D.
Senior Advisor
National Center for Learning Disabilities
Washington, DC

Caroline Linse, Ed.D.
Senior Lecturer
School of Social Sciences, Education, and Social Work
Queen's University Belfast
Belfast, Northern Ireland

PAUL H. BROOKES PUBLISHING CO.®

Baltimore • London • Sydney

Paul H. Brookes Publishing Co.
Post Office Box 10624
Baltimore, Maryland 21285-0624
USA

www.brookespublishing.com

Typeset by Progressive Publishing Services, York, Pennsylvania.
Manufactured in the United States of America by Sheridan Books, Inc., Chelsea, Michigan.

The information provided in this book is in no way meant to substitute for a medical or mental health practitioner's advice or expert opinion. Readers should consult a health or mental health professional if they are interested in more information. This book is sold without warranties of any kind, express or implied, and the publisher and authors disclaim any liability, loss, or damage caused by the contents of this book.

The individuals described in this book's case examples are composites or real people whose situations are masked and are based on the authors' experiences. In all instances, names and identifying details have been changed to protect confidentiality.

Figures 1.1, 1.2, and 2.1 were created by Holly R. Fischer, MFA, Ann Arbor, Michigan.

Library of Congress Cataloging-in-Publication Data

Names: Hahn, Erik von, author. | Horowitz, Sheldon H., author. | Linse, Caroline T., author.
Title: Essential skills for struggling learners: A framework for student support teams / by Erik von Hahn with Sheldon H. Horowitz and Caroline Linse.
Description: Baltimore: Paul H. Brookes Publishing, Co., [2020] | Includes bibliographical references and index.
Identifiers: LCCN 2019008002 (print) | ISBN 9781681252551 (pbk.)
Subjects: LCSH: Learning disabilities. | Learning disabled children—Education. | Slow learning children—Education. | Remedial teaching.
Classification: LCC LC4704 .H337 2020 (print) | LCC LC4704 (ebook) | DDC 371.9—dc23
LC record available at https://lccn.loc.gov/2019008002
LC ebook record available at https://lccn.loc.gov/2019980460

British Library Cataloguing in Publication data are available from the British Library.

2023 2022 2021 2020 2019

10 9 8 7 6 5 4 3 2 1

Table of Contents

About the Authors

Erik von Hahn, M.D.

Dr. Erik von Hahn has worked with children with diverse disabilities for more than 20 years. He has extensive consultative relationships with schools, especially in Massachusetts, and earlier in his career in New Hampshire. He has developed a deep understanding of children with disabilities, as seen through the lens of the school professionals who serve them.

In addition to his consultative practice with schools, Dr. von Hahn maintains a clinical practice in a teaching hospital. He uses his experience working with schools to help families in the clinic communicate successfully with their child's school team. As part of his academic duties, Dr. von Hahn has substantial teaching duties with Tufts University School of Medicine. He provides training and supervision of future Developmental-Behavioral Pediatricians, future general pediatricians, and future allied health care professionals in social work, speech pathology, and psychology. Finally, Dr. von Hahn provides regular continuing education services to both educators and local general pediatricians in their practice. Successful service to children with disabilities occurs when adults can work successfully with one another. All of Dr. von Hahn's clinical and teaching encounters emphasize service to children with disabilities through collaboration among home, school, and clinic.

Sheldon H. Horowitz, Ed.D.

Dr. Sheldon H. Horowitz is a Senior Advisor at the National Center for Learning Disabilities. Prior to his arrival at NCLD, he directed hospital-based evaluation and treatment programs in outpatient psychiatry and in developmental and behavioral pediatrics, as well as having taught at the primary, secondary, and college levels, and served as a consultant to school districts throughout the New York City metropolitan region. He has published in the areas of fetal alcohol effects in children, language-based learning disabilities, and disorders of hyperactivity and attention and has contributed content and expertise to several web sites in the area of learning disabilities. Dr. Horowitz is a regular presenter at professional conferences and is frequently cited in the popular press on topics including parenting children with learning disabilities and other special needs, attention-deficit/hyperactivity disorder, assessment and evaluation, evidence-based interventions, parent advocacy and special education policy reform, post-secondary transition, and LD throughout the life span.

Caroline Linse, Ed.D.

Dr. Caroline Linse is a Senior Lecturer at Queen's University, Belfast, where she teaches in the School of Social Sciences Education and Social Work. She teaches in the TESOL (Teaching English to Speakers of Other Languages) program and works directly with current and future teachers who must address cultural and linguistic diversity as a core element of the instruction that they deliver. She has worked in a variety of countries with learners and teachers from different cultural and linguistic traditions.

I

Neurological Frameworks

1

Vision Skills

INTRODUCTION AND GENERAL DEFINITIONS

Section I focuses on neurological functions and associated skills necessary for learning. Although all of the skill sets discussed in this book have a neurological basis, the three discussed in this first section (vision, hearing, and motor skills) are especially dependent on intact biological structures. The term *neurological* is used for this section to highlight the importance of biology. Without intact neurological structures, it is more difficult for students to develop the skills that are discussed in this chapter and the two that follow. This chapter is focused on vision and will introduce key components of vision, all of which are critical to successful functioning at school and elsewhere.

As a first step, it is important to recognize that vision is a complex skill set that includes unique and separate components. Because of the many skills discussed in each chapter, frameworks were organized into skill sets and skills. The term *skill set* refers to a category or group of skills. Skill sets are further divided into component functions and skills. When one considers all of the skills that make up each framework, the importance of categorizing skills this way becomes clear. For example, normal vision does not include only the function or the skill of seeing objects clearly at near and at a distance. Normal vision includes many other functions and skills, such as the capacity to see clearly, even if lighting conditions change. Normal vision includes being able to use of the full field of vision, extending nearly 180 degrees in all directions and involves the ability to see colors. It allows for the capacity to notice subtle differences in reflected light to make out differences in depth or surface texture, a capacity used to notice changes in ground surfaces while walking or in facial expressions while speaking to a friend. Vision not only allows us to understand three-dimensional space that is visible but also allows us to understand three-dimensional space that is imagined. Further, normal vision is dependent on motor skills. The motor skills required to move the eyes allow us to look at and focus on objects that are either stationary or moving, as well as to look at and focus on objects, while we are ourselves moving. In sum, vision consists of many skills. Impairments in any of the different components that contribute to vision can interfere with the functions and skills just listed and can affect participation at school and elsewhere. As will be evident later in this chapter and throughout the book, it is important and challenging to organize so many skills into a logical framework.

The reader will notice that these first chapters (vision, hearing, and motor skills) list anatomical structures in addition to skill sets and skills. This chapter first presents key aspects of visual anatomical structures. The Vision Skills Framework then introduces the visual functions and skills that are so important to learning. The chapter goes on to explain how to set up an observation and how to build an intervention plan or an individualized education program (IEP) with objectives and strategies focused on vision. It wraps up with a Case Example of a child with a vision impairment and provides a brief summary and conclusion.

There are four anatomical and functional aspects to vision:

1. Ocular muscles
2. Ocular structures: Cornea, pupil, iris, lens, and retina
3. Connections between the eye and the brain: Optic nerve, optic chiasm, optic tract, and geniculate body (These connections and the connections to the visual cortex are collectively referred to as the *visual axis*.)
4. Neurological structures that support visual processing by the brain: Connections between the geniculate body and visual cortex; connections between the visual cortex and other parts of the brain

Each of these aspects is discussed in more detail in the framework section that follows.

TERMINOLOGY USED IN CONSTRUCTING EACH OF THE FRAMEWORKS OF THIS BOOK

Each chapter uses information about typical child development to identify functions, skill sets, and skills. This book differentiates biological structures and functions from skills and abilities that emerge through typical child development and through learning. One way to consider these different terms is from the perspective of nature versus nurture. *Nature* refers to the neurological or biological endowment of the child, with its associated structures and functions. *Nurture* refers to the experiences, education, and training that children receive that help to shape the way the brain develops and allow them to perform successfully in the world. To lay the groundwork for all the frameworks presented in the book, this section will discuss the nature–nurture distinction at greater length, using vision as an example.

In this book, the term *nature* pertains to bodily structures and functions. Bodily structures are anatomical parts of the body such as organs, limbs, and their components. Body functions are the ways that body parts and systems work, including psychological and neurological functions of the brain (World Health Organization, 2007). Examples of bodily functions and structures include breathing by the lungs, digesting by the gastrointestinal tract, and movement by the muscles. In the case of vision, bodily structures include the lens of the eye (and its function of focusing light rays on the retina) and the retina (and its function of transforming light information into electrical impulses that are then delivered to the brain). These structures and their associated functions are all largely present at birth, though some changes occur with growth and development following birth. For example, in the case of the eyes, some visual functions, such as visual acuity, change with growth and development in the first year or two of life. Like most bodily functions, visual functions emerge early in life and do so in a largely spontaneous manner as long as the infant or toddler maintains good health. Vision is therefore primarily about the unfolding of nature rather than the influence of nurture. The three neurological frameworks of this book (i.e., vision, hearing, and motor skills) are all categorized in this way.

Nurture, in contrast, refers to the experiences, education, and training that children and youth receive over time. Nurture also includes the responsiveness of the environment to the child. Nurture allows the child's nature to flourish and expand into a variety of skills and abilities. Skill sets and skills emerge from intact neurological and bodily structures and functions but only when children and youth are provided with the right environmental stimulation, training or practice, and education (nurture).

Skills are learned capacities that develop through nurture. Skills do not involve the use of any assistive devices, technologies, or accommodations. *Skills* and *skill sets* refer to most of the behaviors discussed in this book, such as interpreting visual information and its three-dimensionality, listening to sounds and identifying words, using the motor system to walk or run, manipulating the tongue and lips to produce speech, making a decision to go outdoors instead of watching television, or thinking about someone else's feelings by paying attention to his or her behaviors. *Abilities*, in contrast, refer to behaviors that make use of tools, assistive devices, technologies, and/or accommodations. Abilities are those skills that develop with tool use, use of instruments, or use of accommodations or supports. For example, using tools, a person can feed him- or herself using a spoon. Sometimes, a person needs adaptations of the spoon in order to self-feed, such as a larger handle to account for a clumsy grasp. Using a hearing aid, a person may be better able to listen and engage in conversation. Using a cane, a person may be able to walk. Using computer software, a person may be better able to use expressive language through a speech-generating device. This same logic applies to the ability to play the piano or the ability to draw. Abilities do not necessarily refer to the skills that students with disabilities develop through accommodations; they refer to any skill that emerges through use of a tool, an instrument, or a support of some kind. The distinction between skills and abilities is not always clear. That said, the distinction is useful conceptually, especially when students do not show the development of skills as expected but can perform successfully when accommodations are provided. For the purposes of this book, the distinction between skills and abilities chiefly applies to students who may need accommodations in order to perform as well as their peers.

This book is dedicated to a description of the early emerging skills and abilities seen in typically developing children and youth. This book presents the *essential skills* that children and youth need to thrive. Although these skills and abilities may seem to emerge in a spontaneous manner in typically developing children, most of them are dependent on successful child–environment interactions. They emerge through nurture, not from nature alone. Regardless of the framework, the terms *skill sets*, *skills*, and *skills-building* all refer to those skills that that emerge out of intact structures and functions and through typical child development. Biological and neurological functions undergo physical growth, develop and refine with age, and result in new skills and abilities. It is through healthy interactions with the environment and through education and training that children and youth develop these skills and learn how to perform successfully in the world. The skill sets and skills discussed in this book emerge in a relatively predictable manner in typically developing children. Each of the frameworks presented in this book lists these functions, skill sets, and skills in a hierarchy that proceeds from least to most. The hierarchy often mirrors typical child development but is not intended to provide an accurate description of child development. Rather, the frameworks are useful for organizing educational objectives in a developmentally appropriate manner.

The dividing line between each of these definitions (bodily structures and functions, skill sets, and skills) is not always crystal clear. Nonetheless, the distinctions among the three terms is useful conceptually. It helps to organize the presentation of information throughout the frameworks in this book. See Colenbrander (2010b) and Hyvärinen (2010) for a similar discussion of the same distinctions. See also Box 1.1, which places the discussion of nature and nurture into a larger context and highlights the importance of defining terms accurately.

BOX 1.1. Nature, Nurture, and the World Health Organization

The World Health Organization (WHO) highlights nature and nurture through its two classification systems: The International Classification of Diseases (ICD) and the International Classification of Functioning (ICF). The ICF has a version for children and youth, the ICF-CY (International Classification of Functioning–Children and Youth) (WHO, 2007).

(continued)

BOX 1.1. *(continued)*

The ICD focuses on body structures and bodily functions, which is a focus on nature. In contrast, the ICF focuses on a person's functioning in the environment and the environmental factors that can affect a person's activity and participation in life. Its focus is on nurture. Both the ICD (which fits into a medical model) and the ICF (which fits into a social model) are important in describing and cataloging a person's state of well-being and establishing healthy functioning. Both of these models can be considered and should not be seen as competing perspectives. That said, sometimes it is difficult to know which model is the right one to use for a given situation. Does disease or injury need to be eliminated, so that a person can function more successfully? Should the environment provide accommodations and reduce demands on the individual? Or does the individual need to develop skills and abilities? At what point does the student need intervention by a health care practitioner, support from a school professional, or a change of environmental demands? When might it be appropriate to stop focusing on nature and instead direct our attention to nurture? These questions pervade all the frameworks in this book and are important to consider as children and youth, especially those with disabilities, live their lives and receive services in different settings. Educational success and the successful participation of students with disabilities at schools depend on an understanding of the influence of nurture on nature. Just as is true for the two classification systems of the WHO, educators and professionals working in schools need to develop an understanding of where nature ends, where nurture begins, and the often complex and changing relationship between the two throughout the course of development.

Even though the educational model fits more closely with the social model, students' experiences in school are not simply about changing the environment or creating environmental opportunities. Education is the path to developmental growth. Education helps people develop skill sets, skills, and abilities. It changes people. We argue that education changes nature. It enhances the biological endowment of people by helping them build skills and abilities. Sometimes, the impact of education on nature is just as powerful as the impact of any medical intervention. The student who has impaired vision, hearing, or motor structures and functions can still learn to participate successfully in the world. The same holds true for all of the frameworks discussed in this book.

The difference between the three categories of frameworks presented in this book lies primarily in how much any framework is an expression of nature versus nurture. The first three frameworks (the neurological frameworks of vision, hearing, and motor functions and skills) rely more heavily on intact neurology and the successful unfolding of nature. However, this book will illustrate that vision, hearing, and motor functions must be nurtured over time and with experience in order to become more fully developed skill sets and skills. The last three frameworks (the educational frameworks for reading, writing, and math) are almost entirely the result of nurture. They depend on intact neurology, but only develop with explicit instruction and education. The middle section of this book, dedicated to the developmental frameworks, lies in between these two competing perspectives. The distinction between nature and nurture will be highlighted from time to time throughout this book.

At times, especially in the case of children with disabilities, nature does not supply all the structures and functions for the typical unfolding and development of important skills. Students can have a biological or structural limitation in vision, hearing, and motor skills just as they can have a biologically determined limitation in their development of language skills, executive skills, or emotion-management skills. These children and youth need more nurturing.

