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Human Development and Performance

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MARY BETH MANDICH

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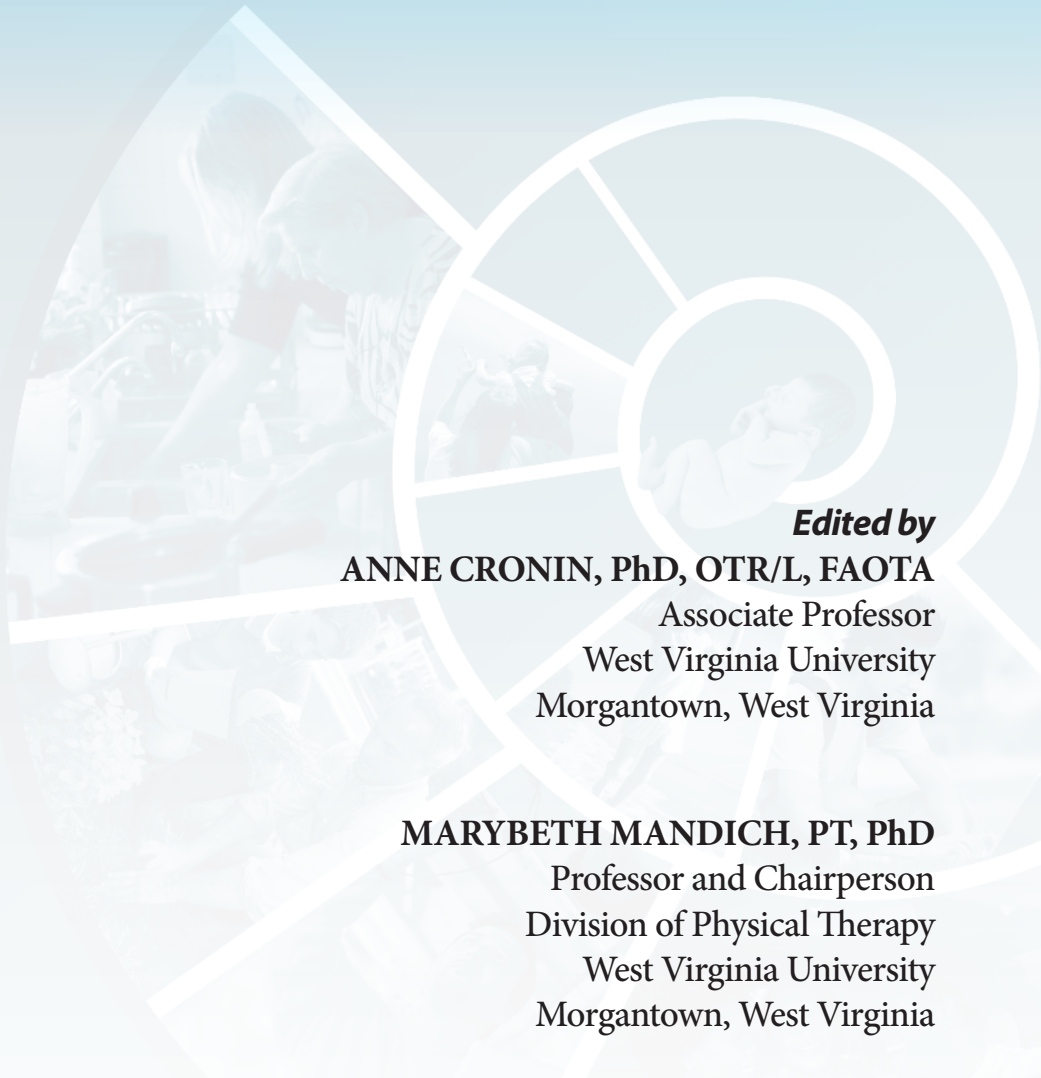

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Dedication

We would like to express our appreciation to West Virginia University for the time and administrative support that has supported our work on this project. We would also like to thank our faculty and staff colleagues, who helped us in so many ways, including writing case studies, editing, advising, and reviewing. As pediatric therapists, we would also like to thank all the children and their families who have so enriched our professional lives over the years and who have taught us so much. As academicians, we would like to thank all the students who have been in our classrooms, listened to our thoughts and information, and ultimately joined us as professional colleagues.

Anne Cronin: My father, Thomas Cronin, told me that he was proud of me for following a long family tradition when I chose to be a teacher. His pride continues to sustain me. My father, and my whole family, are my inspirations, teaching me much about life beyond the science that informs this text. Since the first edition of this text, I have had the opportunity to learn from occupational therapists all over the world. It is my fond hope that they will find their influences throughout the text.

MaryBeth Mandich: To my parents, Anne and Sam Mandich, children of immigrants who believed strongly in education as a path to success and who provided unfailing support in all my endeavors. To my children, Heather, Sam, Scott, and Ben, who have inspired me, helped me grow, and taught me invaluable lessons about the life span from infancy to young adulthood. Finally, I am enormously grateful for the wonderful new additions to my kinship network, Devin, Melissa, and Angie.

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Preface

The purpose of this text is to provide entry-level students who plan to work in health care, especially in the rehabilitation disciplines such as occupational and physical therapy, an overview of normative life tasks and roles across the life span. The Joint Commission requires that all health care providers be able to deliver age-appropriate plans of care. The unique aspect of this text is, in addition to providing information about typical human development life tasks, it discusses the impact of disease or disability on human occupations. Finally, the foregoing information is embedded in the World Health Organization's International Classification of Functioning, Disability and Health (ICF), which has now been the standard of health outcomes for over a decade, and is the foundation to the text.

Other key guiding documents and concepts include the life course model (adopted as an organizing framework by the Bureau of Maternal and Child Health), Healthy People 2020, the discipline of occupational science, and updated theoretical models from the pertinent literature of multiple disciplines. The text also serves as a resource for practicing professionals, especially those who were not educated in the conceptual framework of newer models, such as the ICF. Each chapter includes current, research-based scientific findings that offer insight into aspects of human development that may expand on earlier learning.

Since the 1960s, there has been a significant, perhaps revolutionary, change in clinical and sociologic perspectives of disability that has impacted both health services and public policy. One evidence of this impact is the passage of many pieces of legislation guaranteeing individuals with a disability the right to participate in society, including the right to education and the right to employment. In addition, as discussed in Chapter 20, the notion of health-related quality of life has become an accepted metric for judging the outcome of biomedical and psychosocial interventions. In summary, health is increasingly viewed as the ability to participate in normal and desired life roles to the maximum extent possible.

The education of health professionals, especially in the rehabilitation disciplines, must prepare professionals to deliver successful interventions in this context. Although it is often stated that there is a disconnect between academic theory and clinical practice, this text is designed to help bridge that gap with the extensive use of both clinical case studies and examples of theory applications for rehabilitation professionals. Our hope is that this compilation of science, theory, and clinical cases facilitates the learning of future generations about how to promote full participation outcomes in those individuals we serve.

NEED FOR THIS TEXT

As mentioned previously, our experience shows there is currently not an available resource that integrates information from a number of core disciplines to permit easy understanding of the newer concepts of health and participation. Professionals such as occupational and physical therapists have always studied life span human development. They have also studied medical sciences, psychology, sociology, and professional roles. However, the paradigm shifts just described will demand that rehabilitation professionals of the twenty-first century will be able to integrate knowledge of normative developmental life roles or tasks with other information to assist individuals with disabilities to participate in desired societal roles. The ICF model forms the conceptual foundation for the text, with a secondary developmental framework. Particular attention has been made to include many of the basic constructs in the field of occupational science throughout this text. The study of human occupations must be inherently grounded in the understanding of human development, and this text offers a strong adjunct to this foundation for students in this field of study.

This text meets the needs of entry-level professionals by preparing them to view both health and disability from a life tasks perspective on activity and participation. Although life span development has traditionally been considered foundational knowledge upon which to build an understanding of various health conditions, recent social and legislative trends have demanded an increased application of developmental information in setting goals and planning interventions. Increasingly, reimbursement for rehabilitation, especially occupational and physical therapy, is based on the ability to reflect and document goals directed at functional outcomes that promote individuals' health-related quality of life by participation in interpersonal, social, and environmental roles.

No prior knowledge of human development or disability models is required to use this text, commensurate with the entry-level target audience. However, exposure to basic anatomy, psychology, and physiology will help students understand the structure-function sections of each chapter. Prior courses in life span human development and sociology will allow students to apply previously learned theory to their education as health care professionals.

ORGANIZATION OF TEXT

The text is organized into three main parts: Foundations for Understanding Function, Disability, and Health; Life Stage Characteristics; and Special Topics in Human Development and Performance. The foundational section introduces readers to contemporary conceptual and theoretical models in the field of health and disability. The first three chapters in this section provide an introduction to the core frames of reference including the ICF, the life course model, and traditional developmental theories. Successful health interventions require practitioners who are culturally competent and who can apply learning and communication strategies in their therapeutic interventions. Finally, the impact of environmental contexts on health and participation are considered in this section. The second part of the book, "Life Stage Characteristics," follows a traditional developmental framework; however, basic physiologic content is presented in every chapter as an introduction, as well as the developmental characteristics of the particular life stage. Few texts combine the 360-degree approach to the study of human development across body systems, as well as dimensions of performance (motor, psychologic, and sociologic), as this text does. Interspersed in this section are chapters addressing the impact of disability at various life stages. The final section of the book, "Special Topics in Human Development and Performance," presents some contemporary topics for occupational and physical therapists, as well as others. Chapter 20, "Wellness, Prevention, and Health Promotion," prepares readers to analyze the responsibility of health care professionals to do more than treat disease and instead to participate in prevention and health promotion. The ICF contextual factor of health policy is discussed in Chapter 21, "Public Policy and Health Care." Finally, Chapter 22, "Assessment of Human Performance across the Life Span," introduces readers to the concept of accountability for evidence-based practice with documentation of outcomes at the level of activities and participation.

FEATURES OF THE TEXT

The text provides readers with a large amount of information on life span development, organized around the conceptual framework of the ICF. All chapters have case studies based on true clinical situations, which help students apply the information in the text to the practical setting. In addition, most chapters have a section called "Speaking of. . . ." These sections are informal notes from individuals—both professionals and family members of individuals with disabilities—about the application of content in the chapter. They bring to life the real challenges and experiences of individuals who have unique perspectives on the issues discussed in each chapter. These notes are intended to help readers with the "emotional intelligence" aspect of learning.

NEW TO THIS EDITION

CHAPTER 1

- Completely revised to the latest terminology and organizational frameworks in the field and the most current ICF and practice frameworks

- Reflects the evolution of ICF applications into disciplinary practice over the past decade
- Introduces the occupational model and defines human occupations in the context of the ICF and practice frameworks

CHAPTER 2

- New chapter, encompasses some content from former the Chapter 1
- Reflects the increasing demand for health to be viewed from a life span perspective
- Introduces the life course theory (LCT)
- Integrates the use of the ICF with the LCT
- Includes an increased focus on families, including the presentation of the systematic family development model (SFD) and family development theory

CHAPTER 3

- Formerly Chapter 2
- Minor revisions and updates to address new thoughts and correlate to current practices

CHAPTER 4

- Heavily revised and rewritten with a focus on understanding mainstream American cultural norms and acknowledgment and identification of cultural norms in other populations that may be encountered in practice settings
- Updated in response to the changing cultural demands and experience of competent practitioners
- Focus on occupational deprivation as illustrated in the interactions between social factors such as poverty and human occupations

CHAPTER 5

- Heavily revised chapter, with features of language structure deemphasized and an increased focus on functional communication
- Rewritten to emphasize what all health professionals should know about the development and nature of communication, emphasizing intentional communications of all types
- Cases were included to illustrate the essential role of communication for human development and human function across the life span

CHAPTER 6

- Formerly Chapter 3
- Heavily revised chapter, providing more focus on correlation to the ICF
- Incorporates discussion of contemporary neuroscience related to use-dependent brain plasticity, embodied cognition, and executive functions
- Introduces new theories and thoughts on mental functions and learning

CHAPTER 7

- Formerly Chapter 18
- Revised to reflect evolutions in understanding ICF applications
- Updates on new ideas and concepts such as universal design and virtual environments
- Expanded discussion of social and cultural environments and their potential impacts on human occupation

CHAPTER 8

- Formerly Chapter 6
- Added discussion about ethical decisions involving the embryo and fetus
- Added new information about stem cells and prenatal diagnosis and treatment
- Added/updated information about prenatal assessment and diagnosis

CHAPTER 9

- Formerly Chapter 7
- Enhanced discussion of biologic and environmental risk
- Added sections including neonatal abstinence syndrome

CHAPTER 10

- Formerly Chapter 8
- Added section about positional plagiocephaly and the Back to Sleep initiative
- Added discussions about risk and resilience, including the importance of nurturing and supportive environments in alignment with the life course theory

CHAPTER 11

- Formerly Chapter 9
- Discussed the social and economic factors related to disability and illness in children
- Introduces common disabilities and common illnesses in infancy
- Expands focus on the family and the impact of infant illness or disability of parental and sibling occupations
- Presents the best-practice standard of family-centered care