They need more explicit training or instruction to acquire skills that other children acquire more spontaneously or more easily. In some cases, certain skills cannot emerge successfully, because bodily structures or functions have been disrupted, are absent or underdeveloped, or are slow to develop. For example, a child with a vision impairment or with cerebral palsy may never fully develop some of the skill sets and skills discussed in this book. In such cases, children and youth may need to acquire compensatory skills, so that they can perform successfully. Similarly, a child with a language impairment, an impairment in executive skills, or an impairment in emotion-regulation may also need to acquire compensatory skills. However, many of the skills discussed in this book depend upon education and training and not just on biology. Nurture plays an important role. Compensatory skills are not always as well-developed as the skills that usually emerge when there is no impairment to begin with but can allow for very successful functioning. In some cases, compensatory skills only emerge through the use of accommodations. In this case, the compensatory skills are referred to as *abilities*. They are commonly dependent on technologies or accommodations. Whether because of biological limitations or lack of educational exposure, more nurture can help to build underdeveloped skills.

HOW THIS FRAMEWORK WAS CONSTRUCTED

The visual functions and visual skills described in this framework are discussed using terminology found in reference texts and review articles on the subject. The text that follows in this section represents a synthesis of information contained in the References section. There is relatively good agreement here about how to label and define the functions and skills related to vision, with only minor variations in terminology among authors. The reader is invited to review this chapter's references to deepen understanding of this important area of development.

HOW CAN THIS FRAMEWORK HELP ME?

This chapter is designed to serve as an introduction to important visual functions and visual skills. The terms and definitions in this chapter will help professionals to identify performance difficulties in vision, and to discuss with colleagues the vision functions and skills of students. The chapter provides important terms needed to communicate about a student's current function and his or her educational/therapeutic goals and objectives. For the expert, this chapter is designed to serve as a platform for teaching. By using the terms presented in this chapter, the expert can share his or her knowledge of vision with other less experienced colleagues through daily collaboration or through interprofessional training. The chapter also helps all professionals, no matter their experience, communicate with students and their families about key aspects of vision and visual skills.

In addition to sharing and defining important terms related to vision, the Vision Skills Framework can help school teams think strategically about how to optimize visual function and enhance visual skills for the student with a vision impairment. Although strategies to enhance visual functioning are especially important for the student with vision impairment, some of the strategies discussed in this chapter may also be useful to students who do not have a vision impairment. When visual information is presented optimally, a variety of students with and without disabilities may find it easier to focus their attention and complete their work. For example, use of computers to change font size, illumination, colors, or contrast can be helpful for students who become distracted or fatigued by excess visual stimulation. Judicious use of lighting, font size, color, and reduction of visual clutter (among other examples) can reduce visual processing demands for a student with significant cognitive impairments and thereby facilitate the student's focus on the content of the visual material instead. Students with limited cognitive skills can benefit from visually modified materials, such as photographs or fine line drawings, to communicate important concepts, instead of relying upon the interpretation of printed words or symbols. See Box 1.2 for additional examples. This chapter will introduce strategies to help school professionals optimize the presentation of visual information in their classrooms. The strategies do not always require special technologies or teaching methods and are often already available in general education classrooms. As noted above, many of these strategies do not need to be reserved only for students with a vision impairment.

BOX 1.2. Vision Is Important Everywhere

Consider how words, paragraphs, and other elements are presented in this chapter. Decisions about the visual organization of information on this page were made with the intention of improving visual attention. By using bold, large font for headings and subheadings, some information on the page is visually highlighted, whereas other information recedes into the background. Boxes signal additional information and help the reader to organize information differently than would be the case if all of the information were incorporated into the body of the text. Figures serve as their own visual focus, again highlighting content in a different way.

Visual strategies and the organization of visual information are used in many different walks of life: In the presentation of material on the Internet, in how print appears on the page, and in how furniture is set up in a home or public setting. A classroom can also be organized visually. For example, a rug sets off a corner of the room into a space designated for group-learning activities. Information on the walls can be visually organized and positioned in ways that prioritize what students should see first or be able to reference at different times during the school day. Be sure to put information at the level of students' sight line if you want them to notice what you have put on the walls! In printed text, visual salience influences what the eye is drawn to first, second, third, and last. Separating ideas through the use of bold font and colors helps to differentiate key ideas from supporting ideas, main teaching points from supplementary teaching points, just as in this book. By making use of visual strategies, educators and therapists can improve a student's ability to focus and learn.

VISION SKILLS FRAMEWORK: TERMS AND DEFINITIONS

There are several overlapping and interrelated skill sets and skills that pertain to vision. Information about ocular structures and ocular health are presented first. The remainder of the information is dedicated to skill sets: Oculomotor skills, visual functions related to the globe (the eyeball), and visual processing skills. Although all frameworks in this book discuss both functions and skills, the Vision Skills Framework primarily focuses on functions, as visual competencies are more highly dependent on nature rather than nurture.

The framework, which is summarized and available in Appendix 1.1 for quick reference, includes the following:

1. Ocular structures and ocular health: Important structures of the eye globe
    a. Cornea
    b. Lens
    c. Ciliary body

    d. Retina
    e. Optic nerve
    f. Oculomotor muscles
2. Oculomotor functions and skills: The muscles that move the eye and that affect the shape of the lens
    a. Scanning
    b. Localizing
    c. Fixation and focus
    d. Tracking
    e. Tracing
3. Ocular functions related to the eye globe
    a. Acuity and focus
    b. Visual fields
    c. Contrast sensitivity
    d. Light–dark adaptation
    e. Color vision
4. Visual processing functions and skills
    a. Stereopsis and depth perception
    b. Object recognition functions
    c. Spatial awareness and motor planning

Each of the sets and their corresponding skills and functions will be explained in depth in the sections that follow.

Ocular Structures and Ocular Health

The Vision Skills Framework first introduces information about ocular structures and ocular health. Ocular structures consist of the structures that make up the eye globe. Ocular functions are the functions of the eye globe. The Vision Skills Framework involves the structures of the eyes described in the following sections. Figures 1.1 and 1.2 are diagrams of each of these anatomical and functional areas.

Cornea The cornea is the most exterior portion of the eye globe. It is clear, covers the area over the iris, and functions to protect the eye from damage, such as from sand or dirt.

Iris The iris is a colored muscle. People usually notice the iris when looking at someone's eyes, because it is colored differently from one person to the next. The iris is a circular muscle that opens and closes, controlling the amount of light that falls into the lens. It surrounds the pupil, which is an open space that lies on top of the lens and underneath the cornea.

Lens The lens is a crystal-like structure inside the eye. The purpose of the lens is to focus light rays on the retina. The lens focuses light rays onto the retina by *accommodating*, the act of changing the shape of the lens to focus light rays on the retina. Accommodation is performed by

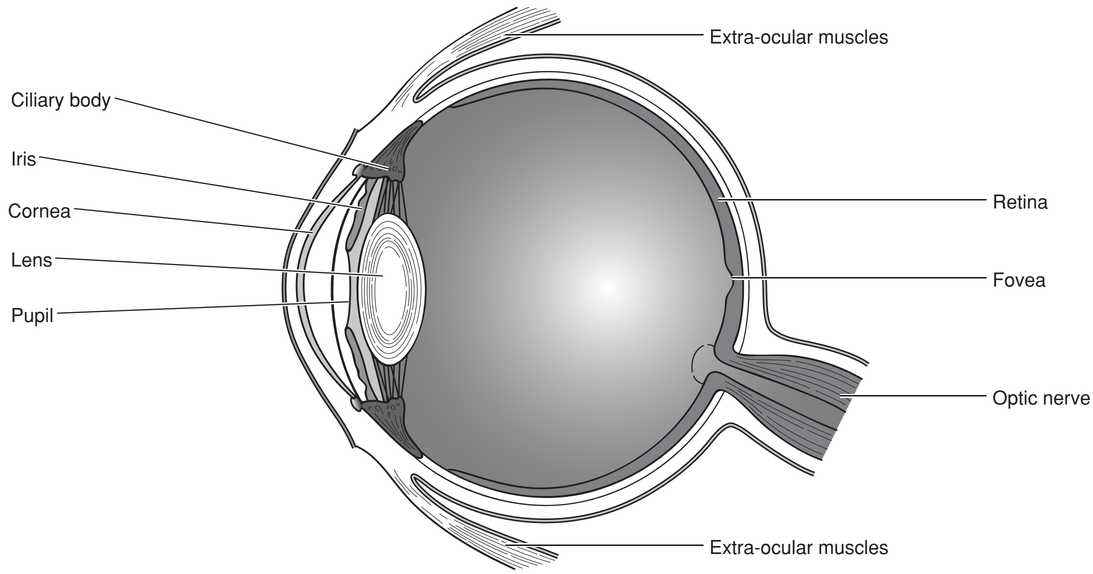

Figure 1.1. Key components of ocular anatomy, including the ciliary body, iris, cornea, lens, pupil, retina, and optic nerve.

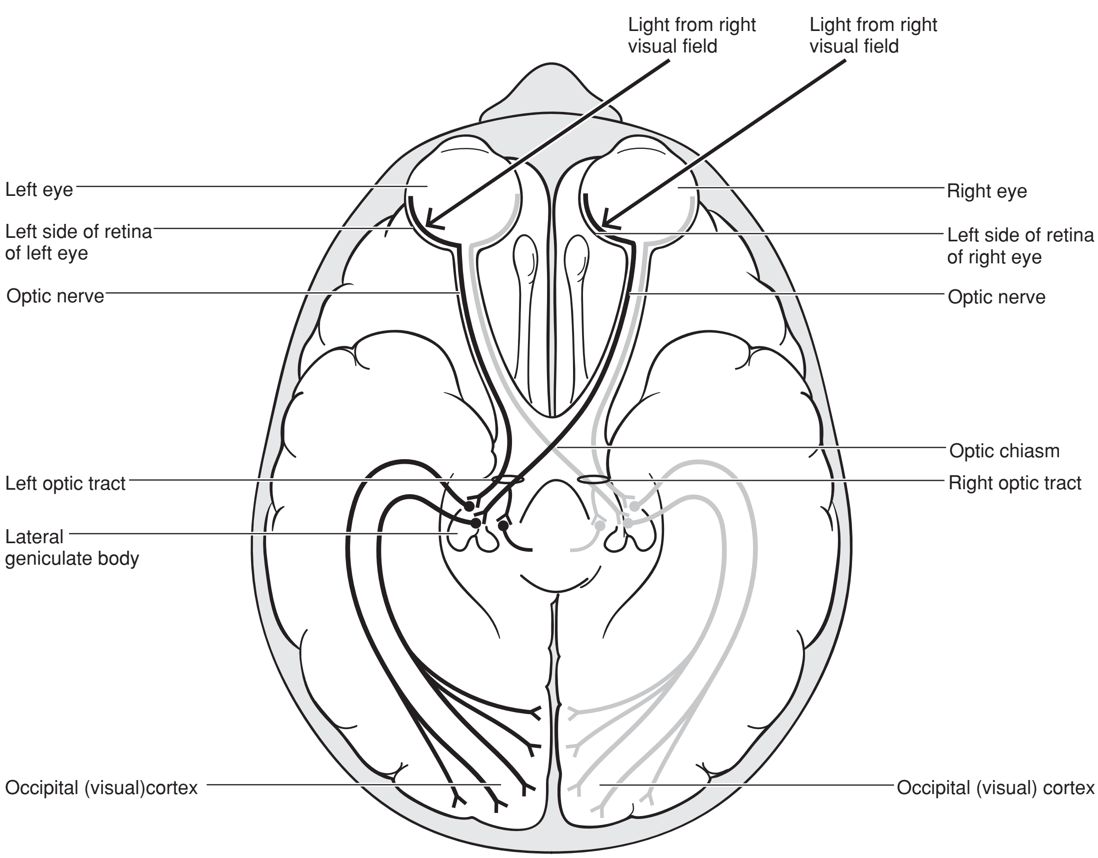

Figure 1.2. This diagram illustrates the connections between the eyes and the brain, including the optic nerves, optic chiasm, optic tracts, and geniculate bodies. The black-shaded pathway shows how light from the right side of a person's visual field lands on the left side of each retina. The left side of the retina then transmits this light information to the left side of the brain via both optic nerves, the left optic tract, and the left geniculate body. The converse is also true.

the ciliary body, a muscle located inside the eye. It changes the shape of the lens by contracting or relaxing its tension on the lens. When the ciliary body changes the shape of the lens, it allows light from different distances to become focused successfully on the retina. This process allows for clear vision at different distances. All of the visual skills discussed in this chapter must be applied to visualizing objects located at different distances from the eyes. Distance effects are important to take into consideration when discussing visual functions and visual skills. A student may not have any visual difficulties at one distance but may have performance difficulties at another. See Box 1.3 for more information.

BOX 1.3. Vision at Different Distances

Distance is often classified as near, middle, far, and distant spaces, as follows:

- Near space: 3–12 inches
- Middle space: 1–6 feet
- Far space: 6–20 feet
- Distant space: 20 feet and greater

The ranges listed above are a good reference for near point and far point vision. A person with myopia cannot see objects clearly when they are too far away. In contrast, a person with hyperopia cannot see objects clearly when they are too close. In both cases, the lens is unable to accommodate enough to allow clear vision of either distant or near objects. Presbyopia is the term used when adults become middle aged and need to wear glasses to see clearly something held close to the eyes, such as fine print in a book. Presbyopia refers to an age-related difficulty with accommodation, especially for objects at near.

The eyes and the brain have to account for differences in distance. For example, oculomotor muscles are used differently if the object being visualized is at near or distant space. Features of the environment, such as color and lighting, affect vision differently, depending on whether the object is at near or distant space. Throughout the chapter, it is important to take into consideration not only which function, skill set, or skill is under discussion but also how each is affected by the distance of the object(s) from the eyes.

Retina The retina is the most posterior (farthest back) portion of the inside of the eye (see Figure 1.1). The retina consists of two types of cells: Rods and cones. Cones distinguish different wavelengths of light and allow for color vision. Rods distinguish between different intensities of light and are especially important for night vision or when light levels are low. The rods and cones of the retina convert light information into electrical impulses that are recognizable by the brain. The signals from the retina are transmitted to several regions in the brain to perform functions such as opening or closing the pupil to control the amount of light entering into the eye, or to detect motion and assist with stabilizing the individual using the motor system. Light information from the retina also informs the hypothalamus about circadian (recurring naturally in a 24-hour cycle) changes in light and dark. Finally, light information from the retina is transmitted to the lateral geniculate body and then to higher cortical centers to allow for visual processing.

Optic Nerve The optic nerves are the most posterior portion of the eye and carry the electrical impulses from the retina to the brain. As demonstrated by the black-shaded pathway in Figure 1.2, light from the right side of a person's visual field lands on the left side of each retina. The left side of the retina then transmits this light information to the left side of the brain via both optic nerves, the left optic tract, and the left geniculate body. Similarly, light from the left side of a person's visual field lands on the right side of each retina. The right portion of the retina then transmits light information to the right side of the brain via both optic nerves, the right optic tract, and the right lateral geniculate body. The X-shape formed when the optic nerves cross in the brain is called the optic chiasm. Light information from the left side of a person's visual field is processed by a person's right cerebral hemisphere; light information from the right side of a person's visual field is processed by a person's left cerebral hemisphere.

Oculomotor Muscles There are six oculomotor muscles that are attached at the four quadrants of the eyes (top, bottom, left, and right). Two additional oculomotor muscles have an oblique orientation, extending from the top or bottom of the eye globe in a diagonal orientation. They make it possible for the eye globes to rotate. All six oculomotor muscles help to move the eyes in many different directions.