CHAPTER 12

- Formerly Chapter 10
- Reorganized around the ICF Framework
- Expands discussion of body structures and functions relevant to this life stage
- Introduces theories of sensory integration and sensory processing
- Increased focus on play and the interactions between play and development in early childhood

CHAPTER 13

- Formerly Chapter 11
- Reorganized around the ICF framework
- Expands discussion of body structures and functions relevant to this life stage
- Increased content on ADL and IADL participation during this life stage
- Updated to include changes in the social and communication demands placed on children with their increased access to digital communications and social media

CHAPTER 14

- Formerly Chapter 12
- Completely rewritten and reorganized around an ICF framework
- Increased attention to IADL activities such as driving and work
- Introduction of concepts of occupational roles including student and work roles
- Added discussions of eating disorders and enhanced discussion of other health conditions associated with adolescence

CHAPTER 15

- Formerly Chapter 13
- Expanded discussion of learning and intellectual disabilities as well as traumatic injury
- Integration of theoretical materials introduced earlier into aspects of family and child functioning
- Expanded coverage of family stress and resilience in the contexts of child illness and disability

CHAPTER 16

- Almost completely new, reflecting the changing experience of young adults, 21 to 34 years of age, including the twenty-first-century social experiences related to interpersonal, work, and family participation
- Reorganized around the ICF framework
- Introduces the construct of occupational identity
- Includes expanded content of vocational and career choices in early adulthood

CHAPTER 17

- Formerly Chapter 15 Adulthood
- Now titled Middle Adulthood and focuses on ages 40 to 65 years old
- Reorganized around the ICF framework
- Expands upon occupational science constructs introduced earlier in the text, including occupational balance and occupational deprivation
- Greatly expanded content in the areas of community, social, and civic life

CHAPTER 18

- Formerly Chapter 16 Aging
- New title, Late Adulthood, focuses on ages 65 to 80 years old
- Reorganized around the ICF framework
- Greatly expanded content in the areas of community, social, and civic life
- Expands focus on models of successful aging, integrating longitudinal research support on this topic
- Introduces construct of occupational transition and changes in occupational identity associated with aging

CHAPTER 19

- Formerly Chapter 17
- Reorganized around the ICF framework
- Expanded discussion of common disabling conditions
- Introduces readers to the disability rights movement and the constructs of self-determination and self-advocacy as they relate to individuals with disabilities
- Expands discussion of adult performance contexts including workplace contexts (sheltered workshop, supported employment, and integrated employment) and residential contexts (group home, hospice, and nursing home)

CHAPTER 20

- Formerly Chapter 19
- Completely rewritten chapter, with updates to Healthy People 2020
- Presents a broader overview of prevention, wellness, and health strategies
- Presents the view of "clients" as individuals, groups, or community
- Incorporates new theoretical paradigms about health promotion including Lifestyle Redesign and the "health belief model"

CHAPTER 21

- Formerly Chapter 20, completely revised and updated
- Presents the United Nations' *Convention on the Rights of Persons with Disabilities* and the *World Report on Disabilities* in terms of potential impact on health policy
- Updated content on U.S. legislation that impacts both individuals with disabilities and health professions
- Enhanced discussion of HIPPA
- Adds information about the Affordable Care Act and its implementation

CHAPTER 22

- Almost completely rewritten and reorganized from the former Chapter 21
- Discusses the latest assessment tools available in the fields
- Discusses challenges and opportunities in assessment of participation
- Emphasizes needs for evidence-based outcomes

SUPPLEMENTARY PACKAGE FOR INSTRUCTORS

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An instructor's manual with two main components accompanies this text. The first component is the critical-thinking guide. For each chapter, a minimum of three questions have been selected to guide the students' thinking about the content presented. The questions are suitable for in-class discussion, small-group work, or essay questions on tests. The second component of the instructor's manual is the active learning experiences designed to enhance learning of chapter content. They include such activities as web searches and analysis of current literature. Where laboratory activities are suggested, laboratory guides are presented. These components have been carefully designed to provide instructors with key tools to help facilitate student comprehension that will follow them into their professional lives.

FEEDBACK

The authors welcome comments and feedback about this text and may be contacted at the following addresses:

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We would like to thank all those who contributed to this book. First, to our chapter authors, who are all busy professionals and who did an outstanding job in their work on this text. Second, to all the therapists who provided case studies from their practical experience—you helped to make the text applicable and relevant. Finally, to therapists and family members of individuals with disabilities who wrote "Speaking of . . ." sections and who told us "the rest of the story"—the effort would have been much less meaningful without your contribution.

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Anne Cronin, PhD, OTR/L, FAOTA, has been practicing pediatric occupational therapy for many years. She received her BS in occupational therapy from the University of Missouri and an MA in health services management from Webster University in St. Louis, Missouri. Her PhD was received from the University of Florida in medical sociology. Dr. Cronin has taught extensively, including content in human development, research, and clinical practice of occupational therapy, with an emphasis on practice with children and youth. Her research interests include community integration of children with disabilities, routines and time use in parenting, the establishment of healthy habit patterns in children with developmental differences, and the efficacy of occupational therapy interventions with pediatric populations. Dr. Cronin has been a leader in the exploration of assistive technology applications to support people with disabilities across the life span. In addition, Dr. Cronin has served as a member of the Board of Directors of the American Occupational Therapy Association and the Rehabilitation Engineering Society and Assistive Technology of North America. She has been a Fulbright senior specialist in Chile, Mexico, and Sri Lanka, providing occupational therapy consultation. Dr. Cronin is currently an associate professor of occupational therapy at West Virginia University.

MaryBeth Mandich, PT, PhD, has been practicing pediatric physical therapy for many years. She received BS and MS degrees in physical therapy from the Medical College of Virginia/Virginia Commonwealth University. She went on to receive a PhD in development psychology from West Virginia University, with a major area of emphasis in infancy and a minor area of emphasis in developmental neurobiology. Dr. Mandich has taught extensively, including content in neuroanatomy and neurophysiology, embryology, human development, and pediatric and adult neurologic rehabilitation and research. She teaches students from many other disciplines, such as medicine, education, occupational therapy, and nursing about neuroplasticity and the importance of early intervention and rehabilitation. Her own research interests have focused primarily on premature, high-risk infants. She has published studies on both outcome and effects of therapeutic intervention for this population. She maintains an active clinical practice in high-risk infant follow-up. Dr. Mandich is currently associate dean for professional and undergraduate programs in the School of Medicine at West Virginia University. She holds an appointment as professor and chairperson of the Division of Physical Therapy.

PART 1

Foundations for Understanding Function, Disability, and Health

CHAPTER 1

Human Performance: Function as an Organizing Framework

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Objectives

Upon completion of this chapter, readers should be able to:

- Define *quality of life,* and relate the definition to health outcomes;
- Define the concept of disablement and apply the concept to practical situations;
- Describe the medical and the social models of function, activity limitation, and disability;
- Define and give examples of the framework dimensions of ICF: "Body Structure and Function," "Activity and Participation," "Personal Factors," and "Environmental Factors";
- Differentiate contextual factors in the process of human activity; and
- Discuss how the ICF impacts the rehabilitation professional frame of reference.

Key Terms

activity
activity limitation
activity of daily living (ADL)
affective domain
age-normative influence
barrier
body functions
body structure
capacity
cognitive domain
contextual factor
disability
disablement
environmental factor
facilitator
frame of reference
function
health
history-normative influence
instrumental activity of daily living (IADL)
International Classification of Functioning, Disability and Health (ICF)
interprofessional education (IPE)
medical model
nonnormative
nonnormative influences
normative
occupations
occupational model
participation
personal factors
psychomotor domain
quality of life
risk factor
social model

INTRODUCTION

Human beings are complex creatures capable of a myriad of accomplishments. As students of human performance and health, it is essential to understand the complex interplay of biological, behavioral, psychological, social, and environmental factors that influence individual humans over the course of their life. Like all living things, human beings have a life cycle: birth, infancy, puberty, adulthood, and old age, eventually leading to death. It is now possible for the human lifespan to encompass a century or more. During that century of life expectancy, humans have the unique capacity to study, learn about, and analyze mental processes within the self. No other creature displays the curiosity, the cognition, and the drive to attempt to explain its own behavior and actions.

Throughout the human life course there unfolds an array of challenges or tasks that must be accomplished. Some of these tasks are **normative**, consistent with general patterns and experiences seen within a population, such as the usual timing and sequence associated with learning to walk or to read. Some of the tasks are **nonnormative**. These are not consistent with general patterns seen within a population. An example of a nonnormative challenge would be adapting to a disease or disability. Throughout this text, the authors will emphasize normative patterns in human development and performance as well as the potential impact of the nonnormative experiences on future life course experiences. Another term for nonnormative is atypical. In some cases the two descriptors may be used interchangeably. The next chapter will present and explain recent theoretical models that tie the life span experience to human health.

Quality and quantity of life are separate issues. **Quality of life** may be defined as a perception of life satisfaction through fulfillment of both basic and complex needs. Maslow defines human needs as a hierarchy, from the most basic need for sustenance to the need for self-actualization and love (Maslow, 1954). A good quality of life implies that all the individual's needs are being adequately met.

DEFINING HEALTH, FUNCTION, AND DISABLEMENT

The most widely accepted definition of **health** is that of the World Health Organization (WHO) found in the 1946 preamble to its constitution, where *health* is defined as a state of complete physical, mental, and social well-being, not merely the absence of disease and infirmity (WHO, 1948). It includes the motivation to become engaged in life, a sense of control over one's actions, and a desire to interact and connect with others, and perhaps most importantly, engages the individual's self-esteem. Health is a potential for all humans that can be supported through societal efforts including social policies, community support systems, and environments that enhance health, optimal development, and quality of life. For those professions seeking to promote a high quality of life for all individuals, it is important to understand these complex factors, both those intrinsic to individuals, and social and environmental factors extrinsic to individuals.

The WHO definition of health is operationally present when an individual is *functioning* at a level appropriate to achieve desirable outcomes. **Function** has been defined generally as the purpose for which a person or thing exists, including synonyms such as *purpose* and *occupation* (Merriam-Webster,

Incorporated, 2014). In 1965, a sociologist named Nagi, in a landmark paper, proposed that *function* was not inherent in a given *disease* or *health condition.* For example, two people might have the health condition known as chronic low back pain. One of these people may have been accommodated to the workplace and life activities, and may continue to participate in the accommodated environment. Another person may become quite sedentary, removed from normal roles such as vocation, and hence may be very depressed. Therefore, the functional status of these individuals is not defined by the medical condition, that is, chronic low back pain.

This premise that disease or health condition is a factor, but not a determinant, of function is a sociologic concept known as **disablement**. Disablement is a *sociomedical* concept describing **disability** as the product of the impact of a health condition on function, taking into account personal and environmental factors that serve as risk factors, interventions, or exacerbators (Verbrugge & Jette, 1994). A **risk factor** is a personal or environmental factor that diminishes health, leaving an individual less likely to realize their full developmental potential (UHHS, 2010). *Disability* is a term used to encompass problems with various dimensions of human function, activity, and participation (WHO, 2001b).

CONCEPTUAL FRAMEWORKS OF DISABLEMENT

The concept of disablement merges two core conceptual frameworks traditionally used to discuss health. The first is the **medical model**, which emphasizes the person, and that person's impairments, as a cause of disease, trauma, or some other health condition (World Health Organization, 2001b). Within the medical model, disability is a feature of the person that requires medical care provided in the form of individual treatment by professionals to "correct" the problem. The focus of intervention is medical care, and the principal feature of intervention is to change health care policy. Therapy clinicians working within the medical model will identify impairments such as weakness, and develop strategies to improve the individual's abilities or to help him learn to compensate for the impairments. For example, in the case of a person with a spinal cord injury, a therapist offers activities to strengthen muscles at the same time she is training the person in new ways to complete activities of daily living. **Activities of daily living (ADL)** are the daily self-care activities within any of an individual's routine environments (home, leisure, work, and so on). Special equipment such as wheelchairs and adapted vehicles are examples of additional compensations. This is the traditional approach presented in the rehabilitation literature.

The **social model** views the loss of function associated with a disease, trauma, or health condition, as an attribute of the social environment, which is managed by change in social policy. For example, using the person with the spinal cord injury example again, this model would argue that the individual becomes disabled, not by the spinal cord injury itself, but because he cannot access local stores, public transportation, and theaters. The focus on the problem is change in social policy. An example of such policy in the United States is the 1990 Americans with Disabilities Act (ADA), which assures accessibility and civil rights to individuals with potentially disabling health conditions. In another illustration, perhaps the person with a spinal cord injury needs an adapted motor vehicle to be able to drive to work or school but is unable to obtain the financial resources necessary to purchase such a vehicle. Access to adequate financial resources is a social condition, not a medical condition. **Figure 1-1** offers two images of a young man with a spinal cord injury. The picture on the left illustrates a caring but contextually limited *medical model*. The picture on the right shows the young man as an active participant in a valued activity within a community setting. This second picture illustrates the *social model*.

A

B

Figure 1-1 **A.** The Medical Model **B.** The Social Model

In a subtler example, the condition of attention deficit disorder has received a lot of attention in the last 20 years. This disorder has a rising incidence in the United States and western Europe. At the same time, the incidence is relatively low in eastern Europe, South America, and Africa. The difference in frequency of identifying this as a health condition seems to lie in societal expectations for a child's behavior. Impulsivity, distractibility, and high activity levels are disruptive in large elementary school classrooms. Cultures that offer alternative educational and social options for children may not identify such behavior as a disability.

THE INTERNATIONAL CLASSIFICATION OF FUNCTIONING, DISABILITY AND HEALTH (ICF)

The World Health Organization has long been the recognized source for universal classification of disease, with the International Classification of Disease (ICD) serving as the basis for reimbursement coding in the United States health care system. The ICD is a health care classification system that provides codes to classify diseases and a wide variety of signs and symptoms, as well as social circumstances and external causes of injury or disease. This ICD was the first in the WHO Family of International Classifications (WHO-FIC) and was designed to promote international comparability in the classification and presentation of international health statistics (World Health Organization, 2014).

In 2001, WHO member nations endorsed a new classification system, representing the culmination of several decades of attempts to classify disablement for purposes of research, reporting, and establishment of benchmarks. WHO (1993) had developed its own precursor model in 1980, known as the International Classification of Impairments, Disability, and Handicap (ICIDH); however, by the end of the century, it had rejected that model in favor of a newer model, entitled the **International Classification of Functioning, Disability and Health**, known by the acronym **ICF**. Unlike previous classifications, the ICF has the stated purpose of emphasizing health and de-emphasizing the concept of disability, hence the acronym ICF does not include the term *disability* as part of the title. The WHO (2001a) states, on its ICF home page, that any human can have a decrement in function at any time, thereby "mainstreaming" the notion of disability. Therefore, a continuum of function is the underlying construct, which avoids previous negative connotations associated with the term *disability.* In addition, the ICF acknowledges the impact of factors on function that can be attributed to an individual (person) or to an environment (social and physical). A final note is that the ICF helps to operationally define components of health and related quality of life.

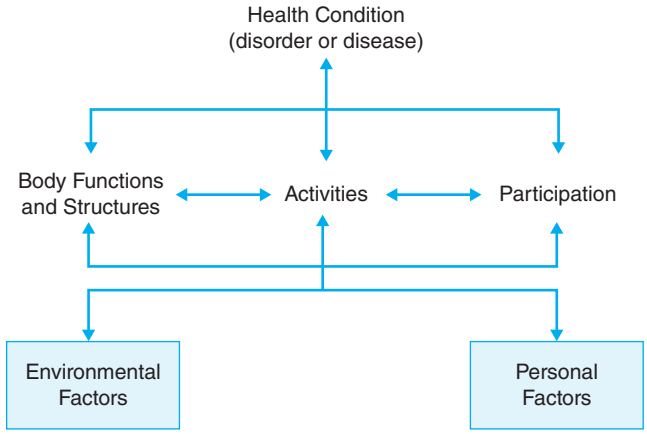

Figure 1-2 This model reflects the ICF view of the interactive relationship between health conditions and contextual factors.
Source: Towards a Common Language for Functioning, Disability, and Health (ICF), World Health Organization (2002).

The current ICF model can be imagined as a matrix with major two components: (1) health condition and (2) contextual factors (environmental and personal). These are illustrated as the top and the bottom of **Figure 1-2**. As illustrated, disability and functioning are viewed as outcomes of interactions between health condition and contextual factors. At the center of the diagram is the activity that the individual wishes to engage in.

BODY STRUCTURE AND FUNCTION

Body structures are anatomically categorized by body part, such as the nervous system or structures related to movement. **Body functions**, as the name implies, are physiological in nature and organized by functional system, such as mental functions, cardiovascular functions, or movement-related functions (WHO, 2001b). **Table 1-1** is a summary of Body Structures and Functions as presented in the current ICF model (WHO, 2001b).

ACTIVITIES AND PARTICIPATION

Activity is defined as the execution of a task by an individual, and an associated construct is the notion of capacity. **Capacity** is a construct related to an individual's ability to perform a task in a controlled environment, such as a rehabilitation setting. *Capacity* represents, as the term implies, what an individual could do in an optimum setting with extrinsic factors controlled. The second level of human functioning, **participation**, is involvement in a life situation, most typically life tasks or actions. *Performance* is a construct related to the actual environment in which the task is usually executed (WHO, 2001b). Consider the situation of an individual with a severe traumatic brain injury (TBI). At some point in the rehabilitation hospital experience, professionals will work to assure the individual can

TABLE 1-1 Body Structures and Functions

Body Structures	Body Functions
Structures of the nervous system	Mental functions
The eye, ear, and related structures	Sensory functions and pain
Structures involved in voice and speech	Voice and speech functions
Structures of the cardiovascular, immunological, and respiratory systems	Functions of the cardiovascular, hematological, immunological, and respiratory systems
Structures related to the digestive, metabolic, and endocrine systems	Functions of the digestive, metabolic, and endocrine systems
Structures related to the genitourinary and reproductive systems	Genitourinary and reproductive functions
Structures related to movement	Neuromusculoskeletal and movement-related functions
Skin and related structures	Functions of the skin and related structures

Source: Towards a Common Language for Functioning, Disability, and Health (ICF), World Health Organization (2002).

walk, talk, and perform self-care activities. However, the fact that the individual can dress herself under the supervision of an occupational therapist in the rehab setting does not guarantee that, once at home, the individual will get up every day and perform self-care routines independently. Therefore, the individual has the capacity for independence in some functional tasks, but performance will only be assured once the individual is doing the activity within a typical environmental context, without the support of the professionals and routines encountered in rehabilitation. **Table 1-2** summarizes the Activities and Participation dimensions of the ICF (WHO, 2001b).

TABLE 1-2 Activities and Participation

Learning and Applying Knowledge
General Tasks and Demands
Communication
Mobility
Self-Care
Domestic Life
Interpersonal Interactions and Relationships
Major Life Areas
Community, Social, and Civic Life

Source: Towards a Common Language for Functioning, Disability, and Health (ICF), World Health Organization (2002).

CONTEXTUAL FACTORS

One of the most notable aspects of the ICF is the incorporation from the social model of the notion of *Contextual Factors* as the second part of the classification. **Contextual factors** are shown in relationship to activity and the ICF model in **Figure 1-2**. Contextual factors may be either *personal (intrinsic)* or *environmental (extrinsic)*. **Personal factors** include attributes of the individual that impact health, including such things as motivation, cultural perspectives such as fatalism, or personality. **Environmental factors** include the physical, social, and attitudinal environmental context in which an individual lives. **Table 1-3** lists some examples of environmental factors as they are described in the ICF. Personal factors may include individual characteristics such as age, gender, education, profession, coping style, faith, social background, past, and current experiences.

ICF QUALIFIERS AND CODING

Because the ICF is a coding system, qualifiers are applied to each component along the continuum of functioning and disability.

Body structures and functions are qualified by a general scale indicating extent or nature of impairment ranging from none to complete, with the negative qualifier termed *impairment.* Body structures also have a qualifier for nature of the change in the body structure, such as whether there are deviations in structure such as a malformation (for example, a club foot) versus absence of the part in question (for example, amputation). There is also a location qualifier for body structure, indicating limbs or sides of the body affected.

TABLE 1-3 ICF Environmental Factors

Domain	Sample Components
Products and Technology	Products and technology for consumption, ADLs, mobility, communication, employment, recreation, and building design for public and private use
Natural and Human-Made Changes to Environment	Physical geography, population, climate, light, sound, air quality
Support and Relationships	Immediate and extended family and friends, professionals
Attitudes	Individual attitudes and societal norms
Services, Systems, and Policies	Architecture policies, policies for production of consumer goods, housing services, public places, communication and media services, civil and legal services, economic policies, health services

Adapted from—Source: Towards a Common Language for Functioning, Disability, and Health (ICF), World Health Organization (2002).

Activities and participation are represented on a continuum of function, which is biased towards "*functioning*" when the qualifiers are positive and towards "*disability*" when the qualifiers are negative. Activity is qualified by the general magnitude scoring scale, with the positive qualifier being *function* and the negative qualifier termed *activity limitation*. In the ICF, **activity limitation** is a descriptor which moves the continuum of function into the range of disability.

Likewise, Participation is qualified by magnitude, with the positive qualifier being *Performance* and the negative qualifier termed a *participation restriction*. Like its counterpart of activity limitation, the negative qualifier of **participation restriction** implies the individual is functioning in the range of disability. By employing ICF codes and qualifiers, it is possible to avoid focus on disability per say, but rather to objectively describe the individual's activities and participation as a snapshot on a continuum of function.

Contextual factors are qualified in a dichotomous system as either *barriers* or *facilitators* (WHO, 2001b). A **barrier** is a factor, such as low socioeconomic status, which limits the individual's access to factors that support health. Conversely, a **facilitator** is a factor that supports healthy participation. A high socioeconomic status, for example, may permit an individual who has lower extremity paralysis to live quite independently in his own home because he can afford to modify the home for his needs.

PUTTING THE ICF INTO PRACTICE

A simple application of ICF principles that has appeared recently in the physical therapy literature is in reference to the function of walking or gait. Fritz and Lusardi (2009) suggest that gait velocity, that is, how fast someone walks, should be considered a "vital sign." The authors base this premise upon research demonstrating correlations between how fast someone walks and other aspects of independence. To be considered able to walk in the community, which underlies participation, a person must walk about 3.1 miles per hour. Physical therapists often time a 10-meter walk in the clinical setting. To be ambulatory in a community, a person should be able to walk 10 meters in about 7 seconds. The time taken to do a 10-meter walk in the clinical (or standard) setting represents the capacity of the person for ambulation activity. If the person has the capacity to be a community ambulatory, participation would be determined by other factors, such as motivation, opportunity, or terrain. These are also contextual factors. Performance is the actual ambulation in the community setting, which reflects both capacity and contextual factors. Furthermore, Fritz and Lusardi (2009) make a convincing argument that not only does gait velocity relate to ability to move about and participate in community functions, it also relates to other aspects of activity and participation such as ADL independence. These interrelationships are summarized in **Figure 1-3**.

Activities and participation as defined in the ICF focus on normative behaviors of adulthood. In 2007, the World Health Organization introduced a version of the ICF especially focusing on children and youth, which is known as ICF-CY (WHO, 2007). The framework of the ICF-CY mirrors that of the ICF, but it addresses children in the context of their developmental continuum. It attempts to capture impacts of physical and social environment, such as malnutrition, and permits the inclusion of children with developmental delay in the classification system (Lollar & Simeonsson, 2005).

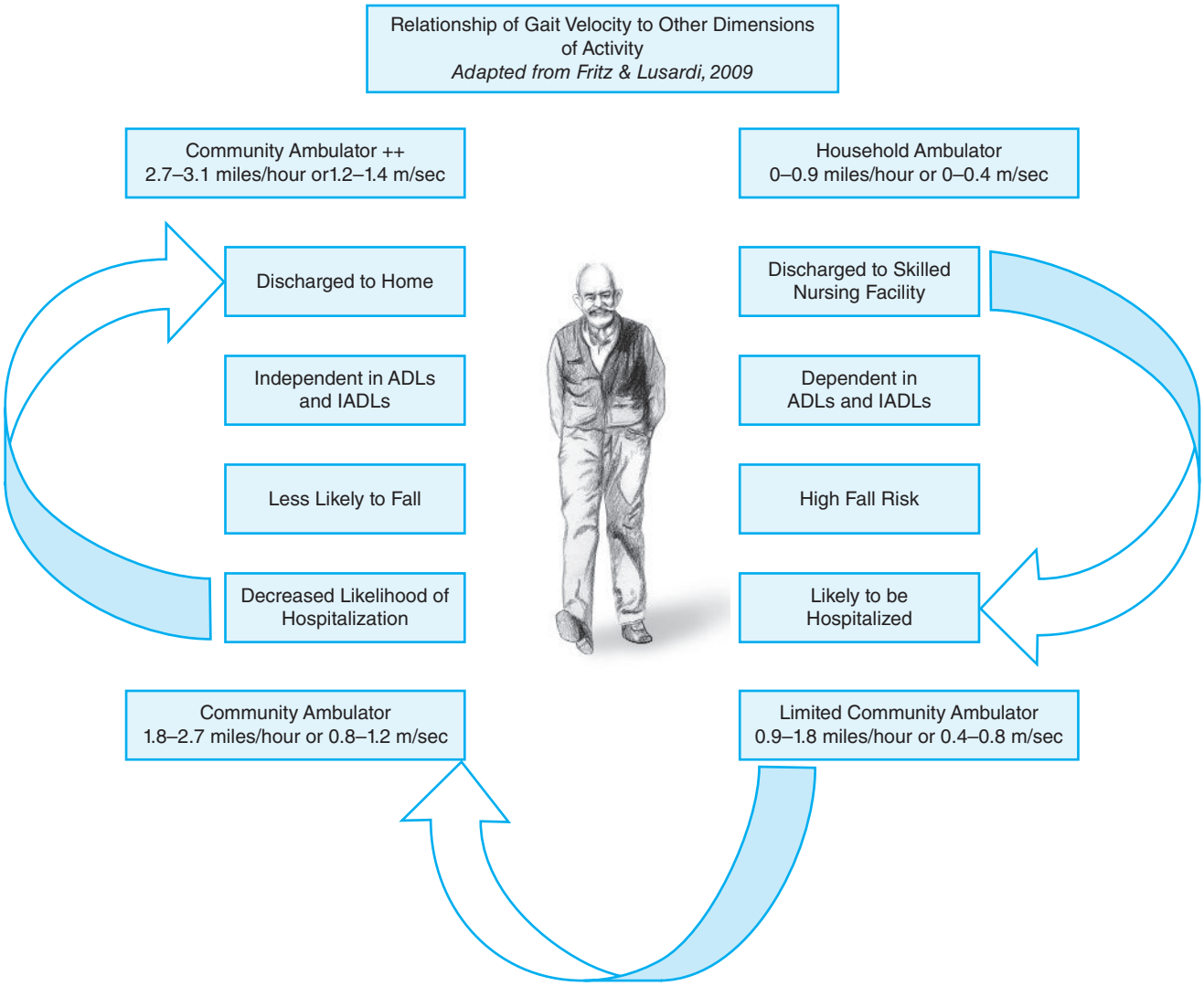

Figure 1-3 Relationship of Gait Velocity to Other Dimensions of Activity

DOMAINS OF PERFORMANCE AND FUNCTION

Traditionally, in the psychological study of human development, three domains have been addressed: cognitive, affective, and psychomotor. The **cognitive domain** involves thought, the **affective domain** involves feelings, and the **psychomotor domain** involves movement. The ICF has a much more specific and detailed analysis of behaviors that can be tested and used to infer capabilities. ICF combines the categories cognitive, affective, and psychomotor into the single category of "Mental Functions." Mental functions will be described in detail in Chapter 6 of this text (WHO, 2001a). These broad domains of human behavior, or body structure/function in ICF terminology, provide the matrix upon which function occurs.