Oculomotor Functions and Skills: How the Eyes Move

Oculomotor muscles are positioned around the eye globe and move the eyes in all directions. They also act to keep the eye still when needed. Oculomotor skills mature early in life. Whereas oculomotor functions serve the purpose of moving the eyes in different directions, oculomotor skills serve the more specific purpose of understanding visual information, making use of visual information, and helping to navigate the environment. The oculomotor behaviors described in this section are skills because they are related to a person's successful functioning in the environment. They might need to be developed explicitly in some students with a vision impairment. In typically developing children, eye movements, especially scanning, develop in response to the environment within the first year of life. Other skills described later in this section develop long after age 1 year, in conjunction with the development of motor skills of the body as a whole. The following sections provide more specific information about the development of oculomotor skills, which are also the focus of training in students with low vision who must learn to use residual vision effectively. The information here is summarized in Lueck and Heinze (2004) and Lueck (2004a) and in other standard references that describe oculomotor functions and skills.

Scanning *Scanning the environment* refers to large, sweeping movements that people make with the head and eyes to locate (localize) an object of interest and then fixate (defined below) on it. Scanning requires gaze shift, moving the eyes to let go of the first visual stimulus in order to look at a second object or second visual stimulus. This letting go is a specific oculomotor function, but it is also a skill, because it matures and becomes more efficient with age and experience. Scanning is used to locate objects in distant and far space. Scanning is needed to walk through a room and avoid obstacles, or to find one's way in an unfamiliar building or in the community. In near and middle space, scanning is needed for reading controls on a panel or looking at different images on a computer screen or different objects on a desk. In near space, think of tracing (defined below) as equivalent to scanning.

Localizing After scanning, the student needs to localize the object of interest, meaning he or she needs to recognize where the target of interest is located. Localization is both a cerebral (cognitive) and an ocular skill. Localization requires a prior understanding of where to scan in order to find a necessary object or item. For example, localization is necessary for finding the beginning of a page, the correct dial on a machine, the price of a grocery store item that is located on a shelf in a store, or an object in the environment that one wishes to pick up. All of these skills are cognitive skills, acquired through experience. Once an object is localized, the eyes then have to fixate. Localizing is thus a combination of strategic scanning and then fixating successfully. Fixating is described below.

Fixation and Focus Normal vision requires being able to control when to move the eyes and when to keep them still. Oculomotor skills are required for moving the eyes, as well as for keeping the eyes in one position, stabilizing the eyes, and preventing any additional movements. In addition to stabilizing the eyes, the oculomotor muscles of each eye also must be coordinated with one another. Both eyes have to be able to look at the same object at the same time. Convergence (keeping both eyes positioned in the same position) is the ability to keep both eyes fixated on a target, whether the target is stationary or moving. After fixating, focusing is required to see the object or other visual target clearly. Focusing refers to the ability to change the shape of the lens so that light is focused on the retina. The ciliary body, a muscle located inside the eye, changes the shape of the lens. This creates a clear image on the retina.

Fixating and focus are possible in part because the child knows what portion of the eye to use. He or she moves the head, the eyes, or the object being viewed so that its image can be focused on the fovea of the retina. The fovea is the portion of the retina that has the greatest density of photoreceptive cells and allows for the most precise perception of objects, including seeing colors.

Tracking Tracking is the ability to follow a moving object in the environment, such as following the trajectory of a moving car in the street or following the path of a person walking across the room. During tracking, the eyes remain on the target during all movement directions: Horizontal, vertical, circular, and diagonal. When tracking successfully, the eyes move at the same rate as the object being tracked—the eyes do not move more quickly or more slowly than the object. The two eyes track together as conjugate movements, meaning both eyes are held in the same position and move together in tandem.

Tracking is used not only to follow moving targets in the environment. It is also used to determine one's position in space in relation to the moving object(s). For example, tracking is used to cross the street safely while also following the movements of oncoming traffic. The same type of skill is needed in many sports activities. Among other skills, the successful athlete is able to coordinate body position and movements in relation to a moving ball and in relation to moving teammates. The skill of tracking is continually refined and enhanced, depending on the environmental demands.

Tracing Tracing is a type of scanning. It involves visually following a stationary line in the environment. For distance vision, the child uses lines in the environment to move her or his visual attention from one place in the environment to another. For example, a person with vision impairment might use lines in the environment to locate important targets for localization. By tracing the vertical lines of a building, he or she can subsequently locate the lines of the curb and then finally locate a traffic light. Tracing in near vision occurs when using the eyes to follow the movement of a pen across a page or when following the movement of a needle when sewing. Tracing is a relatively simpler skill than tracking, because the object being traced is stationary. In the case of printing or sewing, the pace of the moving object is controlled by the person who is looking at the object. This is a less demanding skill than having to watch a moving object whose pace of movement is under someone else's control.

Ocular Functions

The cornea, iris, lens, and retina are the primary structures of the eye globe. These structures serve the function of accepting sensory information (light) and transmitting this information to the optic nerve, which then transmits light information to the brain. Ocular functions are discussed in more detail in the sections that follow. The information presented in this section is summarized from Lennie and Van Hemel (2002). It can also be found in other standard references that discuss vision.

Visual Acuity Visual acuity is a measure of the ability to resolve fine detail. It develops to maturity in the first year of life. Visual acuity is the most commonly assessed visual function and is the only function measured during a routine vision screening. Typically, such assessments use an eye chart, such as the type of chart used by the school nurse or in in a doctor's office. Visual acuity charts use optotypes (figures or letters of different sizes) to test the capacity of the eyes to resolve fine detail. Each line of the chart consists of a series of symbols (usually letters or numbers); each of the symbols on each line is the same size and is equally spaced. Each line of the chart uses progressively smaller symbols. As the viewer proceeds down the chart, the lens has to accommodate more and more to resolve the details.

A visual acuity measure does not capture all the other visual functions and skills discussed in this chapter. In other words, passing a visual acuity measure does not guarantee that the person has normal vision. It is a good first measure to use when assessing vision, but impairments in a variety of visual functions and skills may be present even if the visual acuity test results are normal.

Visual Field and Visual Field Defects The visual field is the perceived space on either side of both eyes that is visible when the person is looking straight ahead. The normal visual field measures as an oval-shaped field that is a bit less than 180 degrees in width. Each eye has its own visual field, though there is substantial overlap between the two. A (learned) skill associated with use of the visual field is to recognize when something is located outside the visual field and to move the eyes or the head to orient the eyes toward the object so that it lies within the visual field. This skill develops within the first year of life. With the awareness of what might lie just outside the visual field, the person can make adjustments, such as turning the head, turning the eyes, or shifting the position of an object so that it lies within the visual field.

Contrast Sensitivity Contrast sensitivity refers to the ability to detect differences in brightness between an object and its background. The higher the person's sensitivity to contrast, the lower the degree of contrast that the individual can detect. A common example used to illustrate this concept is to compare the degree of contrast in a pastel painting with an oil painting. The contrast between colors in a pastel drawing is lower than the contrast between colors in an oil painting. For a person with low contrast sensitivity, it is harder to detect differences in colors and to identify lines and borders in the pastel drawing. The reduced contrast makes it more difficult to identify the objects portrayed in the pastel drawing. An oil painting that uses strong differences in color between objects or between foreground and background has higher contrast. In the painting, it is easier to detect differences in color and to identify lines and borders. For a person with low contrast sensitivity, the oil painting will be easier to see, whereas the pastel drawing will be more difficult to see. To understand contrast in paintings and drawings, see Box 1.4.

BOX 1.4. Value and Saturation

Value and *saturation* are terms that are pertinent to the topic of contrast sensitivity. The value of a color is its lightness or darkness. The saturation of a color is its intensity. Pastel colors have lower value (brightness) and lower saturation (intensity), whereas neon paints have high value and high saturation. Objects or colors similar in value or saturation have a low level of contrast between them and are more difficult to distinguish from one another.

Two shades of pastel blue have less contrast between them, as is the case for two shades of neon yellow. Objects or colors with different value and different saturation have a higher level of contrast and are easier to distinguish from one another. A pastel drawing has lower contrast than a drawing made with bright colors.

One skill that students develop in their art classes is that of understanding relationships among colors, value, and saturation. The painter can manipulate colors, their value, and their saturation to create higher or lower contrast between different aspects of the painting. By manipulating these variables, the artist can create the illusion of colors that may not actually be present. Using differences in contrast, the painter can also create the illusion of shadow and light, foreground and distance, without using any lines or even perspective. Color and contrast can be used to enhance or diminish the three-dimensionality of the painting, for example, or can bring attention to one part of the canvas while reducing attention to other parts of the canvas. Vision specialists use knowledge of contrast sensitivity to enhance visual attention or facilitate visual interpretation of objects and pictures for individuals with vision impairment.

The issue of contrast sensitivity has practical implications, beyond the appreciation of art and painting. Contrast sensitivity is used to help locate an object that is partially hidden within a cluttered array of objects or an object that is placed on a patterned background. Contrast sensitivity is also used to understand depth, for example, to notice the difference between foreground and background and to notice differences between near and far objects. The capacity to distinguish between objects or surfaces that are nearer or farther away influences a person's ability to walk down a flight of stairs or to walk through a hallway. Unless distant objects are lit more brightly, nearby objects normally appear as brighter than distant objects. A person with low contrast sensitivity will have difficulty making out the difference between near and distant objects unless the lighting is sufficiently different between the two. Noticing differences in surface texture also depends on noticing differences between what lies in the shadow and what lies closer to the surface. Contrast sensitivity is necessary to detect these differences when walking on an uneven surface but is also needed to detect differences in facial expressions. Changes in facial expression involve only very small changes in the contrast between the lighter foreground and the darker background. These differences are more difficult to detect if contrast sensitivity is low.

The person with higher contrast sensitivity can detect subtle differences in lighting between foreground and background in distant space, between foreground and background for uneven surfaces in middle space, between foreground and background as facial expressions change, and/or between objects that have to be retrieved from a within a cluttered array or that are located on a patterned background (middle and near space). The person with low contrast sensitivity will have difficulty with all of the visual demands just listed. As objects change in size (usually as objects get larger or are magnified), contrast sensitivity can improve (Markowitz, S. N., 2006). This is known as contrast acuity.

Light–Dark Adaptation and Light Sensitivity The eye spontaneously adjusts to changes in lighting. This ability occurs through rapid changes in the opening of the eye, controlled by the iris. When a person exits a dimly lit room and enters into bright sunshine, the iris contracts and reduces the amount of light that reaches the retina. This function is important because it ensures that only a moderate or reasonable level of light ever reaches the retina.

Color Vision Normal color discrimination develops by the end of the first year of life, even if color identification (the capacity to identify colors by name) occurs somewhat later.

The capacity to see different colors not only enhances visual pleasure but also affects the capacity to distinguish between objects.

Visual Processing Functions and Skills: How the Brain Understands and Uses Visual Information

Visual processing refers to what the brain does with the visual information delivered to it by the eyes (Goodale, 2010). Nearly half of all cortical (cerebral) neurons are devoted to the processing of visual information (Schiefer & Hart, 2007). This underscores the importance of vision in the life of humans. Although visual processing is defined as something that occurs in the brain, successful visual processing requires an intact visual axis: It starts with intact ocular structures that lie outside the brain and includes all of the nerves and structures related to vision that are located inside the brain. See the description of the visual axis in next paragraph.

Effective visual processing starts with the best light information. The best light information is delivered to the retina when there is good light in the environment and when oculomotor functions and the structures and functions of the eye globe are all intact. Light information is then transmitted by the retina to the optic nerves. The optic nerves connect the eyes with the brain. Each optic nerve connects at the optic chiasm and then connects to the geniculate body in each cerebral hemisphere. The geniculate body then connects to the visual cortex, and the visual cortex connects to other regions of the brain. All of the neuro-anatomical components just listed make up the visual axis and have to be intact for successful visual processing to occur.

Visual processing reflects any of the interconnections that occur between light information delivered by the eyes to the visual cortex and the subsequent interconnections that can occur with all the other regions of the brain. Visual processing includes depth perception, object recognition functions, visual-motor functions, and imaginary functions. Visual processing includes the integration of visual information with higher cognitive functions, such as hearing and touch; with motor skills; and with general knowledge such as reading, writing, and math or personal experience and general knowledge. The sections that follow discuss some of these visual processing functions and skills in more detail.

Visual Processing and Depth Perception (Stereopsis) As discussed above, the function of contrast sensitivity helps in understanding depth; for instance, when walking down stairs, differences in contrast between the higher and the lower steps provides information about the location of the steps and the point at which depth changes. Depth perception is also possible because of differences in the visual field between each eye. Each eye takes in slightly different information because each eye does not have exactly the same field of vision. When both eyes are functioning successfully together, the slightly different visual perspectives from each eye are delivered to the brain. The brain integrates this information and creates a three-dimensional representation that includes depth and distance (Markowitz, S. N., 2006). This capacity is known as stereopsis, which is critical in helping the individual navigate the environment successfully. Stereopsis is a basic, or fundamental, type of visual processing. It develops over the first year of life as the infant learns to look at and explore three-dimensional space.

Visual Processing and Object Recognition Information from the visual cortex is distributed to two important brain regions, the temporal and parietal lobes. This section focuses on the temporal connections. The pathway that carries visual information from the primary visual cortex to the temporal lobe is called the ventral stream. This pathway is important for the perception and recognition of colors, objects, and faces (Dutton, Cockburn, McDaid, and Macdonald, 2010; Zihl, Schiefer, & Schiller, 2007). Information carried by this pathway is then integrated with other brain regions. Connections are made with sensory modalities such as hearing and touch, with motor skills, and with general knowledge. The ventral stream skills develop with age. The infant and toddler have to recognize and identify objects. The toddler also learns to interpret or understand photos or drawings and understands that photos and drawings represent objects and are not the same as the actual objects. Visual recognition demands can be placed into a hierarchy, as described in the following sections.

Objects Seeing or looking at objects requires the lowest level of visual interpretation. The object is what it is: An object. The visual interpretation required is to know what the object is used for and what it is called. Infants and toddlers recognize objects when they see them, though they often also rely on tactile or other cues to understand the nature of what they see. With increasing knowledge, they combine visual information with information about the use or function of the object. They then learn that different objects can be of the same type (e.g., all cups are cups, even though two cups can look different from each other). They learn to recognize similarities in form and function. The skill of identifying two different objects as being the same is subsequently linked with language skills. The toddler can now identify the cup using a word.

Photographs Although a photograph is an object (i.e., it is a piece of paper with colors on it), it is also a representation. It is a picture of an object and it can thus represent (stand in the place of) an object. Infants do not understand photographs as representing an object; they only understand that a photograph is a piece of paper with colors on it. Understanding that a photograph is a representation of an object is a skill that is acquired after the first year of life. A common initial manifestation of this skill occurs when a toddler correctly identifies the photo of a person as being that person and knows that the photo is not the actual person.

Fine Line Drawings Fine line drawings are similar to photographs in their demands on visual processing. Toddlers and preschoolers can understand that fine line drawings represent objects in the real world, as long as the level of detail provided is clear and as long as the drawing has the colors and contrasts needed to identify the object(s) or person(s) clearly.