The ICF operationally defined the list of functional domains categorized as "Activities and Participation," summarized in **Table 1-2**. These functional domains incorporate long-existent terminology associated with function. For example, in the ICF domain of "Self-Care" are behaviors traditionally referred to as activities of daily living (ADLs). Examples of ADLs are personal hygiene (toileting, bathing, feeding, dressing, and grooming). The ICF domain of "Domestic Life" incorporates a more complex set of functional behaviors traditionally known as **instrumental activities of daily living (IADLs)**. These are the activities of daily living that typically involve cognitive sequencing as well as chains of behaviors. Examples are grocery shopping, managing money, planning and preparing meals, and using transportation. The ICF domain of "Mobility" incorporates physical function, including the ability to maneuver in the environment through some means of locomotion. Physical function abilities underlie the execution of work, productive activities, and leisure. **Table 1-4**

TABLE 1-4 ICF Activities and Participation Domains

Domains	Sample Components
Learning and Applying Knowledge	Basic learning such as learning to read, applying knowledge in thinking, reading, writing, calculating, and solving problems
General Tasks and Demands	Undertaking a simple or complex task, carrying out daily routines, handling stress
Communication	Receiving verbal and nonverbal messages, speaking, producing nonverbal messages, participating in conversations and discussions
Mobility	Maintaining and changing body positions, carrying objects, walking and moving using transportation
Self-Care	Washing, toileting, dressing, eating, drinking, taking care of health
Domestic Life	Acquiring a place to live, household tasks, caring for household objects, and assisting others
Interpersonal Interactions and Relationship	Forming and maintaining relationships including application of social rules, reacting appropriately with equals, subordinates and authority figures, maintaining family and intimate relationships
Major Life Areas	Education, employment, and economic life
Community, Social, and Civic Life	Community life, recreation and leisure, religion and spirituality, politics and civic life

presents a summary of these operational definitions associated with the "Activities and Participation Domains."

As an example of how the ICF domains of "Activities and Participation" are used in rehabilitation to describe outcome, consider the aforementioned individual with a TBI. The person sustained severe damage to structures of the nervous system, specifically the frontal lobe of the brain. This results in a moderate to severe impact on mental functions (such as learning and memory), speech functions, and movement-related functions. As a result of these impairments in body structure and function, the individual has activity limitations. She may not be able to participate in self-care or feed herself. She may not be able to walk or propel a wheelchair. She is not able to behave appropriately in environmental contexts. Therefore, for the time being, she has severe participation restrictions. She cannot function in her home environment, much less return to work or school. Her intimate relationships are altered because of her dependence. Leisure is not available. If the resources permit and she enters a period of appropriate activity-focused rehabilitation, the goal is that she will ultimately return to work, school, leisure, and family life in age-appropriate roles. Thus, her participation restrictions will be lifted, and her place on the continuum of function moves away from the negative aspect of disability and toward functioning.

This example illustrates the use of the ICF for an individual with an acquired impairment. In the example given, the individual was following a normative developmental and functional performance path until she had an accident resulting in a TBI. From that point on, her life course was altered. The ICF can also be useful in understanding quality of life and function in a person with a congenital impairment. For example, an infant born deaf will have different developmental experiences and demands. The baby will be challenged in the development of mental functions, because he is not receiving sound information from his environment. He will have impairments in language and social skill development for the same reason. Although hearing loss is specific to one sensory organ, the impact on development can be pervasive, and without identification of the problem, or intervention, the boy may develop very differently from his peers.

In the case of a congenital problem, like deafness, intervention would focus on strategies that will help the boy have a more normative developmental experience, with typical developmental opportunities. In this example, a technological intervention, a cochlear implant, can offer sound input and help restore his developmental trajectory. Other interventions might include speech therapy, developmental therapy, and special education.

CLINICAL FRAMES OF REFERENCE

Rehabilitation professionals have embraced the disablement concept as a *frame of reference* for practice. A **frame of reference** is the theoretical perspective or viewpoint that organizes the approach to client management. Two professional groups, occupational therapy and physical therapy, have slightly different historical frames of reference

in the management of disability. Frames of reference guide clinical reasoning in the health professions. They support the identification of assessment strategies, intervention goals, discharge planning, and offer support for advocacy and community engagement activities.

Occupational therapy has historically had strong ties to social models of disability, as well as medical models. In the practice guidelines for occupational therapy, a careful differentiation is made between the medical model, with its focus on the absence of disease, and the **occupational model**, with its more societal focuses on competence in performance in desired human occupations. Throughout this text, the term *occupation* is used as a descriptor for "all that people need, want, or are obliged to do; what it means to them" (Wilcock, 2006, p. 9). The interdisciplinary study of occupation, called occupational science, focuses on daily human occupation and how they are invested with meaning, value, and power.

Throughout this text we explore occupation in terms of how people typically occupy their time at differing developmental periods, what factors influence people's choice of occupations, and how occupation impacts heath and participation in society.

The *Occupational Therapy Practice Framework (OTPF)* closely parallels the ICF model and reflects an occupational perspective, especially in its unique emphasis on contextual factors. The OTPF describes **occupations** as "engagements in which people participate in their daily life and throughout their lifetime. Occupations occur in context and are products of the interplay among client factors, performance skills, and performance patterns. Occupations occur over time; have purpose, meaning, and perceived utility to the client; and can be observed by others (e.g., preparing a meal) or be known only to the person involved (e.g., learning while reading a textbook)" (AOTA, 2014, p. 9). The OTPF cites as the domain of occupational therapy "supporting health and participation in life through engagement in occupation" and terminology closely parallels the ICF model, as illustrated in **Figure 1-4**.

The *Occupational Therapy Practice Framework* (2014) also emphasizes that the target of intervention, that is, the client, may be people, groups, or populations. Physical therapy has

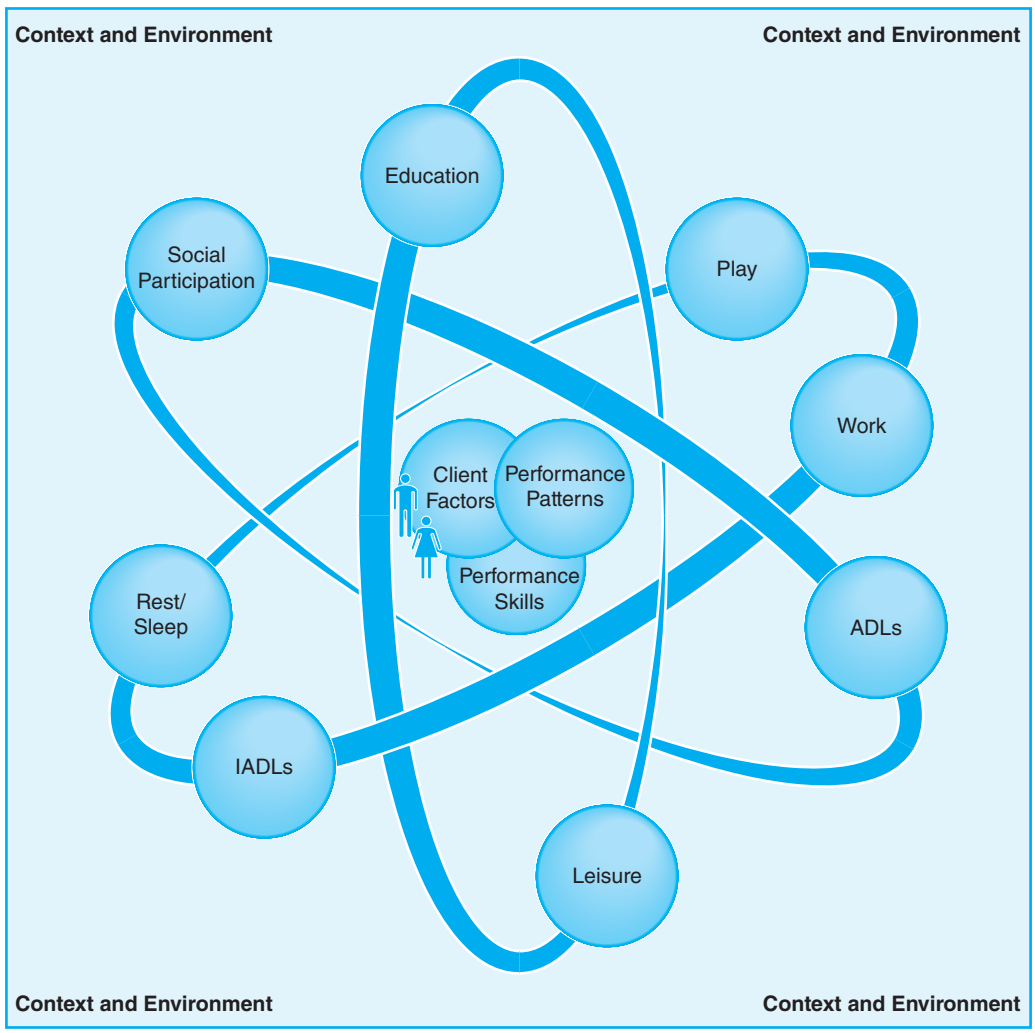

Figure 1-4 Occupational Therapy's Domain

Source: American Occupational Therapy Association. (2014). Occupational Therapy Practice Framework: Domain and process (3rd ed.) Bethesda, MD: AOTA Press.

a deeper history in the medical model, but has more recently adopted the disablement perspective as a key frame of reference. In a landmark paper published in *Physical Therapy,* the profession's flagship journal, Alan Jette proposed a disablement model adaptation based on a Nagi revision and closely aligned with the WHO's ICIDH model (Jette, 1994). The proposed model includes terms such as *pathology, impairment, functional limitation,* and *disability*. Jette related disablement to *quality of life,* which he defined as emotional well-being, behavioral competence, sleep and rest, energy, vitality, and general life satisfaction. Jette further posited that quality of life is impacted at the level of functional limitation and handicap or disability (Jette, 1994). Jette's paper and associated terminology was incorporated into the *Guide to Physical Therapy Practice,* published in 1997 and revised in 2001 by the American Physical Therapy Association (APTA). Jette (2006) summarized the history of incorporation of the disablement concept into models by the World Health Organization and others, and recommended the adoption of the ICF as the path toward a "common language" for function, disability, and health. In 2008, the APTA House of Delegates adopted the ICF as the frame of reference for all subsequent documents, and the association is in the process of revising its core documents, such as the *Guide*, to align with the ICF. In 2011, a special issue of *Physical Therapy,* edited by Jette and Nancy Latham, summarized the progress made by the profession in implementing a new concept of disability. In fall of 2014, the newly revised Guide to Physical Therapy Practice 3.0 was published as an on-line document. This new version of the Guide incorporates the ICF as an organizing framework.

In rehabilitation, it can be argued that clients often seek out professionals for the express purpose of improving or maintaining quality of life. Therefore, desired therapeutic outcomes or goals should focus on activities and participation. The domains of "Body Structure and Function" should be a focus of therapeutic intervention ONLY as they underlie activities and participation. This perspective has major implications for rehabilitation professionals, in all aspects of their practice including assessment, treatment, and reimbursement.

Many health professionals, including both occupational and physical therapists use the language and classifications of the ICF in their clinical practice and in communicating with professionals in other health fields (Stucki, Ewert, & Cieza, 2003). This important tool has direct clinical implications, but has been increasingly used as a tool to guide program evaluation and program development (Üstün et al., 2003). The ICF guides clinical reasoning to recognize that desired therapeutic outcomes or goals should focus on activities and participation.

THE ICF AND REHABILITATION

In the decade since the WHO published the ICF, it has increasingly become the standard for terminology applied to rehabilitation outcomes in key publications (Frontera, Grimby, Basford, Muller, & Ring, 2008). Therefore, it is imperative all professionals understand and use the terms correctly. The standardization brought to the field by the ICF and ICF-CY has been interdisciplinary in nature, with benefits that are widely referenced (Cramm, Aiken, & Stewart, 2012). Over the decade, an increasing number of disciplines have adopted or recommended use of ICF terminology. For example, Linden (2012) proposed ICF terminology as the solution to the need for operational definitions in the mental health professions.

Steiner and colleagues (2002) discussed using the ICF as a clinical problem-solving tool for rehabilitation practice. One issue related to using the ICF for clinical purposes is incorporating the terminology and concepts into assessment. Goldstein, Cohn, and Coster (2004) suggested the ICF implies a top-down approach to assessment. As will be discussed in Chapter 22 of this text, a top-down assessment is one that initiates the assessment process by asking what the outcome should be in terms of participation. The remainder of the assessment process then focuses on determining what factors enable participation and what factors interfere with the desired outcome. Intervention involves the development of strategies to improve performance or bypass barriers to participation. Rehabilitation professionals were challenged by this concept in the sense that few commonly used assessments routinely looked at participation. O'Neil et al. (2006) did an extensive review of assessment involved in the evaluation of children and youth with spastic diplegia and discovered that although many assessments targeted activity and body structure/function, only a handful of assessments were geared toward participation.

Resnik and Plow (2009) did an extensive review and content analysis to determine participation-related items found in selected measures. They reported five measures that had items linked to all nine activity-participation dimensions (see **Table 1-2**). The specific measures found will be discussed more completely in a later chapter. It is important to understand, however, that adoption of the ICF has resulted in a need to analyze current measures and develop new ones with a participation focus. Van der Zee and colleagues (2011) studied four participation measures for sensitivity to change during outpatient rehabilitation and reported the USER-Participation Restriction scale to show the best responsiveness.

In addition to developing new tests and measures emphasizing participation, attempts have been reported to link current measures commonly used in rehabilitation, such as the Functional Independence Measure (FIM) score as reported in the medical record, to the ICF (Ptyushkin, Vidmar, Burger, & Marincek, 2012). It is also noteworthy that Ptyushkin et al. (2012) cited one of the complicating factors in attempting to complete their work was the large number of discipline-specific assessments found in the medical record. Because they were studying records of patients with traumatic brain injury (TBI), which traditionally involves a large multidisciplinary team, the authors were

particularly enthusiastic about the potential for ICF terminology to provide standardization of outcome measures.

There is growing literature about how the ICF and ICF-CY influence clinical practice. Sullivan and Cen (2011) used a technique known as knowledge translation (KT) involving a variety of statistical analysis techniques to assess individuals with post-stroke walking disability. The authors reported the direct effect of impairment on participation was not statistically significant; however, the indirect effect through activity was significant. Therefore, the notion that rehabilitation outcomes should focus on activity and participation domains was validated. Darrah, Wiart, and Magill-Evans (2008) surveyed pediatric physical therapists to determine their use of participation as a concept in establishing therapy goals. The authors found 78 percent of therapists established at least some goals at the level of activity or participation; however, they also found therapists *assumed* spontaneous translation to participation from achievement of goals at lower levels. The ICF has also forced a more long-term community-based outcomes focus to the rehabilitation process, as exemplified by a study identifying long-term needs of survivors of stroke (Sumathipala, Radcliffe, Sadler, Wolfe, & McKevitt, 2012). These authors concluded that the ICF framework was particularly useful to investigate the influence of contextual factors on long-term needs of post-stroke survivors.

It is important to note one of the key potentials cited in ICF literature is the improvement in interprofessional communication in team-based health care. As the United States health care system undergoes changes in the twenty-first century, the health care team is considered an important founding principle to high-quality, cost-efficient care (Sheldon et al., 2012). In a paper discussing implementation of the ICF in a neurorehabilitation setting, the "team" is considered the working unit, rather than the individual treatment discipline (Rentsch et al., 2003). These authors stated that adoption of the ICF in daily practice of neurorehabilitation improved team communication and documentation, the quality of interdisciplinary work, and ultimately resulted in a more systematic approach to rehabilitation (Rentsch et al., 2003). In fact, to address emerging trends in health care, professional education programs in the health professions have begun to adopt **interprofessional education (IPE)** into professional curricula. IPE is defined by the Centre for the Advancement of Interprofessional Education (CAIPE) as: "… when two or more professions learn with, from and about each other to improve collaboration and quality of care" (2002). In a 2008 survey, Mueller, Klingler, Paterson, and Chapway asked physical and occupational therapists their perception of IPE. Of the responses, 97 percent reported a favorable perception, with 65 percent believing IPE should occur in the clinical setting, and 26 percent in the classroom setting.

Predictably, the enthusiasm with which the ICF and ICF-CY have been greeted is tempered with some concerns. Stucki, Ewert, and Cieza (2002) discussed the application of the ICF to rehabilitation and commented that, although the ICF classification system is comprehensive, it is also unwieldy and impractical in its original form. Haglund and Henriksson (2003) assessed the utility of ICF concepts in classification as applied to the profession of occupational therapy. They compared ICIDH-2 classifications with two discipline-specific classifications of 33 clients with learning disabilities, as rated by a panel of occupational therapy experts, and concluded that the ICF in isolation was insufficiently inclusive of occupational therapy concepts to replace discipline-based assessment and classification systems. One key complaint appearing in the literature is the difficulty in differentiating between the concepts of activity and participation. It has been noted that, although they are conceptually separate, by putting them in a single category for classification, the WHO made it difficult to clearly code problems identified in clinical practice (Cramm et al., 2012; Jette, 2006). In a published commentary, Ring (2010) stated the ICF was not a useful research tool, because the categories and frameworks were too imprecise to be useful. Wiegand and colleagues (2012) reviewed global diffusion and clinical implementation of the ICF and found that, although the terminology and concepts had successfully permeated rehabilitation, the effect on rehabilitation practice was idiosyncratic.

Despite problems and, in some cases, calls for modification, the ICF and ICF-CY have had an enormous impact on how disability is viewed and categorized. Many of the concepts embedded in the ICF framework, such as focus on long-term participation as the outcome and consideration of the impact of contextual factors on outcome, complement other emerging trends in health care such as life course theory (LCT), the occupational therapy practice framework, IPE, and team-based health care. All health professionals should be able to apply the ICF to their niche in the health care system and work to ensure integration at all levels of engagement.

DIMENSIONS OF HUMAN FUNCTION OVER THE LIFE SPAN

To study human function over the life span, it will be important to keep in mind that both development and aging are continuous processes. There is not a point in the life span where development ceases, and although we tend to prefer the word *maturation* when considering the very young, aging begins with conception. The focus of this text is normal aging. Normal aging is a developmental process that involves changes in function that are the result of maturation or the passage of time. Three types of influences on aging will be considered as you progress through this text:

(1) age-normative influences, (2) history-normative influences, and (3) nonnormative influences.

AGE-NORMATIVE INFLUENCE

Age-normative influences are the aspects of development that are chronological (Hayslip, Patrick, & Panek, 2011). Many age-normative changes are physiological and reflect the maturation of an organism. As you learn about development in the prenatal period and in infancy, many age-normative patterns of development will be presented. The developmental milestones used to screen young children for developmental delay are an example of age-normative developmental expectations. In Chapter 2, developmental models will be discussed as they impact health across the life span.

HISTORY-NORMATIVE INFLUENCE

A cohort is a generational group as defined in demographics. One of the most famous cohorts in recent American experience is the cohort of the "baby boomers." The baby boomers are a generation of Americans who were born in a "baby boom" following World War II, roughly between 1944 and 1964. **History-normative influences** are the aspects of development that affect a cohort in time (Hayslip et al., 2011). For example, the baby boomers were born in a prosperous time, with a strong belief that they will achieve more than their parents before them. American history influenced the worldview of the baby boomers to such a degree, that the cohort has been described as having characteristics that are unique, and not common to all Americans. The baby boomer generation is identified as confident, independent, and self-reliant. Because members of this generation grew up in an era of reform, they entered adulthood believing they could change the world. Baby boomers have also been described as "work-centric," motivated by position, perks, and prestige.

Chapter 4 of this text introduces the idea of *subcultures*. In some ways, history-normative influences, such as those baby boomers experienced, result in a subculture that is distinctive. Students of development will find few history-normative influences in the study of young children, but from adolescence all history becomes an important factor influencing development. For example, young adults entering college today are described as being part of the "net generation" (or *Internet* generation). The historical influences on this generation include the perception that computers are a natural part of their environment, and the virtual world is an extension of their real world. This perception is unique in human history, and we are only now beginning to see how it influences adult function and decision making. Chapter 16 addresses how the experience of today's young adults has been greatly influenced by the global economic recession. Chapter 17 describes the generation split, with older people in this age span as members of the baby boomers, and the younger half of this age cohort described as generation X. As we consider human performance and function in middle adulthood, it will be vital to also consider the history-normative influences in order to understand developmental trends.

NONNORMATIVE INFLUENCE

The final type of influence on development that we will consider is the nonnormative influence. **Nonnormative influences** are factors that influence development that are not related to either age or personal history. Nonnormative influences will be mentioned in many chapters as we give examples of types and impacts of disabilities. Other nonnormative influences we will consider are the impact of family violence, illness, and poverty.

SUMMARY

The study of human performance and function is vital to understanding the contexts within which people seek rehabilitation or other interventions to restore quality of life. Participation in daily life occupations is central to positive developmental and health outcomes and will be addressed throughout the text. Normative and nonnormative influences on behavior and development will be considered as they relate to each age cohort described in Part 2 of this text. Rehabilitation professionals must understand the complex relationships that allow individuals to be healthy, in the fullest use of the term. This chapter has introduced basic terminology and constructs that will serve as a guide to the study of human performance across the life span. In Case 1, you will meet Jayden, a young man with a developmental delay that is congenital and that potentially limits his participation in activities and major life areas. Linda, in Case 2, was well established in her community and was able to assist her daughter in providing child care prior to acquiring a health condition. In her case, she has life roles she hopes to return to. These two cases illustrate applications of the ICF with congenital and acquired health impairments.

As you move through Part 1 of this text, you will see the WHO ICF terminology used, often in parallel with more commonly used clinical terms for the same concept.

Part 1 of the text covers the large overarching frameworks that influence human performance and function at all levels of development. This section of the book focuses on contexts and influences on occupations that may impact individuals at any developmental period. In Part 2 of the text, readers will be moved sequentially through life span development. In all of Part 2 of this book, readers will see the ICF framework used to structure the chapter. After the chapter introduction, each chapter will begin with significant issues in body functions and structures, and then move on to areas of activities and participation. Examples of occupations that are typical within the developmental period on which the chapter focuses will be offered. Human occupations become more varied and complex throughout the life span, and this is reflected in the text as well.

Engagement in activities in the preschool period expands with a child's growing skills, and from this point on become a central focus of the book. Readers will note that the bulk of the chapters on adulthood focus on activities and participation. Because this change in focus reflects changes in the developmental life course, the focus returns to body functions and structures in the chapter on late adulthood.

The final part of this text focuses on specific societal and professional trends that impact functional performance and our ability as health professionals to support people to achieve a high quality of life. Throughout the text, case studies and clinical examples have been introduced to help readers understand the impact of developmental issues on everyday function.

CASE 1

Jayden

Jayden is 2 years and 6 months old. He has typical mental and sensory functions for his age, but has impairments in neuromusculoskeletal and movement-related functions. With secondary to poor muscular control, Jayden also has unclear speech production, known as dysarthria. He has incoordination of all large muscles limiting postural control, mobility, communication, and fine motor control. Jayden communicates through gestures and facial expression with some vocalizations. He currently attends a special needs preschool. He has attended occupational therapy (OT), physical therapy (PT), and speech therapy (ST) since birth and has been making steady gains in motor control over the past 2 years.

Jayden is very social but does not communicate well verbally because of his dysarthric speech patterns. He is intellectually able to keep up with classroom activities, and he especially loves story time. His parents want him to be able to go to the neighborhood school and attend regular classes when he is 5 years old. They are interested in learning how to best support him so that he can achieve this. Communication, mobility, and self-care are the three biggest participation areas that need additional support if Jayden is to achieve this goal. His physical therapist has been exploring mobility options for Jayden. He is working on walking with a walking frame in the clinic, but in the community his parents use a baby stroller to take him around. The focus of physical therapy intervention will be to maximize the movement and mobility abilities that he has while offering assistive technology (leg braces, wheelchairs, or power scooters) to be sure that he can keep up with his age peers and access the school environment independently.

Because of his limited physical mobility and poor muscle coordination, Jayden has had difficulty learning to dress himself, to bath himself, and to use the toilet. His family helps him with tasks that are difficult for him, and Jayden relies on them to organize and direct his play as well as his self-care activities. Jayden does not have much interaction with other children his age. Occupational therapy will work to adapt clothing and tasks so that Jayden can learn to take care of himself in dressing and personal hygiene tasks. The therapist will work with the family to arrange his clothing and other task-specific items in a way that he can reach them without adult help. In addition, the occupational therapist will help Jayden develop some play

Continues

Case 1 *Continued*

activities that he can do by himself and with other children. This may include using electronic games, board games, or imaginative play.