Schematic Drawings and Pictographs Schematic drawings and pictographs require a higher level of visual processing than do objects, photographs, or fine line drawings. They contain less visual information, and as a result, they require greater interpretation. To interpret and understand pictographs, more visual recognition functions and skills are needed. The person viewing the schematic drawing or pictograph has to make connections with familiar objects or scenarios by filling in the gaps with prior experiences or using general knowledge. For example, a simple line drawing of a teapot produced with a black pen is more schematic than a fine line drawing of a teapot with colors that highlight its three-dimensional nature. A pictograph or icon, such as the sign for a bathroom in public places, is even more schematic. Interpretation of the icon requires prior knowledge or prior experience to understand its meaning. Pictographs and schematic drawings are interpretable by preschoolers and young school-age children if they are provided with instruction. Comprehension of pictographs and icons is a learned skill.

Symbols: Letters, Numbers, and Words Symbols such as the letters of the alphabet, numbers, and the printed word are highly symbolic and require the highest level of visual interpretation. Printed text, which is a form of visual information, has to be connected via recognition functions and recognition skills to the language center as well as with general knowledge housed in other parts of the brain. The interpretation is visual but also linguistic and cognitive. The capacity to interpret symbols such as printed letters or words (i.e., the understanding that the printed material represents objects, actions, or other information) is present by the early school-age years. At this point, visual processing is no longer a function; it is a skill. Nurture has acted on nature and has linked visual information with other types of knowledge and other types of skills, such as language and reading decoding skills and general knowledge.

Visual Processing and Visual-Spatial Perception and Motor Planning The section above showed that information from the occipital (visual) cortex is carried to the temporal lobe and allows for object recognition functions. In contrast, information carried from the visual cortex to the parietal lobe allows for visual-spatial and visual-motor skills. Occipitoparietal connections are referred to as the dorsal stream (Dutton et al., 2010). Dorsal stream functions are associated with visual-spatial perception and orientation (Zihl et al., 2007). Dorsal stream functions and skills include skills such as understanding and interpreting depth and distance, awareness of physical space, understanding maps and routes, and awareness of mathematical space. The dorsal stream allows for hand-eye coordination, following a map to find one's way in space, and maintaining one's orientation in space. It integrates vision information with motor functions and motor skills. Based on the delivery of good light (visual) information, and based on successful recognition of that visual information, children and youth need to be able to act on what they see. For example, young children learn to use visual information to create a three-dimensional understanding of their environment. They learn how to locate items or places that are not yet visible (e.g., a toy that they know is located in another room). They learn to avoid obstacles and how to judge distances. Using this new understanding of distance and space, they can also acquire other skills. They can learn to judge the time needed to traverse certain distances. They can use their understanding of distance, space, and timing to enhance motor control and perform more skillfully in sports activities. When young children learn to draw, they learn how to use visual fine motor skills to produce lines, shapes, and simple stick figures. With age, children learn that lines and shapes can be manipulated to produce the illusion of three dimensions, for example, a three-dimensional house. The artist advances this skill further, using more and more visual strategies to create the illusion of three dimensions in two-dimensional space.

Advances in Visual Processing Advances in visual processing occur through repeated cycles of recognition, mentalizing (imagining and reflecting on what was seen), and (motor) production. For example, an artist can render an image of three dimensions in two dimensions by using pencil, pen, or paint. The artist also applies visual processing when producing a sculpture. Using a mental image of a three-dimensional object, person, or place, the sculptor produces a three-dimensional representation of that object, person, or place. Dorsal stream functions and the appreciation of three-dimensional space include understanding space when there is no light information, as occurs when producing an architectural drawing for a new building or when solving math problems. Persons who are legally blind can still have an understanding of three-dimensional space, a skill they acquire through auditory and tactile cues and from experience.

GENERAL COMMENTS ABOUT THE TERM *PERFORMANCE DIFFICULTIES* IN THIS BOOK

Performance difficulties, as defined in this book, are caused by a lack of development of the skill sets and skills described in each of the frameworks. Performance difficulties can occur when there is an injury to bodily structures or functions, when there is a lack of nurture, and/or when there is a lack of quality instruction. The goal for school professionals is to identify performance difficulties when they occur and, subsequently, to identify the types of activities (experiences) needed to nurture the student's growth and development.

Performance difficulties often manifest as atypical behaviors, or as behaviors that are unexpected for the student's chronological age. The recognition of performance difficulties is often the first step in the process of assisting a student. As defined in this book, stating that a student has a performance difficulty is the same as stating that the student is missing certain essential skills. Professionals can choose their preferred term for the situation: Performance difficulty, or missing or underdeveloped skill sets or skills. The missing skills can be developed through nurture.

Each of the frameworks provides an organizational structure for understanding the essential skills discussed in this book. The frameworks are useful for identifying performance difficulties. Each time a school professional identifies performance difficulties in a student, the framework can be used to identify which skills are missing. In turn, the professional can also identify which of the earlier-emerging skills in the framework might be present, and which of those skills could be developed further. More nurture, such as intentionally targeted instruction and intervention, may be needed to make up for the missing or underdeveloped skills.

PERFORMANCE DIFFICULTIES IN VISION

Successful performance in vision is always related to intact biological structures and biological functions. Students who do not have intact structures and functions may show a variety of impairment-related behaviors. They often also have impairments in areas outside of vision, such as motor skills, language skills, and/or general cognition (Rahi & Solebo, 2012). It can be challenging to identify performance difficulties that are related to vision specifically and to separate vision performance difficulties from performance difficulties that might be associated with the other frameworks in this book. The sections that follow provide examples of vision performance difficulties and relate those performance difficulties to their underlying (missing or underdeveloped) visual skills.

Performance Difficulties Related to Ocular and Overall Health Status

Different from other chapters, this section starts out by asking the reader to consider medical information. Medical risk factors for vision impairment are important to identify, because they are the first clue that a performance difficulty might exist. These medical factors are not challenging to identify if the student's medical history is available and if the school nurse or another medical provider can review the student's medical record. Performance difficulties related to vision often occur in certain medical conditions such as individuals who were born with extreme prematurity, or who have cerebral palsy, or known eye diseases. When medical conditions like these are uncovered as part of a review of the student's medical history, school professionals should think more carefully about the student's vision. If medical risk factors are present, the school nurse should communicate with the student's health care provider to ask whether a vision assessment is required. If the family prefers, the school nurse can provide a list of observations and questions related to vision, which the student's family can then share with the student's medical providers. Boxes 1.5 and 1.6 provide information about whether additional medical evaluations are needed.

BOX 1.5. Medical Conditions That Can Be Associated With Vision Difficulties

The following conditions can potentially be associated with visual performance difficulties:

1. Prematurity and associated retinopathy of prematurity
2. Prematurity and associated cerebral palsy, intraventricular hemorrhage, periventricular leukomalacia, and/or hydrocephalus
3. Cerebral palsy due to causes other than prematurity
4. Spastic diplegia

(continued)

BOX 1.5. *(continued)*

5. Intellectual disability
6. Epilepsy
7. Traumatic brain injury
8. Ocular injuries or diseases associated with eye disease
9. Chromosomal disorders associated with eye conditions

When one of these conditions is noted in the student's medical record, the school nurse's input is important because she or he can help determine whether there is an associated vision impairment. The school nurse should take into consideration the student's visual acuity test results, the student's medical history, and a history of other student performance difficulties. Together with the student support team, the school nurse can then decide whether additional evaluation of the visual system is needed.

Before considering whether a medical condition exists, it is important to confirm that the student has undergone a visual acuity assessment and that refractive errors have been corrected. A failed vision screening (visual acuity test) is an automatic reason for concern about the integrity and health of ocular structures. Probing for medical factors further, the school nurse can ask whether there is anything about the student's visual behaviors or medical history that suggests difficulties with ocular structures or with ocular health. Any child who has experienced eye disease, eye injury, a neurological disease, or a head injury (among others) is at risk for damage to ocular structures, the optic nerve, and/or pathways and regions in the brain dedicated to the processing of vision. Students who were born prematurely, especially those who spent the first weeks of life in an intensive care unit, are at risk for vision impairment due to retinal or cerebral injury. Some students may have an eye disease such as glaucoma, which also causes damage to the retina. Cerebral palsy is an important risk factor for vision impairment.

In cases such as the ones listed here, it is important for the child's eyes and ocular health to be assessed by a vision specialist, such as an ophthalmologist or an optometrist. At the outset, it is important to know whether the student has any active medical difficulties related to vision, whether the student is at risk for vision difficulties because of medical conditions, or whether there are no risk factors related to the student's vision. Medical factors should be addressed before making any attempts at observing or interpreting the student's visual skills. As discussed later in this chapter, the interpretation of the student's visual behaviors will be different based on whether there are untreated medical conditions that affect vision.

BOX 1.6. Different Causes and Types of Vision Impairment

Vision impairment can occur because of difficulties with one or more of the anatomical structures described in the following and as shown in Figure 1.2:

1. Oculomotor muscles surrounding the eyes
2. Structures of the eye globe
3. The optic nerve that brings light information from the retina to the geniculate body

4. Connections between the lateral geniculate body and the visual cortex
5. The dorsal and ventral streams that emanate from the visual cortex and connect vision information with other brain regions

In developing countries, causes of vision impairment are more likely related to the eye globe than to the brain. In Western countries, the opposite is true. Cerebral vision impairment (impairment in the visual cortex and its connections to the rest of the brain) is the most common form of vision impairment. In Western countries, the next most common cause of vision impairment is retinopathy of prematurity, followed by optic nerve hypoplasia (Steinkuller et al., 1999; Thompson & Kaufman, 2003). Coexisting intellectual disability, cerebral palsy, and/or epilepsy are common (Mervis, Boyle, & Yeargin-Allsopp, 2002; Ozturk, Er, Yaman, & Berk, 2016). In developing countries, vision impairment is more commonly the result of infections and other causes related to the eye globe, for example, corneal disease (Kong, Fry, Al-Sammarraie, Gilbert, & Steinkuller, 2012).

Performance Difficulties and Oculomotor Skills

Students need to learn to navigate their environment. Students with vision impairment may have difficulty in finding their way in three-dimensional space, whether that space is the classroom, the school building, or the larger community. Students who have difficulty in this area can have one or several performance difficulties related to oculomotor skills, ocular skills, and/or visual processing skills. Oculomotor skills are the focus for discussion here.

The skills of tracking, scanning, and localizing are all needed for navigating three-dimensional space. Students with this type of vision impairment may come to the attention of school professionals because they have already been enrolled for instruction with an orientation and mobility specialist or might already have been identified as needing an instructional assistant or a cane. The student may not have difficulty in navigating familiar environments or in avoiding immediate obstacles. However, the student may have greater difficulty in new environments and/or in navigating larger environments such as walking in the community. Even though oculomotor skills are so critical for orientation and mobility, all visual functions and skills are needed for successful orientation and mobility. In other words, oculomotor dysfunctions and an absence of oculomotor skills may occur in isolation but (more commonly) co-occurs with other types of visual dysfunctions such as those discussed in subsequent sections. When students are not navigating the environment but instead need to navigate a desktop or work on a computer, they are less reliant on oculomotor skills and depend on visual functions related to the eye globe. Scanning and localization skills are still required but within a much smaller field of vision.

Performance Difficulties and Ocular Functions and Skills

The following sections provide examples of vision impairments related to the eye globe.

Performance Difficulties and the Visual Fields (Field Defects) Field defects can show up as the loss of vision within a portion of the visual field. The student may fail to see objects or parts of objects even when they are placed within full view of the student. If the student moves the eyes (or if the practitioner moves the object), it may then become visible. Whereas a field defect can occur on one side or the other (or can occur in the upper or lower portion of the student's visual field), it can also occur in the form of spots or rings within the field. These are referred to as scotomas. A scotoma can prevent a student from seeing the entirety of an object and might result in their seeing only parts of objects in central or peripheral vision, even when the object is placed quite close. A skill that students can develop when they have a known field defect is the recognition or awareness that objects sometimes lie outside their visual field followed by the response to move the eyes or the head in order to see the object fully. In fact, these students can often be seen turning their head into an awkward position to optimize use of the field. This behavior can occur during activities that demand orientation and mobility in space (distance vision), as well as during desktop activities (near vision). In near space, the student may position objects to one side or another in order to see the object clearly.

Performance Difficulties and Contrast Sensitivity Students with low contrast sensitivity can have difficulty seeing or paying attention to important visual information because their contrast sensitivity is too low. They may not notice differences between foreground and background, affecting depth perception as they walk in their environment. They may not be able to see objects in near space that are placed on a similarly colored background. They may also have difficulty seeing similarly colored objects within a cluttered array of objects or picking out objects lying on a patterned background. Students with low contrast sensitivity can also have difficulty noticing changes in facial expression.

Students with low contrast sensitivity end up focusing their visual attention on high-contrast features of the visual field. When walking through space, these students might notice only those features of the environment that are clearly different from the background, such as a bright exit sign in a hallway or a white object against a dark background. When looking at faces, the student may focus only on high-contrast features such as the eyebrows, the hairline, and/or the lips, while not noticing changes in the expression of the eyes or the mouth. They may recognize only extremes of emotion and not recognize more subtle changes in facial expression.

Performance Difficulties and Light Sensitivity Some students have difficulty seeing excessively bright or dark environments or have difficulty adjusting between the two light conditions. They may be sensitive to excessive light (photophobia) or may be attracted to light sources specifically because they are easier to see. They can exhibit night blindness. For any given individual, the optimal level of light, and the optimal wavelength of light, varies by type of visual impairment (Markowitz, S. N., 2006). Some students with visual impairment may perform poorly with high levels of white light and may perform successfully with lower levels of light. For others, the reverse might be true. Still others may need lighting within a narrow wavelength (e.g., light within the blue color spectrum), which is obtained through the use of filters. Glare is an aspect of light–dark adaptation and refers to the degree of reflected light in the environment. Some students may show their light sensitivity in situations of glare, which occurs when sunlight reflects off sand or snow or other light-colored surfaces.

Performance Difficulties and Color Vision Not all individuals can distinguish between colors effectively, which can interfere with effective visual function. Color blindness is often unrecognized, because a student who has never seen certain types of colors will not know that he or she is missing out on parts of the visual spectrum. Color blindness can interfere with the successful interpretation of visual information if colors are used to demarcate different parts of a visual stimulus. By changing the contrast between colors (changing value and saturation), difficulties related to color blindness can be reduced.

Performance Difficulties and Visual Processing

Visual processing depends on the successful delivery of light information by the eyes to the brain. Any of the performance difficulties discussed above would be expected to affect visual processing. When a student does not notice differences in contrast or color or shows light sensitivity, he or she is no longer successfully registering all the light information in the environment.

When a student has reduced visual fields or has impairments in oculomotor functions/skills, she or he may not take in all the visual information present in the visual field. As a result, the light information that is delivered to the brain is reduced and the brain has less information to work with in order to understand the environment. The following sections provide more detailed examples of performance difficulties in visual processing.

Performance Difficulties and Depth Perception (Stereopsis) Students with performance difficulties in visual processing can have difficulty with depth perception. Difficulties with depth perception can result in more difficulty navigating the environment, which may manifest as clumsiness or difficulty finding targets. Depth perception difficulties can be due to difficulties with stereopsis or can be due to difficulties with contrast sensitivity.

Performance Difficulties and Object Recognition Functions and Visual-Motor Skills Even though the visual functions of the oculomotor muscles and the eye globe all mature within the first year or two of life, visual processing skills take much longer to develop. The development of visual processing skills depends as much on intact visual and neurological structures (nature) as it does on experience (nurture). Children learn to recognize objects and to recognize symbolic information such as photographs, drawings, symbols, letters, and numbers. Age and experience allow a student to take in visual information and then develop three-dimensional representations from two-dimensional drawings, for example. Children learn to comprehend symbolic information, such as letters, numbers, or symbols. They learn to imagine spaces in the mind's eye, instead of relying on concrete representations of space. A student with very limited cognitive skills would not be expected to have developed the full range of visual processing skills. This affects the ability to understand three-dimensional space and to recognize objects. The student's underdeveloped visual processing then affects how successfully the student moves in space or how that student performs visual-motor tasks. Many of the performance difficulties discussed in the above sections can be due to difficulties with visual processing, regardless of whether the eyes deliver good light information to the brain. Difficulties with oculomotor skills and ocular functions/skills can appear the same as difficulties in the processing of visual information by the brain. See Box 1.7 for an extended list of behaviors that suggest vision performance difficulties.

BOX 1.7. Behaviors That Suggest Vision Performance Difficulties and That May Require a Medical Evaluation

The atypical behaviors listed here are categorized by the underlying visual skills that are potentially missing or underdeveloped. When thinking about visual performance difficulties, it is useful to be thinking simultaneously about the interventions that might be helpful to the student. Visual performance difficulties are grouped here using the structure of the Vision Skills Framework. However, atypical visual behaviors and visual performance difficulties can sometimes fall into more than one of the skill sets listed in the framework. They can be caused by one or several different types of impairments along the visual axis. The main point in grouping the following typical visual behaviors is to assist with choosing interventions and in building skills. Information here was synthesized from articles by Matsuba and Soul (2010); Dutton, Cockburn, McDaid, and Macdonald (2010); Dutton, Macdonald, Drummond, Said:Kasimova, and Mitchell (2010); and Sargent, Salt, and Dale (2010).

(continued)

BOX 1.7. *(continued)*

1. Low vision (low visual acuity)
    a. Holds objects too near to the eyes
    b. Sits too close to the television screen: less than 60-cm distance, or closer for a handheld screen
    c. Misses objects that are obvious to the normally sighted person, such as a bright ball on green grass
2. Atypical visual behaviors, visual sensory-seeking behaviors
    a. Light gazing
    b. Finger flicking in front of the eyes
    c. Eye-pressing or eye-poking behaviors
    d. Roving eye movements
3. Color vision
    a. Inability to discriminate objects by color
    b. Inability to name colors
4. Contrast sensitivity
    a. Has difficulty seeing at far distances unless provided with adequate lighting
    b. Cannot discriminate facial expressions
    c. Cannot identify details in a fine line drawing
    d. Does better with an illuminated object in an otherwise dark space
5. Difficulties related to visual fields
    a. Head tilting when viewing objects or when walking in the environment
    b. Has difficulty finding the beginning of a line when reading
    c. Has difficulty finding the next word when reading
    d. Walks out in front of traffic
    e. Bumps into doorframes or partly opened doors; bumps into furniture; bumps into low-lying items, such as low furniture or objects on the floor
    f. Misses pictures or words on one side of the page
    g. Leaves food on one side of the plate untouched
6. Light–dark adaptation
    a. Avoids extremes of bright light
    b. Has difficulty with transitions between dark and light spaces
7. Difficulty with visual processing functions (object recognition functions and skills)
    a. The following developmental age levels are useful when analyzing visual behaviors that require the student to respond using language to name objects. Students

need to have the following language age levels in order to name the following types of objects and symbols:

- Naming objects: from 18 months
- Naming pictures: from 21 months
- Matching symbols: from 30 months
- Naming pictograms: from 33 months
- Naming letters: from 42 months

b. Has difficulty recognizing familiar objects, such as the family car, shapes, animals, after already having developed knowledge of these objects

c. Has difficulty managing a complex visual scene, such as in the examples listed here:

- Able to attend to only one object in a visual scene at a time
- Difficulty finding a toy in a toybox
- Difficulty finding a preferred food item on a grocery store shelf
- Difficulty finding an object on a patterned background
- Difficulty finding an item of clothing in a pile of clothes
- Difficulty finding food on a plate
- Tendency to get lost in crowded situations

d. Has difficulty seeing a distant object

e. Has difficulty reading, particularly crowded text

f. Has difficulty with recognizing persons

- Difficulty finding a close friend or relative who is standing in a group
- Difficulty recognizing close relatives in real life or from photographs
- Mistakenly identifies strangers as being familiar
- Difficulty interpreting facial expressions or seems uninterested in looking at faces
- Relies on nonvisual information such as a person's voice, clothing, or odor to identify that person

8. Difficulty coordinating visual functions with mobility

a. Has difficulty negotiating floor boundaries, for example, looks down when crossing over a boundary, even if the surface is smooth

b. Has difficulty walking over uneven surfaces and uses tactile cues to cross between a tiled and a carpeted floor

c. Has difficulty negotiating stairs and curbs, especially when going down (gets stuck, freezes, refuses to step down, or trips when stepping down), difficulty using escalators and with getting on and off

(continued)

BOX 1.7. *(continued)*

- d. Has difficulty managing obstacles; bumps into furniture, out of keeping with overall motor skills; gets angry when furniture is moved; makes excessively large head or body movements to accommodate for difficulty with oculomotor skills; has difficulty navigating a room with excess visual clutter
- e. Has difficulty managing spaces; quiet spaces, crowded spaces, or open spaces generate anxiety and/or disruptive behaviors

9. Difficulty coordinating vision with arm or hand movements
    - a. Has inaccurate or atypical visually guided reach, such as reaching for food items, eating utensils, pencils
    - b. Knocks over items during visually guided reach
    - c. Reaches for objects while simultaneously looking away from the object
10. Difficulty recognizing and responding to objects in motion
    - a. Has difficulty seeing things that are moving quickly, such as small animals; does not see or respond to fast-moving objects, such as traffic
    - b. Avoids watching fast-moving television and/or chooses to watch slow-moving television
    - c. Has difficulty catching a ball
11. Impaired orientation
    - a. Gets lost in known locations and new environments
    - b. Has difficulty finding one's way in the community
12. Impaired attention
    - a. Has difficulty performing more than one visual task at a time; difficulty performing visual tasks while also performing an auditory task
    - b. Exhibits marked frustration at being interrupted
    - c. Bumps into things when walking and talking at the same time
13. Variability in visual performance
    - a. May perform better in the early hours of the day as opposed to later in the day; performance wanes when tired, feeling hungry, or when feeling unwell

SETTING UP OBSERVATIONS: GENERAL COMMENTS ON THIS BOOK

An important goal of this book is to help school professionals make good observations of their students. A good observation consists of an accurate description of a student's performance. The first step is to be descriptive (include a good level of detail) and to be objective, not interpretative. Each chapter in this book includes a Skills Observation Sheet in the appendix; professionals can use this form to apply the framework to their practice and to structure their observations.

During the observation, professionals should pay close attention to each student behavior and take detailed notes. Although interpretation is critical for understanding the behaviors, professionals should engage in interpretation and analysis only after the observation is completed. Each chapter will provide examples of how to gather information about student behaviors in an objective manner.

After completing the observation and taking time to reflect, professionals can begin the process of interpretation and analysis to identify which skills are developing appropriately, which skills are underdeveloped, and how any skill gaps might best be addressed. The frameworks presented in each chapter help to make connections between the observation and the resulting interpretation. The interpretation occurs in response to a question: "What does this behavior tell me about the framework of interest?" Alternatively, the school professional can ask, "For the framework of interest, what do the student's behaviors tell me about the skills that he or she has already mastered? Which skills are missing?" As a general rule, skills listed at the top of each framework (i.e., at the beginning) are more basic and emerge earlier in typically developing children than those listed toward the bottom. They are also more commonly present in students (regardless of disability) than those skills listed later in the framework. That said, many students with disabilities need to develop *all* the skills in a given framework, not just those at the top. With practice, professionals will become more accurate at identifying the full range of skills that are either present or absent (or underdeveloped) in any given student and for any given framework.

Although it is important to identify performance difficulties, it is equally important to identify performance successes. It is just as important to identify the skills that the student is missing as it is to describe those that are present. Only by identifying both can the professional make good interpretations and decide how best to intervene on behalf of the student.

SETTING UP AN OBSERVATION FOR VISION

As noted, performance difficulties tend to capture the observer's attention first. In the case of vision skills, for example, the observer might first notice that the student bumps into objects, uses groping motions of the hands to find her or his way around a desktop, holds the head at an angle in order to read, or holds objects too close to the face and uses touch to explore them. Atypical behaviors such as these can be a first sign that the student may be having performance and learning difficulties. Box 1.7 lists commonly observable behaviors a teacher or other school professional might notice in the classroom setting that are related to underdeveloped or missing visual functions and skills.

The observable behaviors chosen for this section are relatively specific to vision. However, any observable behavior in any student is likely to have more than one possible explanation. In fact, some of the atypical behaviors discussed in this chapter could be related to factors that lie entirely outside of vision. For example, a student's inability or uninterest in looking at faces or recognizing people may be related to visual processing difficulties and can also be related to difficulties with social cognition. The Social Skills Framework (Chapter 6) discusses the importance of eye contact and social attention and is another framework for interpreting some of the visual behaviors of students. A student who is clumsy may have difficulties with visual perception and visual-motor skills. The student might also show those behaviors because of difficulties with the motor system or because of inattention. The Motor Skills Framework (Chapter 3) discusses the skill of coordination, whereas the Executive Skills Framework (Chapter 7) discusses the skill of paying attention. Thus, for any observable behavior, it is important for the school professional to consider more than one of the frameworks presented in this book. The observer has to decide which framework(s) are the most relevant or the most informative for understanding the student's skills.

Conducting observations, developing an objective description, and interpreting student behaviors should be done in an iterative manner. For any given student, more observations and more attempts at interpreting those observations helps to improve the accuracy of the interpretation by using the best framework(s). By learning about all the frameworks, the professional will gain a deeper understanding of which behaviors to look for and how to interpret them. As the professional becomes more skilled at identifying relevant behaviors and interpreting them accurately, so too will it become easier to determine the best intervention plan.

Although the task might at first seem daunting, the frameworks facilitate effective observation and analysis. They also allow school professionals to share the workload with colleagues. No one practitioner will master all of the frameworks nor be capable of making all of the observations and interpretations needed to address all of the student's needs. The main goal for the reader at this point is to know that interpretations of student behaviors can be made in a systematic and structured manner using one or several of the frameworks. Each school professional needs to develop an understanding of the frameworks, skill sets, and skills he or she can identify with confidence as being present. The professional needs to know which frameworks, skill sets, and skills he or she can identify with confidence as being absent or underdeveloped. Finally, the professional needs to know what he or she does not know. For those performance difficulties and observable behaviors that the professional is not able to interpret, it is important to ask colleagues to perform the observations and make relevant interpretations.

HOW TO SET UP AN OBSERVATION FOR VISION

In this book, the How to Set Up an Observation sections are designed to help school professionals make descriptive as well as accurate interpretations. For this chapter, the focus is on making accurate observations of performance difficulties and skills related to vision. To begin, the observer is reminded that good observations and the successful interpretation of those behaviors depends on stable ocular health. Observations will be less useful for making educational decisions if there are any ongoing, unaddressed, or evolving medical conditions. This statement is true for any student, not just the student with a vision impairment. Students need to have generally stable health before behavioral observations will be consistent and can be interpreted successfully. It is important for the school nurse to verify that no ongoing or untreated medical condition(s) may be present that might affect the student's behaviors, visual or otherwise. The boxes in this chapter provide suggestions for the school nurse, so that medical factors related to vision are considered. The references for this chapter provide medical checklists for vision that the school nurse may find useful. When obtaining samples of student behaviors, it is best to choose behaviors that are common and necessary for participation at school. Managing one's belongings, working at a desktop, following classroom rules, reading, writing, and so forth are all examples of the types of behaviors that can and should be used for making observations. Within each of these common school-related activities, professionals can make more detailed observations to understand the student's skills within each of the domains discussed in this book.

Selection of the Student

School professionals should conduct an observation of any student who they know or suspect to have a vision impairment. It is especially important to conduct observations of vision on those students who have risk factors related to vision.

Obtain Sample Visual Behaviors As discussed above, many or most of the observations for vision should be made within the context of everyday classroom and school activities. School professionals can use Appendix 1.2, the Vision Skills Observation Sheet, to structure their observation for vision. The sections that follow outline how to make everyday classroom activities relevant for observing visual skills.

Observations of Oculomotor Skills A commonly used test of oculomotor skills is to ask the student to move the eyes in all directions (up, down, to the right, and to the left). Sample oculomotor behaviors can be obtained by asking the student to perform basic movements such as these. When making observations, the school professionals should note whether the student's eyes move together, and whether both eyes can move the full arc in all directions. Other examples of how to assess oculomotor skills include organizing the materials or print on a desktop and seeing whether the student can scan the items in a left-to-right, top-to-bottom manner. The student should be able to do so without having to move his or her head. The observer should note whether the student can scan a desktop or computer screen and can locate important symbols, icons, or objects. Alternatively, oculomotor skills can be assessed through activities such as asking the student to copy a drawing and seeing whether the student can make scanning movements between two locations at a desktop. In this scenario, drawing requires two skill sets: Oculomotor skills and visual-motor skills.

In middle and distant space, the observer can verify whether the student can scan the environment to locate/localize important objects or landmarks. For example, the observer can ask the student to describe or show where things are located in the classroom or in a larger space. The capacity to do so requires scanning skills. Scanning skills are also needed to navigate three-dimensional space. To navigate successfully, the student needs either to reach or to avoid obstacles or landmarks in near and far space. For example, professionals can observe whether the student can find important locations in the building such as the cafeteria, bathroom, or main office. The observer may notice that the student bumps into objects or seems to get lost. It is especially important to distinguish performance difficulties due to factors not related to vision. For example, some of the activities just described depend on language and motor skills, not only on vision.

Observations of Ocular Functions and Skills To make observations of behaviors related to ocular functions and skills, the student should be observed at a desktop and asked to identify objects, photographs, fine line drawings, symbols, and letters and numbers. The observer can also ask the student to identify colors and shapes or to label other visual information. For instance, the observer might ask the student to point at a named object and describe the objects as appearing clear or fuzzy. The lighting, font size, contrast between foreground and background, and/or the colors can then be varied to see whether the student's visual behaviors or overall participation improve. Field defects can show up as an oculomotor difficulty. Students with field defects are known to move the head instead of moving the eyes in order to see an object more fully. They may be able to improve their vision by holding the head to one side. The observation can be used to introduce backlighting, for example, shining a light on the desktop from behind the student, instead of from above or from in front of the student. This strategy can help determine whether changes in lighting improves the student's vision and allow for more normal visual behaviors. For students who do not have strong language skills, the observations just suggested may need to be made based on spontaneous reaching or play behaviors to understand what the students can see. Students who hold objects too closely, ignore objects named by the observer, or seem to lack interest in looking at any of the objects may have vision difficulties.

Observations of Visual Processing Skills Visual processing consists of more complex understanding and use of visual information. For example, visual processing includes understanding the meaning of visual information, being able to discuss or talk about that information, or being able to act on that information through the motor system. Visual processing starts with depth perception, the ability to recognize what is closer and what is farther away.