The focus of speech therapy will be on helping Jayden communicate verbally with both adults and age peers. The speech therapist may choose to use an alternative communication system, such as a picture board, to serve as a tool to aid communication while Jayden works on articulation skills. Because communication is integral to all aspects of school performance, the OT, PT, and ST will need to work together so that Jayden is able to communicate in all settings and across all tasks. Jayden is unlikely to gain typical age-normative skills in mobility, self-care, play, or communication without the use of assistive devices. The goal of therapy is to maximize his skills and to offer alternative methods of participating in tasks when he lacks the performance abilities to participate in a typical manner.

Guiding Questions

Some questions to consider:

1. What do you think normal *activity and participation* roles for a 2½-year-old child should be?
2. How would Jayden's case be viewed from a frame of reference that arises from the medical model, the social model, and a disablement model?
3. What environmental (contextual) factors need to be considered in Jayden's case?
4. How is an interprofessional model of care used in this case?

CASE 2

Linda

Linda is a 60-year-old woman who had a right cerebrovascular accident (CVA) with left weakness. Linda spent five weeks in the hospital and then in rehabilitation to aid in her recovery. Linda has now returned home. She lives in a single-family home with her 30-year-old daughter and her two grandchildren. She is able to walk independently with "toe drag" on the left, and is walking throughout the ground floor of the house using a standard walker.

Linda is able to feed and groom herself, given setup. She needs minimum assists in transfers to and from chairs and needs assistance to get out of bed. She uses her right hand for most tasks, and will use the left arm as a gross assist in some activities. Her left shoulder and elbow are weak, with muscles scoring in the "fair" grade of strength. She has only gross movement and control of her distal arm.

Linda had been helping her daughter with child care before her CVA and is concerned that the extra burden of caring for her will be too much for her daughter. A physical therapist and occupational therapist have been visiting her home to assist Linda in returning to daily life tasks. Areas of emphasis have been an analysis of the home environment to reduce Linda's risk for falls and to modify the home with safety grab bars and easy-access handles so that Linda can manage independently. PT will focus on Linda's mobility in

Continues

Case 2 *Continued*

the home, helping her gain strength and control in walking. Both the OT and PT will work together to help Linda regain her independence in activities of daily living. Linda wants to regain her previous life roles and participate more in cooking and child care tasks. The occupational therapist will work with Linda to both regain physical control, and also to help organize tasks so that they are easier for Linda to complete. Linda may need home modifications and assistive devices as well as therapy to regain these skills.

Even with these supports, Linda is likely to continue to need assistance in some areas of domestic life, such as acquisition of necessities, household tasks, and assisting others. With Linda and her daughter, the OT and PT may be involved in helping renegotiate roles and expectations within the home. For example, Linda may be able to do more child care and less housework with her current physical condition. Linda may also need support as she returns to old leisure pursuits or explores new leisure options. To fully return to adult roles and participation, Linda will need therapy supports to extend beyond the rehabilitation hospital and as she reenters community life.

Guiding Questions

Some questions to consider:

1. **How do the participation roles in Linda's case differ from those in Jayden's case? Discuss this from a view of age-related participation expectations.**
2. **What contextual factors might affect Linda's ability to participate in her normal life tasks?**
3. **Can you apply the domains of activity and participation presented in Table 1-4 to Linda's current level of performance? Are all domains equally affected by the CVA? If not, which ones are most affected?**

Speaking of The ICF in Practice

MARYBETH MANDICH, PT, PHD
PEDIATRIC PHYSICAL THERAPIST

Many years ago, when I was a young therapist, I was working with a young man, probably 12 or 13 years old, who had spina bifida. In the fairly recent past, before I started working with him, he had given up attempts at walking. Because he was paralyzed from the waist down, he was confined to a wheelchair, and he was pretty good at getting around that way. The reason he had given up walking, it turns out, had nothing to do with energy expenditure or laziness or weight gain. The reason he had stopped walking was very simple—every time he stood up, he had a reflexive bowel movement. Now, I don't remember if this was a recently developed problem or one that he had previously, but with the onset of adolescence, he was unwilling to "pay the price" of walking.

As a brand new therapist, armed with lots of knowledge and very little wisdom, I determined that it would be an important treatment goal for this young man to regain the ability to ambulate. I had pretty good rapport with him, probably because I was so young myself, so he agreed to give it a try. Every day, he and I would leave his classroom, lock his braces up, and begin gait training. Every day, to avoid anyone else knowing his problem, I would perform the required hygiene after the inevitable bowel accident occurred. We kept this up for weeks. Eventually, however, I was

Continues

Speaking of *Continued*

forced to admit what this young man had feared—this reflexive reaction simply wasn't going to become accommodated, and, at the young man's request, we stopped the gait training.

Now, there are good reasons for encouraging walking in individuals with spinal cord injury, including congenital problems like spina bifida. Walking helps keep the bones strong. The energy used to walk helps control weight gain. Many individuals like the idea of being upright with their peers who are able-bodied.

However, I was approaching the issue with what I am now able to see in hindsight was a blatant disregard for this young man's functional abilities. I was focusing at the body structure and function level, and to some extent, at the activity level (the activity of walking). What I missed entirely was the focus on participation. In fact, by having this young man put such an emphasis on walking, I was in fact limiting his activities and severely restricting his participation. However, in the end, it was the ability to participate with his peers that mattered most.

What the ICF and its predecessor, the ICIDH model, have taught us is to expand our worldview in defining outcomes and setting goals for individuals with disabilities. As discussed in this chapter, it is entirely possible to have restrictions in body structure and function but not be limited in activities and participation. Conversely, it is possible to have no restriction on activity but be unable to attend a social function because of environmental or societal barriers. In order to work effectively with individuals who have disabilities, it is important to remember that activity and participation are part of normal functioning, and restoration of these abilities is part of every intervention program. This provides a mandate to the rehabilitation professional. No longer can we view our clients and patients within a single treatment area or department or gym. We have to look out to the world. We need to understand what their developmental and functional needs are in the context of their physical, social, and cultural environment. Where society puts up barriers, we need to become advocates for barrier removal.

The ICF helps us categorize and gives us a classification system to reference. But to apply the ICF correctly, we need to understand normative developmental and functional tasks across the life span. Our hope is that this text and others like it will help rehabilitation professionals learn to incorporate this frame of reference into their interventions.

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CHAPTER 2

Human Performance: The Life Course Perspective

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Objectives

Upon completion of this chapter, readers should be able to:

- Define and describe key terms associated with development, including functional differentiation of the terms *development, maturation,* and *growth;*
- Discuss life course theory (LCT) and associated implications;
- Reflect on the implications of the Human Genome Project and the increased influence of behavioral genetics in the study of human participation;
- Discuss the concept of early programming as it impacts both health and educational policy and best practices;
- Discuss a systems theory of human development and motor control, including correct application of key terms; and
- Define key terms in genetics and apply them to behavior development and health.

Key Terms

agonist
allele
antagonist
anticipatory control
autonomic nervous system (ANS)
behavioral genetics
cardiopulmonary system
central nervous system (CNS)
competence promotion
control parameter
cumulative impact
degrees of freedom
determinant
development
developmental milestone
developmental systems theory (DST)
dynamical systems theory
early programming
effector system of motor control
emergent control
environmental constraint
epigenesis
epigenetics
evolutionary psychology
family development theory
genomics
genotype
health disparity
health trajectory
heritability
hierarchical model
Individuals with Disabilities Education Act (IDEA)
learning
life course health development model
life course theory (LCT)
maturation
motor control
mutation
neuroplasticity
occupational engagement
peripheral nervous system (PNS)
phenotype
prevention science
proprioceptor
protective factor
resilience
risk factor
risk reduction
sensitive period
skill
somatosensory
special senses
systemic family development model (SFD)

INTRODUCTION

If you look at paintings of children from the nineteenth century or earlier, most twenty-first-century viewers would find the portraits somewhat grotesque in proportional scale (see **Figure 2-1**). This is because the artistic expression of the pre-twentieth-century era reflects the commonly held societal belief that children are merely quantitatively different from adults. Taking the fact that children are obviously smaller, the artists projected adult proportions in smaller dimensions, making the paintings appear as unrealistic representations.

From the second decade of the twentieth century, at the close of the First World War, there began to be a scientific interest in discovering the nature of human development. A key factor in this field of study was predicated on federal funding, which was made available to study human development based on interest in prediction of factors such as intelligence and motor aptitude. The nineteenth-century work of Charles Darwin suggested that humans could adapt to environments and that positive traits enhance survival. Throughout the twentieth century until today, human development has been an area of study with an emphasis on qualitative changes. Most of the key theories of human development, discussed in the next chapter, were part of this surge of interest in understanding how humans change over the life span, with emphasis on the early years.

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Figure 2-1 In this portrait of "The Infant Margarita at the Age of Three" by Diego Velazquez, the "infant" looks very much like an adult.

LIFE SPAN BEHAVIORAL CHANGE

An individual acquires an increasing number of behaviors across the life span, particularly in early life. Qualitative changes related to organizational and process change may be considered maturation. **Maturation**, in this context, refers to the process of an individual growing biologically, socially, and emotionally over time, changing gradually from a simple to a more complex level of function. The quantitative changes that occur over time in humans (changes in height, weight, and physical characteristics) are categorized as growth. The process of **development** refers to those changes in performance that are heavily influenced by maturational processes and growth, such as learning to walk (Payne & Isaacs, 2012). For example, maturation of the brain plays a key role in support of early behavioral acquisition, particularly in early childhood. Despite wide varieties of environmental influences, when all body systems are sufficiently mature, most infants will begin walking. Behaviors acquired largely through maturation, such as rolling over or crawling, are referred to as **developmental milestones**. Another fundamental process, **learning**, is the acquisition of new behavior through interaction with the environment. Learning is dependent not only on environmental exposure, but also on such factors as feedback and practice. Behaviors acquired through learning are commonly referred to as **skills**. Related to this is the concept of **occupational engagement**, used to describe "people doing occupations in a manner that fully involves their effort, drive, and attention" (Christiansen & Townsend, 2010, p. 8). As individuals learn and gain skills, they also gain in ways in which they can engage in occupations in their everyday life.

The question of the role of maturation versus learning, with the former based primarily on biologic processes and the latter based primarily on environmental interaction, led to one of the biggest debates of the early developmental theorists, known as the *nature-nurture controversy*. The theorists who believed developmental change over time was inevitable due to the nature of humans were in direct opposition to those individuals who believed human behaviors arose solely from environmental exposure. Although essentially resolved by the understanding that *all* behaviors have differing contributions from nature and nurture, advances in the study of neuroscience and genetics in the late twentieth century have resurrected a new iteration of the debate, which will be discussed later in this chapter.

An example of the theoretical dispute of the 1930s to the 1950s was between the motor theories of Myrtle McGraw and Arnold Gesell (Payne & Isaacs, 2012). McGraw is remembered today for her classic 1930 studies of the identical twins, Johnny and Jimmy. The twins were observed over their childhood, with one twin given more toys and overall greater opportunities for stimulation (McGraw, 1935). Several key findings of these classic studies are still accepted today. For example, some skills, such as roller-skating, appear to be learned and retained better when introduced at an early age. Children will not learn to roller-skate or without exposure and practice. The young girl in **Figure 2-2** is gaining skill with skating. However, skills such as walking, creeping, and so on are less affected by environmental exposure. Arnold Gesell, on the other hand, believed firmly in the unfolding of developmental acquisitions irrespective of environmental experience.

Of course, as we look back on these controversies from our twenty-first-century perspective, we know there are no dichotomies. Contemporary scientific findings in genetics and neuroscience show it is a question of extent rather than absolutes. For example, acquisition of behaviors such as rolling over, while heavily maturational, can be influenced if the environment is extremely deprived. Cross-cultural studies have revealed infant caregiving practices, if relatively supportive, result in children being able to walk at around 1 year of age. However, in extremely deprived environments, even

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Figure 2-2 Learning to skate using in-line skates requires practice and exposure; based on McGraw's studies, this is a skill best introduced early in life.

such a maturational milestone can be delayed. Likewise, although skills such as playing the violin certainly depend on environmental exposure and practice, there is no question that a certain amount of growth and maturation have to occur prior to even the youngest children learning how to play the violin.

NEUROSCIENCE AND LIFE COURSE DEVELOPMENT

One of the key factors that placed the nature-nurture controversy in perspective is the explosion of information arising from *neuroscience,* or the study of the nervous system. Functional imaging studies of the human brain in the latter part of the twentieth century tell us the young brain is very responsive to environmental influences, and this responsiveness persists in diminishing quantity throughout the human life span.