Depth perception is important for finding one's way in space. Visual recognition functions and skills can be observed by providing objects, photographs, fine line drawings, symbols, and/or printed words and asking the student to identify the visual information, discuss it, or make use of it to reach personal or classroom goals. To assess visual-motor functions and skills, the observer should note whether the student pairs visual recognition functions/skills with other types of skills such as motor skills. The observation might also look at whether the student can navigate well through the space or can copy drawings or print letters or words.

Analyze and Interpret the Observations

The visual behaviors discussed above are evaluated in a more precise manner by a functional vision specialist, who is trained to make the types of observations suggested in this chapter and augments the observations suggested above using specialized testing materials. School professionals should not expect to draw firm conclusions about a student's visual functions and skills without the support or guidance of a vision specialist. For any given atypical or unexpected behavior, there may be more than one explanation for the student's performance. The same observable behavior may be due to an impairment in oculomotor skills, ocular skills, and/or visual processing skills. The same observable behavior could also be due to an impairment in language skills, motor skills, or another developmental domain. Sometimes, an impairment in visual skills may be present without any obvious behavioral manifestations. The purpose of the observations suggested in this chapter is to help school professionals who may not be specialists in this area understand the link between observable behaviors and visual skills. By doing so, the professional's daily interactions and observations of student behavior will become easier to interpret. Better interpretations can then lead to more clearly defined educational goals and objectives, as well as the best therapeutic intervention or strategy to introduce. For any observable behavior or set of behaviors, school professionals should aim to accurately describe the student's behaviors, discuss the observations with the functional vision specialist, and then use this information to interpret the behavior. Use the following sections as a guide for interpretation.

Analysis and Interpretation of Behaviors for Oculomotor Skills Behavioral observations should be made to help determine whether the student can move both eyes in tandem while looking at stationary objects. The student should also be able to keep both eyes in tandem while following a moving target. These skills should be present over the full range of eye movements. Notably, any of the skills discussed in this chapter (i.e., ocular functions, visual processing functions) may influence and interfere with the student's ability to use oculomotor skills. Oculomotor skills may look as though they are impaired, when, in fact, ocular and visual processing functions are affected.

Analysis and Interpretation of Behaviors for Visual Acuity A variety of unexpected or atypical behaviors can occur when visual acuity is affected. The best way to assess acuity is through a visual acuity test, as long as the student has the language skills needed to participate. Other behaviors may suggest that visual acuity is not yet in place. For example, a student who holds objects very close to the face, or who cannot see distant objects, may have difficulties with visual acuity.

Analysis and Interpretation of Behaviors for Visual Fields Field defects manifest behaviorally when the student fails to notice visual stimuli in a predictable manner, for example, he or she always fails to notice things on one or the other side. Field defects can also manifest when the student holds objects at an odd angle or always places objects in a particular position on the desktop. The observational data should be analyzed to consider whether the student is able to see the full visual field. If the student tilts her or his head at an odd angle or seems to ignore objects or stimuli in certain portions of the field, the field may be decreased in size.

Analysis and Interpretation of Behaviors for Light Sensitivity Light sensitivity manifests through light-avoidance behaviors. School professionals should consider whether the student's behaviors suggest that she or he seems a preference for either low or high levels of light, or a slow adaptation during transitions between light and dark spaces.

Analysis and Interpretation of Behaviors for Color Vision This analysis considers whether the student is able to recognize colors. Normally, this skill is measured by asking the student to name colors.

Analysis and Interpretation of Behaviors for Contrast Sensitivity The student should be able to perform successfully when there is a low level of contrast between foreground and background. One way to assess contrast sensitivity is to ask the student to retrieve objects from within a cluttered array. Another way to assess contrast sensitivity is to ask the student to notice subtle changes in facial expressions, especially when the lighting is not optimal. During a functional visual assessment with a specialist, contrast sensitivity is measured using specifically designed visual stimuli.

Analysis and Interpretation of Behaviors for Stereopsis and Depth Perception The student should be able to navigate the environment, such as reaching a destination in the building or walking down stairs without support. When walking through the environment, be sure to observe whether the student makes use of tactile or auditory cues to navigate successfully, as opposed to relying on vision alone. Be sure to provide physical supports if the student is at risk of falling.

Analysis and Interpretation of Behaviors for Visual Recognition Functions/Skills The student should be able to recognize objects, photographs, fine line drawings, or symbols, depending on the student's overall developmental age. Students with developmental delay may not be able to identify or select symbols such as letters, for example, but may be able to identify or select objects or photographs. Visual recognition skills include paying visual attention to others such as when socializing and being able to identify others visually. The student should be able to recognize facial features in order to recognize other people and should not have to rely upon familiar articles of clothing or the sound of someone's voice to identify the person.

Analysis and Interpretation of Behaviors for Visual-Motor Functions/Skills The student should be able to use vision to guide motor behaviors when navigating the environment, when using tools or instruments successfully, and for printing and drawing, among other activities. The student should be able to detect errors using vision alone and then make attempts at correcting those errors. Error detection and correction should occur without having to rely on tactile or auditory cues.

Analysis and Interpretation of Behaviors for Visual Processing: Mentalizing Visual Information At times, a vision impairment may manifest as difficulty visualizing three-dimensional space when offered two-dimensional information (e.g., difficulty understanding geometric forms in math or difficulty producing representational drawings).

Analysis for Variability in Visual Functions and Visual Skills At times, a vision impairment may manifest as variability in visual performance. For example, some students appear to have variations in their visual functions and skills. They may be especially vulnerable to visual difficulty when they are tired or hungry or feel unwell. The type of variation described here is more likely to occur in students with a significant disability such as cerebral palsy with substantial cognitive impairments.

Conclusions About Making Observations and Analyzing Successfully

Making good observations and accurate interpretations is a complex task that becomes easier with practice. The frameworks and associated skills presented in this chapter are intended to guide the interpretation of behavioral observations. Notably, professionals should always take into consideration more than one framework rather than quickly focusing the analysis on specific skills sets and skills within any one framework.

GENERAL COMMENTS ABOUT THE INTERVENTION PLAN AND IEP BUILDER FOR EACH OF THE CHAPTERS OF THIS BOOK

The IEP Builder is perhaps the most important section in each chapter of this book. The purpose of the IEP Builder is to provide specific examples of how to help improve student performance. The IEP Builder includes strategies that can be used in both general and special education. It describes sample educational objectives and strategies relevant to that chapter, which can be used by school teams to inform the development of an intervention plan or an IEP. It does not include the development of measurable objectives or make more than general suggestions about service delivery to students.

When performance difficulties are identified, school professionals should make an interpretation of the underlying skill sets or skills that might be missing or underdeveloped. School professionals then need to identify the underlying skill sets and skills that are developing successfully. In fact, it is through the identification of those skills that are developed or are developing more successfully that the professionals can identify appropriate educational goals, objectives, strategies, and/or accommodations. It is the underlying strengths (skills and abilities) of the student that can end up supporting growth for the framework as a whole. As school professionals monitor developmental growth in each student, they also enhance their observational and interpretative skills. Each subsequent observation of the student helps the professionals to better understand the student's skills, to measure progress more accurately, and to select educational objectives, strategies, and accommodations more precisely the next time. Observations, descriptive analyses, interpretations, and measuring progress are all interrelated. This iterative process is true for each of the frameworks presented in this book.

IEP BUILDER

The IEP Builder for vision provides sample educational objectives and strategies to enhance a student's visual performance. Many of the educational objectives discussed will be dedicated to teaching the student compensatory skills to accommodate for oculomotor dysfunctions, field defects, reduced contrast sensitivity, absent or impaired color vision, difficulties with depth perception, and so forth. The same compensatory skills can be used regardless of whether the structural or functional impairment is at the level of the ocular structures, the optic nerve, neurological connections to the visual cortex, or connections to other brain regions. In other words, many of the vision rehabilitation and visual strategies discussed in this chapter help support the entire visual system, not just specific anatomical sites or specific visual functions. For example, strategies such as optimizing lighting or teaching the use of auditory or tactile cues are potentially as useful to the student with a retinal dysfunction as they are for the student with cerebral visual dysfunctions and visual processing difficulties. Enhancing contrast between foreground and background may be as useful to the student with impairments in color vision as it is for students with other types of visual dysfunctions. The information shared in this section of the chapter is synthesized using several of the references in the References section, especially from Lueck (2004a, 2004b, 2004c, 2004d) and Lueck and Heinze (2004).

The vision rehabilitation specialist should work together with the school professional who may be less specialized in this field and help to identify strategies that improve the student's performance. See Box 1.8 for more information about how to share the workload when strategizing for the student.

BOX 1.8. Selecting the Right Team Members

Before building an IEP, a team must be assembled, composed of the professionals best qualified to choose educational objectives and strategies, that will help the student make developmental progress. This chapter is especially useful in highlighting the contribution of diverse specialists, all of whom have somewhat different roles, and all of whom can assist students with vision impairment and visual performance difficulties. Making use of as many members of the team as possible to help teach the student is always a desired goal. Even less experienced members of the team can assist the student with a vision impairment.

Damaged or injured ocular structures are addressed by a medical practitioner, such as an ophthalmologist or optometrist, who can repair or improve ocular structures and functions through the use of medications, surgery, or prescription eyeglasses. When eye structures have undergone maximum repair or treatment, vision can still be improved through vision habilitation and rehabilitation.

The focus in a school setting is habilitation (the building of new skills) or rehabilitation (the building of skills that were present and then lost). When building visual skills, several professionals may be involved, such as a functional vision specialist, vision rehabilitation specialist, or teacher of the visually impaired. Some ophthalmologists and optometrists are certified as low vision rehabilitation specialists. More commonly, vision rehabilitation is carried out by the functional vision specialist, orientation and mobility trainers, teachers of the visually impaired, and occupational therapists (Markowitz, M., 2006; Whitaker & Scheiner, 2012). The purpose of vision rehabilitation is to help maximize residual function by developing visual skills. By developing visual skills, the individual can use her or his vision as successfully as possible (Colenbrander, 2010a).

A functional vision specialist or teacher of the visually impaired can optimize how visual information is presented to the eyes, making desktop and environmental information visually accessible to the student. An occupational therapist can work with students with vision impairment in teaching fine motor and adaptive skills (Whitaker & Scheiner, 2012). It is important for the school team and the student to know what each professional can do and to help coordinate all the different vision interventions that the student may need. It is also important for the specialists to provide instruction or guidance to less experienced professionals, so that all members of the team, not just the experts, can help to support the student with a vision impairment. The concept of team members sharing the workload while also providing interprofessional training and support is a constant theme in this book.

Medical and Health-Related Interventions for Ocular Structures and Ocular Health

Interventions for ocular structures include interventions such as surgery to clear up or replace a cloudy cornea, prescription glasses to assist with accommodation difficulties of the lens, laser surgery to change the shape of the lens or to prevent deterioration of the retina, or medications to reduce ocular disease and/or improve ocular health. School professionals are not normally involved in the assessment or treatment of ocular structures or ocular functions and do not normally provide medical interventions. The main goal for school professionals who work with students with a vision impairment is to make good observations and ask good questions when ocular health is a concern. This function can be provided by the school nurse or by some of the vision specialists mentioned in this section. Medically related questions should be transmitted to a health care professional such as an ophthalmologist or optometrist who can determine whether any medical interventions are required to repair or improve the health or the function of ocular structures (Lueck, 2004c).

Educational Objectives and Strategies for Oculomotor Skills

The following sections provide information about the types of educational objectives, strategies, and accommodations that are useful for a variety of students with vision impairment. The reader should review these sections with the goal of understanding the recommendations that are likely to flow from a specialist who has conducted an assessment of the student's functional vision.

Educational Objectives and Strategies for Scanning and Tracing Students all need to be taught to scan or trace from left to right and top to bottom. The student with vision impairment may need to be taught this skill in an explicit manner. As examples, students with oculomotor dysfunctions, field defects, and low visual acuity will likely need instruction in scanning and tracing. They can learn to scan in a systematic manner by scanning sequentially, scanning in overlapping swaths, and scanning the entire visual area. The degree of effort will vary for near, middle, and distance vision and will depend on the student's capacity for near versus distant vision. However, regardless of the type of visual information, whether it is print, objects on a desktop, or navigating the environment, the basic strategy remains the same. At times, use of the motor system as a whole can help compensate for underdeveloped or missing oculomotor skills. By making movements of the entire head, a student can compensate for missing or underdeveloped oculomotor skills.

Students with developmental delay or with severe vision and/or cognitive impairments may need physical supports to be able to move their body, head, or eyes sequentially from left to right. Physical supports might mean seating supports to keep the head upright or use of the hands of an adult to help move the head in more than one direction. For other students, verbal instruction may be enough. Near vision scanning skills can be trained by placing objects in a predictable order on the desktop. Then, the student would be taught to scan from left to right and top to bottom in a systematic manner. The same type of organized approach can be used to teach a student to scan the environment and then localize an object of interest. The student may need to be taught positional and spatial concepts such as left, right, up, down, close, and farther away.

Educational Objectives and Strategies for Orientation and Mobility Training Orientation and mobility skills require students to move their eyes, as described above, to find their way in space. The concepts discussed above are important aspects of orientation and mobility training. Orientation and mobility training also involves teaching the use of tactile and auditory cues. Students who are legally blind may need specific training in the use of a cane (which provides both tactile and auditory cues) and may need explicit instruction in understanding and anticipating the location, position, and distance of objects. At the desktop, objects can be used for their tactile information to indicate points on the schedule, to indicate which activity will be occurring next, and the like.

Students with residual vision and/or those students with visual processing difficulties may benefit from learning to identify the location of specific objects, symbols, or landmarks in the school building as they navigate that environment. Having symbols of a specific color that indicate that they are in a particular hallway or that outline a specific path to certain locations in the school building can enhance the students' independence in navigating the school building. For example, yellow stars can be used to indicate the path to the cafeteria, whereas blue squares indicate the path to the principal's office. If the student has sufficient vision to start using other types of markers, these specialized visual supports can be gradually taken away. They can instead be paired with natural geographic markers such as an exit sign or other markers such as the stairway, the elevator, the purple classroom door, and so forth. Each of these landmarks can be used to help the student find his or her way around the building. For example, the student can learn a script such as "The purple exit door is halfway between the classroom and the cafeteria." Students who have language skills can benefit from this type of instruction but may not think about using strategies such as these unless instructed to do so. Tactile landmarks can also be useful. For example, sandpapered traction tape on the floor can serve the purpose of guiding a student toward certain important locations in the building.

Educational Objectives and Strategies for Ocular Functions Most of the strategies used to improve ocular functioning are accommodations and would not be considered educational objectives. The Educational Accommodations for Vision section later in this chapter discusses the different types of modifications that enhance ocular functioning. That said, an important educational objective should be to teach the students how to advocate for their own visual needs. This can be accomplished by teaching the student the vocabulary associated with successful functional vision. The student should learn to identify the visual strategies that seem to help her or him the most. By learning the terms of the Vision Skills Framework and the strategies listed in the Educational Accommodations for Vision section, students can begin to advocate for their own needs as well.

Educational Objectives and Strategies for the Visual Field With some experimentation, the student can discover what size objects and images and/or what size font works best for her or his visual acuity, field defects, or other factors. Educational objectives in this case could include teaching the student about these different accommodations and having the student use trial and error to choose the accommodations that work best. For example, when training oculomotor skills, the student can be trained to use just the eyes and to avoid using head tilt or head motions to localize a visual stimulus. The idea is to keep the student's head in an upright or neutral position and train the student to move his or her eyes or to change the position of the object in order to see it. This strategy can be difficult when walking and looking for landmarks or objects in the environment, as the student may need to tilt the head for optimal viewing.

Students with visual field defects need to learn how to position objects to maximize use of their vision and they also need to learn the vocabulary needed to direct others to assist with optimal placement of objects or images. To do this, the student will need to learn vocabulary for positional concepts (e.g., *higher, lower, right side, left side, center, right of center*). When viewing objects, the student will need to learn to keep the head mid-line (i.e., avoid tilting the head) and change the position of objects to see them clearly.

Educational Objectives and Strategies for Enhancing Contrast The student can learn about the strategies used to enhance contrast, for example, through judicious use of lighting and choice of dark background and by using contrasts in color, value, and saturation. Ideally, the student would learn the definitions of the technical terms listed here and elsewhere in this chapter. However, many students will need to learn vocabulary that is developmentally more appropriate. Terms such as "more light" or "lighter color" and "darker color" may be sufficient for some students as they advocate for their needs.

Educational Objectives and Strategies for Light–Dark Adaptation Students can learn to adjust lighting, make use of color filters, verbalize difficulties with excess light and glare, or verbalize difficulties with insufficient light.

Educational Objectives and Strategies for Depth Perception and Distance Orientation and mobility training can help the student with visual impairment to use auditory and tactile cues to identify distance, depth, and space. See the Educational Objectives and Strategies for Orientation and Mobility Training section.

Educational Accommodations for Vision

Many of the strategies used for the student with a visual impairment consist of accommodations. Accommodations do not teach students new skills but can enhance students' functioning and result in the development of new abilities. For example, use of a cane to navigate one's way through a building is an example of an accommodation that helps to develop a new ability (navigating the environment) by making use of auditory and tactile cues. Different types of tactile and auditory inputs can be used to teach orientation and mobility, not just those that result from using a cane. It is important to train the student to make use of accommodations as independently as possible. This means that the student needs to be taught to request or access accommodations when they are needed. The accommodations that follow can help improve functional vision.

Accommodations for a Variety of Ocular Functions Accommodations for a variety of ocular functions include adjusting the size of the objects or print. Changing the size of the object or print can help accommodate for visual dysfunctions such as acuity, field size, and fixation skills, among others. Some students may perform better with smaller font and smaller objects, whereas others may perform better with a larger font or with larger objects or pictures. Objects also can be placed at different distances, as vision may improve when the object is nearer or farther away.

Accommodations to Enhance Contrast Accommodations to enhance visual contrast include the following:

Reducing Visual Clutter Reduction in visual clutter accommodates for difficulties with contrast sensitivity and also accommodates for scanning weaknesses. Visual clutter may need to be reduced at the desktop but may also need to be reduced for the classroom as a whole. For many students, a classroom with less rather than more visual stimulation works better. For example, visual processing demands are reduced when all the furniture is only one color, when different sections of the classroom are demarcated from one another as different color zones, and/or when visual information on the walls is organized into columns and rows. At the desktop, visual clutter can be reduced by presenting information in clearly demarcated rows and columns. Organizing visual information carefully simplifies the task of scanning.

Using a Dark Background At the desktop, contrast can be enhanced by placing objects on a dark-colored desktop or by changing the background color of a computer screen display.

Using Lighting Strategically Shine a light on the desktop while keeping the rest of the classroom slightly darker. This accommodation can make it easier for the student to focus on objects or activities of interest and reduce visual attention to nonsalient objects. Similarly, the student may be more successful in localizing and fixating on an object when it is well lit and when surrounding objects are not as well lit. Some experimentation may be needed to find the right intensity of light.

Accommodating for Color Blindness Reducing the number of different colors can help reduce visual clutter and can be helpful to students who are color blind. Color blindness can affect contrast sensitivity, depending on the colors being used. A student who cannot discern the full array of colors may also have more difficulty separating objects and images from one another. More highly contrasting colors, especially those colors that the student is able to differentiate, can help enhance contrast sensitivity.

Accommodations for the Visual Field Accommodations for the visual field include the following:

Ensuring Correct Placement Within the Visual Field Students may need materials placed strategically. They may benefit from having visual information placed in the center, higher or lower than the center, or to the left or right side. In some cases, the student should weigh in on what is best.

Reducing Scanning Demands Visually salient information should be placed in front of the student. The student can be taught to localize visually important information by teaching positional concepts. For example, a teacher might train the student to follow instructions such as "look up" or "look on the right-hand side," 'lower than that," and so forth.

Making Use of Objects of Reference For students with a small visual field and for students with a variety of other vision impairments, objects of reference can help identify persons and objects. Objects of reference might consist of a bracelet of a certain color that is worn by only one specific person. When the bracelet is placed into the student's visual field, the student knows who is there. The bracelet may be offered for the student to see or touch, communicating who is present. Objects of reference are very useful for deafblind students, as long as the student has some residual vision. Objects of reference are also useful for students with impairments in their visual processing. Some experimentation may be needed to see if objects of reference help the student to perform better. Adults working with students can also choose to wear a specific colored shirt or to wear a specific colored smock. A dark smock can at the same time improve contrast sensitivity.

Accommodations for Light–Dark Adaptation A slower transition between light and dark environments can help the student accommodate to transitions between light and dark. Lighting intensity can be reduced or enhanced. Light shining from behind the student (instead of overhead or in front of the student) can also reduce sensitivity to light. Colored filters can be helpful in reducing exposure to those wavelengths that provoke sensitivity, and polarizing filters can reduce glare. These filters can be used when the student is exposed to fluorescent lighting or very bright light situations. The choice of lighting should be determined by a functional vision specialist, though some experimentation may be required to find the solution.

Accommodations for Depth Perception and Distance Colors and contrast can be used to highlight the contrast between distance and depth. In distant and middle space, symbols of different shapes or colors can be used to highlight pathways through the school building. For example, colored lines, symbols, arrows, or icons with a printed word can lead to different locations in the building. Arrows might lead the student to the main office, whereas colored lines might lead to the cafeteria. In middle to near space, stairs can be highlighted at the edges with a lighter or darker colored strip. In near space, contrast can be enhanced on the desktop by using a dark background, by using highly contrasting colors, or by using lighting judiciously.

Accommodations for Object Recognition Functions and Skills Deficits in higher order visual processing and in recognition functions can be addressed by changing the degree of symbolic representation. A hierarchy of complexity is helpful to take into consideration here. The lowest level of visual processing demands exists for objects, especially when these are displayed using judicious lighting and with high contrast against a dark background. From here, the level of visual processing increases as students are asked to recognize and extract meaning from photographs, drawings, symbols, and/or letters. Students with cognitive impairment who cannot interpret symbols (e.g., letters, words, numbers) can use photographs, drawings, and pictographs for learning. Photographs can be especially successful, particularly when photographs are taken of the student's own environment. Photographs taken for the student should be clear and consistent in size and magnification and have appropriate background for optimal contrast.

Accommodations for Visual-Motor Functions and Skills All the strategies listed above can be used to help build visual-motor skills in distant, middle, and near space. The student may need clearly recognizable objects, building features, pictures, or symbols. From here, the student can learn how to scan the environment for those objects, building features, pictures, or symbols. Subsequently, the student can learn to use their motor system to access objects or building features, using motor skills such as reaching, grasping, or walking.

Accommodations for Variability in Visual Function Some students, particularly those with cerebral vision impairment, may show variations in their capacity to see. For these students, it can be difficult to know which of the above strategies is the most effective, since their functions can vary from day to day or even from hour to hour. Variation in function can occur with variations in the level of alertness or fatigue, level of hunger, level of wellness, or level of sensitivity to environmental stimuli in general. It may require several observations to know how to optimize vision for these students. An assessment of the student's responsiveness to interventions and to accommodations is another way to determine which interventions and accommodations are the most useful. See Box 1.9 for a list of vision accommodations that can be trialed with the student and that can help determine the student's vision needs. More observations over time and under different environmental conditions can help identify the strategies that appear to be the most helpful.

BOX 1.9. Vision Accommodations

Reduce Demands on Scanning, Tracking, and Tracing

1. Optimize viewing distance.
2. Optimize the size of objects or font at near distance.
3. Find the right amount of space between items on the desktop or at near distances.
4. Organize items into a logical sequence on the desktop.
5. For middle distance and far vision, reduce obstacles, enhance visibility of landmarks in the environment through use of color and lighting; provide visual cues that help locate objects or items in the classroom or destinations in the building.
6. Make use of auditory and tactile cues to reduce demands on scanning, tracking, and tracing.
7. Allow more time for scanning, tracking, and tracing.

Reduce Demands on Ocular Functions

1. *Acuity*. At near, optimize the size of items, either slightly larger or slightly smaller. This applies to the size of objects, pictures, and font size.
2. *Field*. At near, place items in the optimal portion of the visual field.

3. *Contrast*. Optimize contrast by using a dark background and/or primary colors (enhance contrast by increasing difference in the value or saturation of colors), creating clear spaces or clear demarcations between visual stimuli. Desktop should be dark. Personnel presenting visual targets should have solid, dark-colored clothing or a smock.
4. *Lighting*. Optimize lighting, for example, use backlighting, reduce use of overhead lighting. Consider use of polarized lenses or consider use of single-color lighting.
5. *Visual clutter*. Decrease the visual complexity or visual clutter by reducing color, using bold colors, enhancing contrast between foreground and background, organizing visual materials into rows and columns.

Reduce Demands on Visual Processing
All of the accommodations listed above also reduce visual processing demands.

1. *Depth perception*. Reduce demands on depth perception by highlighting changes in depth in the environment (e.g., stairs) through use of contrasting colors, lighting, and tactile cues.
2. *Object recognition functions*. Reduce demands on object recognition functions by reducing the level of symbolism, for example, use drawings or photographs instead of symbols or icons, when possible. Use objects instead of photographs if needed. Make use of objects of reference to help a student quickly identify familiar persons, places, or objects that might otherwise be difficult for the student to see because of problems with the visual field or because the visual targets are moving. Objects of reference can be a bracelet, hairband, or article of clothing always worn by the same person and not by anyone else.
3. *Object recognition functions*. Use visual identification tags for familiar objects or places. Objects and locations in the environment can be identified by using a symbol, a color, or an icon to help the student rapidly identify everyday utensils needed by the student, other items that belong to the student, or locations that are important for the student to be able to locate quickly.
4. *Object recognition and motion*. Reduce demands on recognition functions at near when persons or objects are moving. For example, changes in facial expression may need to be exaggerated or repeated. Videotaped material may need to be viewed more than once or may need to be broken down into still images.
   a. Reduce demands on visual-motor functions by either simplifying visual demands (strategies listed above) or by reducing motor demands.
   b. Use auditory and tactile cues to assist with visual-motor demands.
   c. Allow more time for visual processing.
   d. Ensure that the student is not tired, hungry, or feeling unwell.

Accommodations for Students Who Are Not Visually Impaired Use of the accommodations listed above can facilitate learning for students who may not have a vision impairment. Delayed or limited overall cognitive development can account for delays or limited visual processing skills. Demands on oculomotor skills can be reduced by organizing visual information into rows and columns and/or by reducing the number of visual stimuli that the student needs to scan. Demands on ocular functions can be reduced by using lighting judiciously, by enhancing contrast, by reducing visual clutter, and by keeping objects mid-line within the student's visual field. Demands on visual processing can be reduced by using visual information that is more concrete and less symbolic. Students who are inattentive or who have learning difficulty could potentially also benefit from these strategies. By reducing demands on oculomotor skills, ocular sensory functions, and/or visual processing skills, the student can potentially expend more mental energy on other aspects of learning.

CASE EXAMPLE

Yoshe is a 12-year-old student with vision impairment. She has attended her current school for several years and is well known to the staff and student body. Yoshe has come a long way in working with her current team. When she first entered the school, she often appeared anxious or upset. It took her a while to learn to work successfully with the adults in her classroom. Everyone feels very positive about the many gains she has made in her program. As part of her triennial review, her team was interested in summarizing her visual skills and needs. Yoshe will be transitioned into high school in the coming year. Her team wants to make sure that all relevant visual information is transmitted successfully to the receiving team at her high school.

Medical Information Pertinent to Yoshe

Yoshe has a vision impairment, a result of complications related to her premature birth. She often fails to pay attention to objects or persons on her left hand side (left-sided neglect). Yoshe has both ocular impairments and central nervous system–related impairments that affect her vision. Her ocular health is now stable but includes retinal detachment. The retinal detachment, on the right side of the retina of both eyes, resulted in a left-sided field defect. However, the retinal detachment in each eye is different in scope, and the field defect in each eye is therefore difficult to characterize. In general, she does not notice objects or movements on her left side. However, she does respond to visual stimuli at mid-line and to the right of mid-line. Her cornea and lens are intact. She has normal color vision and contrast sensitivity.

Yoshe can walk securely in familiar environments and can use her right arm and hand successfully, though not always very smoothly or efficiently. Yoshe also has global learning delays. She currently shows consistent mastery of preschool concepts and is working on an early school-age curriculum. She has started to identify whole words. She understands basic math concepts such as more and less, and she has started to count and identify numerals.

Observations of Yoshe

The following list of observations and accommodations describe some of Yoshe's visually related behaviors. These observations were gathered by her present team to share with the new team that will work with her in high school.

Oculomotor Skills

Yoshe's teachers remind her to keep her head at mid-line and to use purposeful scanning motions to make sure that she truly sees all of the objects and images that might be in her visual field. This is true for desktop work and for orientation and mobility demands (i.e., navigating her environment). Yoshe is not always able to see objects in distant or far space and does not always recognize people or objects in distant or far space.

Ocular Functions

Yoshe needs objects placed to her right side or near the center, so that visual information is transmitted to the left (intact) side of both of her retinas. As mentioned, Yoshe's team has noticed that she does not always recognize people from a distance. Yoshe usually has a very neutral facial expression when looking at others. She seems to inspect the faces of others in an unusual manner, especially when she is not familiar with the person. Her team wondered whether she is trying to identify facial features that will help her identify the person again at a subsequent visit. At the same time, she is often prone to speaking to others without looking at their face. She turns her face to her social partner only when prompted to do so.

Visual Processing Skills

During an observation of her performance at desktop activities, Yoshe showed that she can read fine print. When reading, she scans from left to right but can do so only with exaggerated head movements to accommodate for her left field defect. She can identify and discuss pictures in picture books. She can identify all the letters of the alphabet and their sounds. Reading skills are limited to sight word recognition. She is not yet decoding any words. Yoshe appears to be most comfortable using printed material with a 14-point font. She does better when teaching staff present drawings and objects one at a time, and when they ask her to scan carefully from left to right when looking at objects on her desk or when looking at a computer screen. In her classroom, lighting is optimized so that it shines on her desk from behind. Overhead lighting is kept low. These strategies reduce glare and enhance contrast. Her desk has a dark blue background, which helps her to focus her vision on the object or book that is placed on top of the desk.