While all body systems undergo life span change, there is no question the **central nervous system (CNS)** is a key factor underlying developmental changes in behavior. The central nervous system, for the purposes of this text, is the brain and spinal cord, that is, the parts of the nervous system that are protected by the bony covering of skull and vertebral column. The **peripheral nervous system (PNS)** consists primarily of nerves and nerve roots that connect the control centers of the CNS to external sites, such as muscles, glands, or skin. The **autonomic nervous system (ANS)** is the part of the peripheral nervous system that acts as a control system functioning largely below the level of consciousness, and controls visceral functions. The ANS is directed by special parts of the brain and peripheral nervous system. The parts of the ANS that communicate with the periphery are subdivided into the sympathetic and parasympathetic systems. The sympathetic nervous system controls "fight or flight" behaviors and is associated with a high level of arousal. Conversely, the parasympathetic nervous system mediates basic physiologic behaviors such as digestion, elimination, and sexual function.

As mentioned earlier, our understanding of the role of the CNS in human behavior has changed considerably over the years. As early as 1945, Myrtle McGraw attempted to specifically tie the acquisition of developmental milestones such as rolling to the level of brain maturation. Her work was an example of a hierarchical model of development. A **hierarchical model** of development suggests that as the CNS matures, the behavior displayed represents the function of that level. A hierarchical model was supported by motor maturational theorists, like McGraw, who hoped to show specific motor behaviors and reflexes tied to functions of certain levels of the CNS hierarchy.

Several areas of developmental study in the 1960s were responsible for the merging of neuroscience and child development studies. First, studies of language development supported a biological predisposition for language in human infants, and second, Nobel prize–winning studies of development of the visual part of the brain were influential in support of McGraw's earlier efforts to link brain maturation with behavioral development (Segalowitz & Schmidt, 2003). The latter studies by Hubel and Wiesel (1962) were also instrumental in the evolution of the science of *neuroplasticity*. **Neuroplasticity** refers to the ability of the human brain to change as a result of one's experience, that the brain is "plastic" and "malleable," and structural and functional changes in the brain are driven by environmental experience. It was once believed the direction of influence was that genes direct brain growth, which directs brain function, thereby ultimately directing behavior (the hierarchical model). However, it is now clear the model is not unidirectional in a top-down flow. In other words, as a child spontaneously engages in a challenging activity because of maturation of the brain, the CNS functions associated with the activity are then modified by virtue of engaging in such activity (Segalowitz & Schmidt, 2003). The role of genetic influences on the cellular and metabolic functions as well as the connectivity of the central nervous system has given rise to a field of study known as **behavioral genetics**. Behavioral genetics is the field of study that examines the role of genetics of behavior in all animals, including humans. Behavioral geneticists study the inheritance of behavioral traits. In humans this is most often seen in twin studies or studies of people who have been adopted. The goal of developmental behavioral genetics is to determine how genetic and environmental influences direct the development of behavior, as mediated by the nervous system (Saudino, 2009).

GENETICS AND LIFE COURSE DEVELOPMENT: NATURE-NURTURE REVISITED

In 2001, the rough draft of the human genome was published, with the completion of the sequence filled in a few years later. The genome is the entire set of genetic instructions in the cell nucleus, and **genomics** is the study of the genetic code in the context of the genome. The goal of genomics and related fields is to create a full picture of how living things are assembled and operate (Watson, 2003). The **genotype** is the genetic makeup of a cell, an organism, or an individual (that is, the specific allele makeup of an individual). The genotype of an organism is the inherited instructions it carries within its genetic code. Not all organisms with the same genotype look or act the same way because appearance and behavior are modified by environmental and developmental conditions. Likewise, not all organisms that look alike necessarily have the same genotype.

A **phenotype** is the composite of an organism's observable characteristics or traits, behavior, and products of behavior. Phenotypes result from the expression of an organism's genes as well as the influence of environmental factors and the interactions between the two. Thus, to the extent the genotype and phenotype are identical, the characteristic can be attributed to the genotype; however, to the extent they vary, some other factor must explain variance in the phenotype. The term **heritability** is used to describe the amount of variability in the phenotype that is attributable to the genotype (Saudino, 2009).

Over recent decades, a field known as **evolutionary psychology** has received increasing attention. Evolutionary psychology is defined as the application of evolutionary biology to psychology, including the notion that the human brain, as the source of behavior, has specialized mechanisms that evolve to solve recurrent problems encountered by the organism in the environment (Bjorklund, Ellis, & Rosenberg, 2007). Core assumptions of evolutionary psychology include the notion that behaviors reflect mechanisms that are designed by nature to be responsive to a particular range of stimuli. Evolutionary psychology has been criticized by some as simply a contemporary form of genetic determinism. Evolutionary psychology has also been criticized as incapable of explaining the enormous variation in phenotype seen among individuals (Bjorklund et al., 2007). In fact, there has been little success in the prediction of phenotype from simple knowledge of genotype (Wermter et al., 2010). Some of this difficulty may arise from the nature of the genome itself.

The Human Genome Project produced the first complete sequences of individual human genomes. At this time thousands of human genomes have been completely sequenced, and many more have been mapped at lower levels of resolution. The resulting data are being used in medicine and many branches of science. There is a widely held expectation that genomic studies will lead to advances in the diagnosis and treatment of diseases. The human genome contains approximately 20,000 protein-coding genes, and protein-coding sequences account for only a very small fraction of the genome (approximately 1.5 percent), and the rest is associated with noncoding ribonucleic acid (RNA) molecules, regulatory DNA sequences, and other sequences. The code is represented by pairs of nucleotide bases that, in triplet sequence, code for amino acids. Amino acids are the building blocks of protein. One important factor of note is that the gene does not directly encode functions or behaviors (Bjorklund et al., 2007). Another important factor is that genes do not constantly exert their influence, but are switched on and off by triggers, which may be other genes sensitive to environmental effects. Finally, genes can be changed or mutated. A **mutation** is a change of the DNA sequence within a gene or chromosome of an organism resulting in the creation of a new character or trait not found in the parental type. One common type of mutation that has been extensively studied in medical genetics is the *single nucleotide polymorphism* (SNP). As implied, an SNP mutation involves only one base pair; however, it may have enormous effects in phenotypic expression of disease, such as mental health disorders or cancer (Wermter et al., 2010). An **allele** is one member of a pair or series of genes that occupy a specific position on a specific chromosome. Alleles can be preexisting or the result of mutation.

Wahlsten (2003) summarized the possibilities inherent in the study of the effect of genes on behavior. "Either genes or environment" was once considered obsolete, but has been resurrected by some claims that long-term changes in the brain and underlying behavior are results of genes that are adaptable over time. The premise "genes plus environment" was the compromise of the late twentieth century and underlies the concept of heritability, that is, given any trait or behavior, the contribution of genetic variability to the overall variability can be quantified, with the remainder of the variability due to environmental influence. A third approach emphasizing "interdependence of heredity and environment," is notable for asserting bidirectional influences between genes and environment. In this school of thought, the notion of determinism is eliminated. Rather, the context in which development occurs is a critical feature. The context may be broadly interpreted to include not only factors acting on the organism, but also the time in the organism's life when the extrinsic factors exert their influence (Wahlsten, 2003). For example, as shown in **Figure 2-3**,

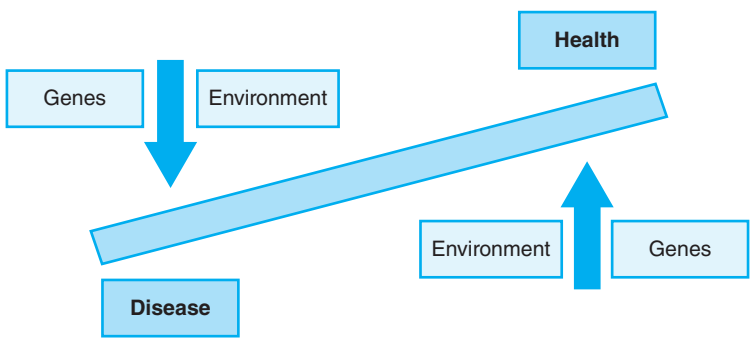

Figure 2-3 Environment-Genetic Interactions on Health

genetic influences and environmental influences can interact in the same direction to promote health or produce disease. On the other hand, healthy lifestyle behaviors can offset genetic influences and tip the scale away from the disease condition.

Wermter and colleagues (2010) reviewed some key examples of gene-environment bidirectional influences. These authors theorize that phenotypic variance may be explained in one of two ways. First, environmental factors may lead to a change in the phenotype, but only in the presence of a certain genotype. Alternatively, a certain genotype may lead to a disorder, only in the presence of certain environmental conditions. For example, in the study of depression, the neurotransmitter serotonin is a key element, and there is a polymorphism associated with the transporter gene for serotonin. The effect of early environmental exposure to maltreatment affected only individuals who carried a certain allele affecting the transport system.

Wermter and colleagues (2010) also presents an interesting review of gene/environment interactions in the problem of obesity, currently a huge public health concern in industrialized countries. The authors report the surge in obesity in recent years suggests environmental factors, including lifestyle, clearly have had an impact. More than 10 genes have been reported as having a role in regulating appetite and body size, with different mutations involved in producing obesity and associated conditions, such as diabetes. Although the two conditions overlap, the effect of restriction of calories and nutritional supplementation has differing effects on the phenotype of obesity and diabetes, depending on the allele form of certain genes carried by the individual (Wahlsten, 2003). Likewise, the effect of genotypes associated with obesity are expressed only when the environment (diet and lifestyle) support the genotype. Researchers in health fields, including those studying development of new drugs, cite the importance of **epigenetics** toward developing an understanding of how to treat health conditions, including such serious conditions as cancer. Epigenetics involves the study of how an individual's genotype may change in response to the prevailing environment, as opposed to how the genotype directs the environmental response. Many of these changes are thought to occur in noncoding parts of an individual's DNA and RNA. If these environmental alterations that direct genes to switch on or off could be thoroughly understood, then behaviors or drugs could help control these "switches" and therefore decrease an individual's likelihood of developing obesity and diabetes, for example (Duarte, 2013).

With respect to behavior, Saudino (2009) reported that, in summarizing across many study designs and methods, there is little doubt temperament has a genetic component. This means that shared environments, such as those siblings experience, do not explain differences in temperament, which must then be attributed to genetic influences. In a recent review article on the nature of temperament, Shiner et al. (2012) introduce the concept of "differential susceptibility" as a paradigm for interpretation of life span influences on temperament. These authors define differential susceptibility as an extension of the "goodness of fit" concept, meaning some traits (such as fearlessness) will result in positive adaptations in certain environmental circumstances and negative adaptations in others. These authors conclude that future studies of genetic and environmental influences on behavior will need to include the notion of differential susceptibility in assessment of risk and resiliency. Guerra & Leidy (2008) summarized recent advances in the study of childhood aggression, stating there have been a large number of studies documenting moderate genetic and nonshared environmental influences, with small shared environment contributions. This means individuals who have temperament characteristics such as low agreeability and low conscientiousness, when placed in an adverse environment, are more likely to develop violent behaviors. There is a wealth of literature on many aspects of behavior that reflect these interaction effects between genetics and environment in a bidirectional manner.

Like the studies mentioned previously with respect to obesity, the clear take-home message in study of human development and behavior is that outcomes must take into account bidirectionality of multiple environmental and genetic interactions in an attempt to understand, and predict outcomes, in hopes of leading to implementation of health and social policies that optimize human potential.

DEVELOPMENTAL SYSTEMS THEORY

Developmental theory has traditionally been regarded as an attempt to explain, predict, and influence change in behavior over time. As evident from the preceding discussion, a simple hierarchical attempt to explain human development is considered to be obsolete. Instead, the concept of systems has been introduced in many contexts to attempt to address the complexity of interactions that influence human behavior and health. **Developmental systems theory (DST)** is a term often applied to a collection of models of biological development and evolution that attempt to incorporate the multiple scientific advances discussed previously. Developmental systems theory embraces a range of positions, from the view that biological explanations need to include more elements than genes and natural selection, to the view that modern evolutionary theory profoundly misconceives the nature of living processes (Oyama, Griffiths, & Gray, 2001). This theory emphasizes the co-occurring contributions of genes, environment, and epigenetic factors on developmental processes. Developmental systems theory has been described as an attempt to resolve the nature-nurture controversy by relational interactions

(Lerner, 2002). In other words, interactions between an individual at multiple levels (genetic, neural, and behavioral) and the environment at multiple levels (physical, social) occur over time and result in the emergence of a more mature individual. **Epigenesis** describes the development of an organism as it moves from a relatively unstructured state to a more ordered and differentiated state over the course of developmental time. During epigenesis the action of the organism influences its own development. For example, as a child attends to a favorite story being read, the process of attending improves the neural mechanisms that underlie attention (Bjorklund, et al., 2007). A general overview of developmental system theory is presented here. There are many more specialized approaches that use developmental systems approaches.

SYSTEMS THEORY OF MOTOR CONTROL

The psychomotor domain of human function has been viewed from a systems perspective for over two decades. In fact, developmental systems theory was pre-dated and developed in tandem with dynamical systems theory. **Dynamical systems theory** developed from the fields of physics and mathematics that refers to self-organization of complex particles. This theory deals with the long-term qualitative behavior of complex dynamical systems. The original theory addressed the motion of systems that are primarily mechanical in nature such as planetary orbits and the behavior of electronic circuits. Dynamical systems theory has been assimilated into many other fields relevant to the study of human development and performance. In particular, dynamical systems theory has recently been used to explain aspects of human development (Miller, 2009). Within this framework, human development is viewed as constant, fluid, emergent or nonlinear, and multidetermined (Spencer et al., 2006).

Dynamical systems theory has been extensively discussed in the literature by Esther Thelen and colleagues (Thelen & Bates, 2003). In the context of human development, dynamical systems theory emphasizes the notion that behaviors are self-organizing and will emerge according to the context or environment in which they are active. Thelen's work on infant movement and motor learning has greatly influenced the practice of occupational and physical therapy. Her work will be referred to in the context of development in later chapters in this text. Important to this discussion of development and theory, dynamical systems theory has been frequently applied to the neuroscientific study of how movements are produced, the field of study known as **motor control**. The dynamical systems view of development and motor control has three critical features that separate it from older models. First is the idea that behavior at any given point in time is the result of variable interaction of a number of complex systems. This interaction occurs in accordance with control parameters and environmental constraints (Kamm, et al., 1991). **Control parameters** are the conditions in existence at the time the task is executed. A control parameter could be a function of change in any one of the subsystems within dynamical systems theory. An **environmental constraint** is any factor in the environment that slows, limits, or restricts a behavior or process within dynamical systems theory.

Second, a dynamic system is dependent on time. In this case time might be considered the age of the person, or where the person is within the trajectory of human development. The current motor performance skills of an individual provide insight into both past experience and potential future experiences.

The third feature of dynamical systems theory that readers should understand is that dynamical systems are relatively stable and include *control parameters* that support the systems' stability.

The generation of a motor program, which represents a pattern of CNS commands about the movement, is not prescriptively generated, but must be flexible, according to what is going on in the environment. For example, consider the task of ringing a doorbell. One option for the CNS to program is a simple elevation and advancement of the arm so the tip of the index finger hits the button. But, consider the situation where a person is holding a heavy box. In that case, the task of hitting the button may be done by moving the body in space so the individual can hit the doorbell with an elbow. In this example, a *control parameter* would be holding the heavy box. The motor program is flexible and emerges based on what is happening in a number of systems. Using the definition common to the field of physics, any of the minimum number of coordinates required to completely specify a motion are called **degrees of freedom**. In the context of this book, the flexibility in the motor program is referred to as its degree of freedom.

Environmental constraints are the prevailing environmental conditions that help shape the movement and typically limit the degrees of freedom. In our example, not having hands free to hit a doorbell would be a constraint, because options for moving would be restricted. As is implied by the preceding discussion, in systems theory, the CNS is no longer the prime determinant of human motor function but is rather one of the key subsystems mediating the motor behavior. Likewise, the outcome of systems processing is probabilistic, not deterministic (Shumway-Cook & Woollacott, 2012).

A second key element of dynamical systems theory is the idea of **emergent control** of behavior, meaning that an individual will alter a task in myriad ways to meet the current conditions. Emergent control goes along with the idea of **anticipatory control**, meaning that the motor program is adjusted even before any interaction with the environment.

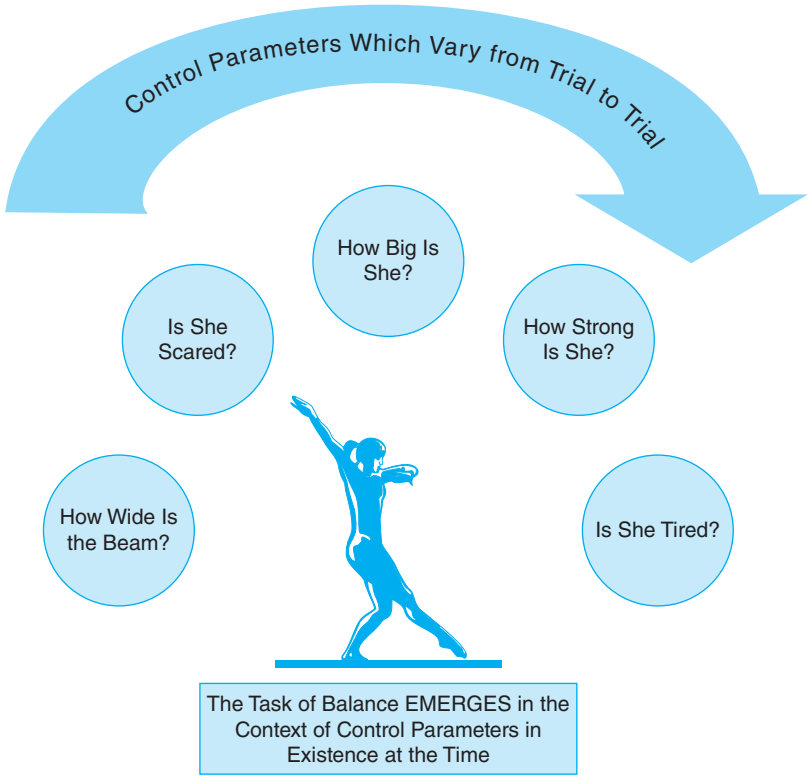

Figure 2-4 Systems theory represented as number of interacting systems, indicated by circles, producing the emergent task of balancing on the beam.

For example, if someone said to you: "Be careful in picking up that box … it is very heavy!" the motor program generated would dictate more stiffness in the limbs and more muscle tension than if you expected the box to be empty. Moreover, behavior from a systems perspective is believed to be self-organizing. This concept implies that there is an extremely complex interaction between systems, which act together in an infinite number of ways to produce a behavioral result (Kamm et al., 1991). **Figure 2-4** shows a common representation of systems theory as a series of interlocking circles or control parameters acting within a given system, in this case for a motor task.

Dynamical systems theory addresses the importance of systems and subsystems other than the CNS in determining psychomotor behavior. One of the key systems in executing motor behavior is the *musculoskeletal system,* considered to be the **effector system of motor control**. The specific parameters of how the musculoskeletal system is to act are coded in a message called the motor program, sent from the CNS to the spinal cord and out to the muscles. The muscles act in accordance with this program. For example, the motor program may specify the amount of reciprocal versus co-contraction of agonist and antagonist muscles. An **agonist** muscle is the prime mover, as the biceps muscle is in the flexion of the elbow, as shown in **Figure 2-5**. The **antagonist** muscle to elbow flexion would be the triceps muscle.

When there is a lot of reciprocal inhibition specified by the motor program, the elbow flexor (biceps) would be relatively inactive during elbow extension, permitting a very pliable elbow joint as it moves into extension. An example of a task requiring a relatively pliable elbow joint is playing the violin. However, when the CNS specifies a large amount of co-contraction of antagonist muscles, the joint is relatively stiff. An example of a task requiring a relatively stiff elbow would be stabilizing the elbows to pick up a pot of boiling water. Therefore, the motor program specifies the amount and pattern of muscle contraction to control joint stiffness.

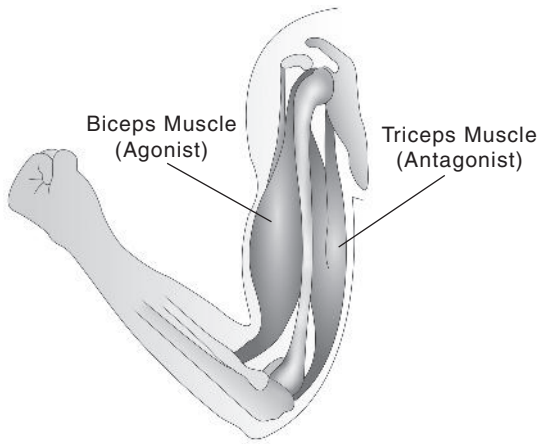

Figure 2-5 The active muscle in this picture is the elbow flexor, the biceps. During elbow flexion, the antagonist triceps muscle is reciprocally inhibited.

Other aspects of movement controlled through the motor program, as executed by the muscles, are the amount of force or tension, timing, and direction of the movement. Of course, the muscles are able to affect the motor program because they act over a system of bones, connected by joints. The bones and joints actually form an elaborate system of levers, with forces being applied over the levers by the contraction of muscles.

Sensory function is also a key element of motor control. The organs of **special senses**, such as vision and hearing, inform us about environmental constraints and provide important feedback about the results of the movement. The **somatosensory** system includes those sensory receptors located in the skin that provide information about touch, pressure, pain, and temperature. **Proprioceptors** are sensory receptors located in muscles, tendons, joints, and ligaments. The vestibular system of the inner ear is also functionally a proprioceptive system. The proprioceptors give us information about position and movement of the body in space. In addition to playing a key role in mediating the motor domain of function, the sensory system also plays a key role in cognitive and affective domains. The ability to receive and process sensory input is important, then, across all domains of behavior, and, conversely, deficits in this ability have implications for all three behavioral domains.

Another key physiologic system in mediating behavior, particularly motor behavior is the *cardiopulmonary system*. The **cardiopulmonary system** is made up of the heart and lungs. It is from the cardiopulmonary system that oxygenated blood is supplied to all organs, permitting normal function. When cardiopulmonary function is normal, the motor control systems have the oxygen needed to perform. Cardiopulmonary deficits can lead to motor control problems, even though muscle physiology is normal. In the context of motor control the cardiopulmonary system supports endurance in motor performance.

FAMILY SYSTEMS

Returning to the cognitive and affective domain of function, an integral contextual factor for individuals is their family. Families are a central feature of human development in all life stages. An understanding of families and family development is essential to creating a vision of the whole individual and to providing a contextually relevant understanding of life course pressures and supports (see **Figure 2-6**). **Family development theory** emphasizes the evolution of families over time. Early family development theorists assumed that all families develop in the same way and designated stages through which families are alleged to develop (Laszloffy, 2002). A central defining attribute of family development theory is that its focus is on families rather than individuals.

Duvall's model (1957) identified eight stages of family development. These eight stages are presented in

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Figure 2-6 The family plays an important role in shaping individuals.

Table 2-1. This theory describes a family life cycle that is intended to characterize the development of most families around the world (Berk, 2010). Duvall's model is dated because it does not account for diversity or possible variations in individual family life cycles. In addition, this model only considers the family within a single generation. In spite of these limitations, Duvall's description of the family life cycle is a useful guide when considering the stresses and influences in adult development.

The **systemic family development model (SFD)** is a process-oriented model grounded in systems theory. This model recognizes that all families share a common process of development; however, within individual families, there is variation in how this process manifests. Laszloffy (2002) asserts that within the SFD model, the common process that all families experience is "the emergence of a stressor (a phenomenon that exerts force on a family system thereby pressuring it to change and adapt)" (p. 207). The end result of the process of changing and adapting is a developmental transition. When a family makes a transition, shifts in family roles and relationships inevitably occur. A strength of the SFD model is that the model assumes that families are complex, multigenerational systems that cannot be reduced to a single generational level.

SYSTEMS AND HEALTH: LIFE COURSE THEORY AND HEALTH DEVELOPMENT MODEL

Systems theories and their various applications, such as developmental, dynamical, and family systems, currently enjoy widespread support. Many new theories have arisen with their foundations directly tied to systems theories. One such theory is known as **life course theory (LCT)**. LCT is a multidisciplinary paradigm for the study of people's lives, structural contexts, and social change. The authors will use

TABLE 2-1 Stages of the Family Life Cycle

Stage	Developmental Tasks
Stage 1: Family of origin experiences	Maintaining relationships with parents, siblings, and peers Completing secondary education
Stage 2: Leaving home	Differentiation of self from family of origin and parents Developing adult-to-adult relationships with parents Developing intimate peer relationships Beginning work, developing work identity Financial independence
Stage 3: Premarriage stage	Selecting partners Developing a romantic relationship Deciding to establish own home with someone
Stage 4: Childless couple stage	Developing a way to live together both practically and emotionally Adjusting relationships with families of origin and peers to include partner
Stage 5: Family with young children	Realigning family system to make space for children Adopting and developing parenting roles Realigning relationships with families of origin to include parenting and grandparenting roles Facilitating children to develop peer relationships
Stage 6. Family with adolescents	Adjusting parent-child relationships to allow adolescents more autonomy Adjusting family relationships to focus on midlife relationship and career issues Taking on responsibility of caring for families of origin
Stage 7: Launching children	Negotiating adult-to-adult relationships with children Adjusting to living as a couple again Adjusting to including in-laws and grandchildren within the family circle Dealing with disabilities and death in the family of origin
Stage 8: Later family life	Coping with physiological decline in self and others Adjusting to children taking a more central role in family maintenance Valuing the wisdom and experience of the elderly Dealing with loss of spouse and peers Preparation for death, life review, reminiscence, and integration

the life course theoretical (LCT) paradigm described by Lu and Halfon (2003) to consider both human development, quality of life, and current health trends such as childhood obesity, asthma, diabetes, and developmental and behavioral issues, all of which are influenced by the social, economic, and physical context of an individual. Life course theory has received major contributions from Glen H. Elder, Jr., who summarized four central principles to the theory. First, human development occurs over changing times and places. Second, a human life occurs within a specific point in time. For example, overall intelligence quotients have increased 9 to 20 points over the last 100 years in industrialized nations, the so-called Flynn effect. This means someone born in 2012 would likely have a higher measured intelligence than someone born in 1912. It is not likely this change can be attributed to wholesale genetic change; therefore, changes in education, health, and nutrition over the last century must play the most significant role (Watson, 2003, p. 381). Third, there is interplay between human development and social phenomena. For example, spending early years in a postrevolutionary