Yoshe has a visual schedule, that is designed to be read from top to bottom. This format appears to be easier for her because vertical scanning circumvents her left-sided field defect. Yoshe cannot remember a schedule very easily, but she always likes to know what is next. Her team is mindful to keep her daily schedule nearby, as she prefers the visual reminder. When the schedule changes when there's a field trip or a special assembly, she often seems agitated and keeps asking, "What's next?" or "What's going on?" Simply providing her with verbal information about the schedule seems not to be sufficient. Her team accommodates her needs by always providing both visual and verbal information pertaining to her schedule and to time intervals. This helps make her feel more secure about the events of the day. Yoshe's attention span is short, and she usually works for 15-minute periods. This attention span is appropriate for her overall cognitive abilities.

During an observation of her gait, Yoshe walks slowly and does not always scan the environment to make up for her left visual field defect, but when reminded, she can do so. She is hesitant when descending stairs, slowing stretching her foot out to find the edge of each step before stepping downward.

Case Analysis of Yoshe

Yoshe's visual limitations have already been identified by a teacher of the visually impaired. Many appropriate vision interventions and accommodations are already in place. That said, it is important for the team to continually observe Yoshe's visual behaviors, with and without the accommodations, so they can be more strategic in using visual accommodations and in monitoring their effectiveness and can help Yoshe make maximal use of her vision. Accommodations and interventions sometimes have to be modified, especially as the student makes developmental progress, or when the student transitions to a new classroom or a new school building. The following sections further analyze Yoshe's visual needs.

Analysis of Yoshe's Ocular Health

Yoshe is followed by an ophthalmologist. Yoshe underwent laser correction of her retinal detachment, but residual field defects persist. She has regular (annual) checkups with the ophthalmologist. The team does not have any concerns about the need for additional amelioration or correction of ocular structures, as her ocular health is stable.

Analysis of Yoshe's Oculomotor Skills

Yoshe has full movement of both eyes in all directions. However, she does not always make use of her oculomotor skills when she should. Her orientation and mobility specialist is teaching her to use her vision consistently by scanning and tracing consistently in both near and distant space. It is harder for Yoshe to track moving objects, given her vision impairment. She tends to be clumsy in her scanning, which is sometimes a bit jerky. If she moves about slowly and scans consistently, she does not bump into objects. However, she does not always anticipate moving classmates and can inadvertently bump into them. Safety awareness in the community is a concern. For now, she needs one-to-one attention when moving through any environment.

Yoshe's Ocular Functions and Skills

Yoshe has a left-sided field defect. She sometimes gets agitated or angry when someone enters into her left visual field without warning and she is taken by surprise. The team is careful to say something to her when approaching from the left, to alert her attention to her left side. Materials on her desktop are always presented to the right of mid-line or at mid-line, so they are placed in the best portion of her visual field. In near space, the team uses appropriate font size, judicious use of color and lighting, and reminders to use her vision skills strategically whenever they present materials to her.

Analysis of Yoshe's Visual Processing Skills

Yoshe has difficulty with depth perception, as is evident from her hesitation when going down stairs and her use of tactile cues to assist her. Placing high-contrast material at the edges of the stairs has helped her understand differences in depth, but this accommodation is not available for all stairs in all settings. Yoshe continues to have difficulty with depth perception at distance. She navigates her environment slowly, in part for this reason. She is not always able to find her way in the school building and needs a lot of support in finding her way in unfamiliar settings.

Yoshe's Visual Recognition Skills

Yoshe has difficulty looking at faces in social situations. It is not yet clear if optimizing lighting and enhancing contrast would help her to read faces more successfully. She seems to become overwhelmed by faces and appears not to know how to register all of the visual information in faces. Perhaps for this reason, she tends not to look at them. Her tendency to touch objects to her face also seems to suggest a desire to see the object through touch. Yoshe does have the visual processing and object recognition skills to identify objects and she can also identify objects in photos and in drawings. At times, lighting and contrast need to be optimized so that she can interpret visual information accurately.

Yoshe's Visual-Motor Skills

Visual-motor skills are another area of difficulty for Yoshe. Although she can move her body normally, she does not coordinate her vision with her movements very successfully. Yoshe's occupational therapist is working with her to help improve visual fine motor skills for adaptive tasks.

Yoshe's Ability to Mentalize Visual Space

Yoshe can move about with relative ease when she is in a familiar environment. This suggests that she can imagine space and can function in space when her mental map corresponds to the real world. It is not yet clear how Yoshe will function as she learns math concepts. Currently, she can count and can identify numbers, but she does not show an understanding of one-to-one correspondence and does not show that she is developing her number sense or a number line.

Educational Objectives and Strategies for Yoshe

The following sections describe some of the educational objectives and strategies that might be useful for Yoshe. She needs to develop all her visual skills and abilities and has to develop some skills both with and without the assistance or benefit of accommodations.

Educational Objectives and Strategies for Oculomotor Skills for Yoshe

Yoshe needs to develop good scanning and tracking skills in both near and distant space. Since she is capable of good scanning when prompted to do so, an objective for her is to rely less often on adult prompts and to use scanning and tracking skills more spontaneously, more consistently, and without adult prompting. She also needs to learn to position her head properly and to position items properly, so that she maximizes use of her visual fields. By not always stepping in to address her visual needs and by use of indirect feedback (e.g., "I wonder if you can see what's in front of you" or "Remember to use your strategies"), adults can expand Yoshe's successful use of her vision and help her to perform more independently. Her team is measuring progress by measuring the degree of support that she needs (physical support, verbal directives, indirect verbal support, or no support). The objective is to reduce the level of adult support. She is learning the vocabulary for concepts related to oculomotor skills, such as *scanning* ("Look on both sides") and *tracking* ("Watch what's moving") and is also learning positional concepts.

Educational Objectives and Strategies for Ocular Functions and Skills for Yoshe

Yoshe's team has discovered the types of visual strategies and accommodations that seem to help her the most. Specifically, materials need to be placed in the right side of her visual field. Backlighting and placement of objects on a dark background are often also needed. Even though she can sometimes see clearly without accommodations, her overall performance improves when the accommodations are used consistently. Yoshe is now ready to identify the accommodations used on her own. By teaching her the vocabulary of her visual accommodations and by teaching her to experiment with visual strategies, her team is making sure she is learning to advocate for her own vision needs. She can learn words related to important concepts such as *fields* and *position* ("Look at everything on the table top" or "Look in all directions"), *contrast* ("Where is your dark desktop?"), and *lighting* ("Do you need more light on your desktop? Do you need less light in the room?") and how to describe what strategies work best for her. Her teachers allow her to experiment with different visual conditions, comparing her level of comfort and her success with and without lighting, contrast, and correct placement of items.

Educational Objectives and Strategies for Visual Processing Skills for Yoshe

Yoshe has mature object recognition skills, meaning that she can distinguish between objects, photographs, fine line drawings, icons, and symbols. She is able to identify different types of objects and their functions. At times, she has greater difficulty with object recognition functions at far and distant space, a result of her difficulties with ocular functions. Her visual-motor processing skills are more difficult to measure because of her motor impairment. Even when she might recognize objects and understand three-dimensional space, she often makes errors in her motor performance because of her field defect and because of her hemiparesis. The team did not include any specific educational objectives for her visual processing skills and decided to use oculomotor functions and ocular functions as targets in identifying their educational objectives.

Accommodations for Yoshe

Yoshe's vision impairment is successfully accommodated, as explained in the Observations section above. The best accommodations for Yoshe depend on vision demands in near space, as opposed to middle, distant, and far space. Yoshe's vision specialist had to try a number of different approaches to identify exactly how and when certain accommodations would work best for her. For example, it took some experimenting to determine where to place objects into her visual field, what type of lighting and contrast to use, and what size of object or print was most suitable for her. It also took some time to determine how to help her use her oculomotor skills (scanning, tracking, tracing) during orientation and mobility demands; see Box 1.9.

Working With Culturally and Linguistically Diverse Learners

School professionals should keep the following elements in mind when working with culturally and linguistically diverse learners on vision skills:

Color Vision

It is very common for educators working with children learning English as a second language (ESL) to use colors as a point of reference (e.g., "Point to the man with the red shirt"). Colors are one of the first vocabulary items taught to ESL learners and this approach should be modified for learners who have color vision difficulties.

Educators may also need to account for cultural considerations related to color. For example, in some Asian cultures it is extremely inappropriate to write people's names in red. The only names written in red are for people who have died.

Vision Acuity Test Example

For some students from other cultures, visual acuity tests should be modified. For example, avoid vision acuity tests that include the letters *B* and *V*, and *A*, *E*, and *I*. In Spanish, *B* and *V* can sound identical and be easily confused. The letters *A*, *E*, and *I* are difficult because of the way they exist differently in English and Spanish. The letter *A* in English sounds like /ah/ in Spanish; the letter *E* in Spanish sounds like the long *A* in English. The letter *I* in Spanish sounds like the letter *E* in English.

CONCLUSIONS

This chapter presented the Vision Skills Framework. The next two chapters are dedicated to the remaining two neurological frameworks of this book, hearing skills and motor skills. This chapter and the two that follow highlight how nurture can act on nature, especially when nature did not unfold as intended, when bodily structures are injured, and when bodily functions are affected. Children and youth with injury or impairment to their vision, hearing, and motor system are less common in special education than are children with difficulties in other areas. Nonetheless, students with performance difficulties in vision, hearing, and motor skills are important to understand because they help school professionals understand students with disabilities in general. Many of the educational objectives, strategies, and accommodations that these children and youth need are also useful for students with other types of performance difficulties. The information contained in these first three chapters helps to set the stage for the second and third sections, developmental and educational foundations for learning.

REFERENCES

Colenbrander, A. (2010a). Assessment of functional vision and its rehabilitation. *Acta Ophthalmologica, 88*, 163–173.

Colenbrander, A. (2010b). Towards the development of a classification of vision-related functioning: A potential framework. In G. N. Dutton & M. Bax (Eds.), *Visual impairment in children due to damage to the brain* (pp. 282–294). New York, NY: Wiley-Blackwell.

Dutton, G. N., Cockburn, D., McDaid, G., & Macdonald, E. (2010). Practical approaches for the management of visual difficulties due to cerebral visual impairment. In G. N. Dutton & M. Bax (Eds.), *Visual impairment in children due to damage to the brain* (pp. 217–226). New York, NY: Wiley-Blackwell.

Dutton, G. N., Macdonald, E., Drummond, S. R., Said:Kasimova, S., & Mitchell, K. (2010). Clinical features of perceptual and cognitive visual impairment in children with brain damage of early onset. In G. N. Dutton & M. Bax (Eds.), *Visual impairment in children due to damage to the brain* (pp. 106–116). New York, NY: Wiley-Blackwell.

Goodale, M. A. (2010). The functional organization of the central visual pathways. In G. N. Dutton & M. Bax (Eds.), *Visual impairment in children due to damage to the brain* (pp. 5–15). New York, NY: Wiley-Blackwell.

Hyvärinen, L. (2010). Classification of visual functioning and disability in children with visual processing disorders. In G. N. Dutton & M. Bax (Eds.), *Visual impairment in children due to damage to the brain* (pp. 265–281). New York, NY: Wiley-Blackwell.

Kong, L., Fry, M., Al-Sammarraie, M., Gilbert, C., & Steinkuller, S. (2012). An update on progress and the changing epidemiology of causes of childhood blindness worldwide. *JAAPOS, 16*(6), 501–507.

Lennie, P., & Van Hemel, S. B. (Eds.). (2002). Assessment of vision in infants and children. In *Visual impairment: Determining eligibility for Social Security benefits*. Washington, DC: National Academies Press. Retrieved from http://www.nap.edu

Lueck, A., & Heinze, T. (2004). Interventions for young children with visual impairments and students with visual and multiple disabilities. In A. H. Lueck (Ed.), *Functional vision: A practitioner's guide to evaluation and intervention* (pp. 277–341). New York, NY: AFB Press.

Lueck, A. H. (2004a). Overview of functional evaluation. In A. H. Lueck (Ed.), *Functional vision: A practitioner's guide to evaluation and intervention* (pp. 89–107). New York, NY: AFB Press.

Lueck, A. H. (2004b). Overview of intervention methods. In A. H. Lueck (Ed.), *Functional vision: A practitioner's guide to evaluation and intervention* (pp. 257–275). New York, NY: AFB Press.

Lueck, A. H. (2004c). Comprehensive low vision care. In A. H. Lueck (Ed.), *Functional vision: A practitioner's guide to evaluation and intervention* (pp. 89–107). New York, NY: AFB Press.

Lueck, A. H. (Ed.). (2004d). *Functional vision: A practitioner's guide to evaluation and intervention*. New York, NY: AFB Press.

Markowitz, M. (2006). Occupational therapy interventions in low vision rehabilitation. *Canadian Journal of Ophthalmology, 41*, 340–347.

Markowitz, S. N. (2006). Principles of modern low vision rehabilitation. *Canadian Journal of Ophthalmology, 41*, 289–312.

Matsuba, C., & Soul, J. (2010). Clinical manifestations of cerebral visual impairment. In G. N. Dutton & M. Bax (Eds.), *Visual impairment in children due to damage to the brain* (pp. 41–49). New York, NY: Wiley-Blackwell.

Mervis, C. A., Boyle, C. A., & Yeargin-Allsopp, M. (2002). Prevalence and selected characteristics of childhood vision impairment. *Developmental Medicine and Child Neurology, 44*, 538–541.

Ozturk, T., Er, D., Yaman, A., & Berk, A. T. (2016). Changing trends over the past decade in the aetiology of childhood blindness: A study from a tertiary referral center. *British Journal of Ophthalmology, 100*, 166–171.

Rahi, J. S., & Solebo, A. L. (2012). Childhood eye disorders and visual impairment. In D. Hollar (Ed.), *Handbook of children with special health care needs* (pp. 131–152). New York, NY: Springer.

Sargent, J., Salt, A., & Dale, N. (2010). Children with severe brain damage: Functional assessment for diagnosis and intervention. In G. N. Dutton & M. Bax (Eds.), *Visual impairment in children due to damage to the brain* (pp. 181–193). New York, NY: Wiley-Blackwell.

Schiefer, U., & Hart, W. (2007). Functional anatomy of the human visual pathway. In U. Schiefer, H. Wilhelm, & W. Hart (Eds.), *Clinical neuro-ophthalmology: A practical guide* (pp. 19–28). Berlin, Germany: Springer.

Schiefer, U., Wilhelm, H., & Hart, W. (Eds.). (2007). *Clinical neuro-ophthalmology: A practical guide*. Berlin, Germany: Springer.

Steinkuller, P. G., Du, L., Gilbet, C., Foster, A., Collins, M. L., & Coats, K. (1999). Childhood blindness. *Journal of the American Academy for Pediatric Ophthalmology and Strabismus, 3*(1), 26–32.

Thompson, L., & Kaufman, L. M. (2003). The visually impaired child. *Pediatric Clinics of North America, 50,* 225–239.

Whitaker, D. B., & Scheiner, E. M. (2012). Evaluating school-aged children with visual disabilities. In D. Hollar (Ed.), *Handbook of children with special health care needs* (pp. 153–158). New York, NY: Springer.

World Health Organization. (2007). *International classification of functioning, disability and health: Children & youth version*. Geneva, Switzerland: WHO.

Zihl, J., Schiefer, U., & Schiller, J. (2007). Central disturbances of vision. In U. Schiefer, H. Wilhelm, & W. Hart (Eds.), *Clinical neuro-ophthalmology: A practical guide* (pp. 185–194). Berlin, Germany: Springer.