

Fundamental Concepts



EXTRA!!! The Times EXTRA!!!

MOTOR DEVELOPMENT NEWS HOUR

Imagine that a TV network wants to start a weekly prime-time news hour on motor development. What types of story segments would you see? Here might be the promotion lines for some interesting stories:

Girls On Boys' Teams Stirs Controversy

A debate over girls playing on boys' wrestling teams and whether boys' "physiological advantages" place the girls at risk of injury

Education Helps Prevent Falls in Older People

A review of a study in which physical therapists taught adults over age 70 how to avoid falls

Gauging Use of Drugs, Alcohol in Pregnancy

A report on drug and alcohol use by mothers and the effect on their babies both before and after birth, including abnormal physical development and developmental delays

School Board Proposes Dropping Physical Education

Board members suggest physical education costs more than it's worth because some children are born athletes and some are not

As these story segments indicate, motor development covers a broad range of topics related to the physical self and to movement abilities (figure 1.1). Also, it concerns individuals of any age, from birth across the entire life span to old age. Movement abilities of interest could be those used in sport and dance, or they could be the everyday movements allowing people to walk to the grocery store or type on keyboards. Individuals of interest could be healthy, young, old, living with disabilities, or in rehabilitation.

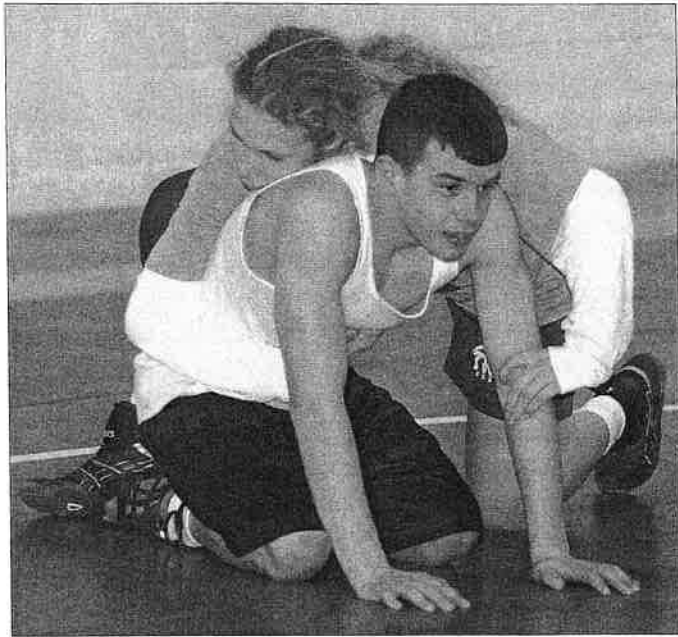


Figure 1.1 Do boys' physiological advantages place girls at risk of injury in wrestling?

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Who would watch our fictitious motor development program? These topics affect everyone to some extent. All of us want our children to grow up healthy and able to reach their full potential, for adults to work and play as they desire, and for retirees to enjoy a quality life. We all have a developmental perspective. Many professionals would watch. Educators, especially physical and early childhood educators, are interested in developmentally appropriate practices. Therapists want to know the factors that affect movement abilities. Engineers and designers want to make appropriately sized and arranged living spaces, control panels, work equipment, sport equipment, and transportation vehicles. Health care providers want to promote movement and exercise as a means to a healthy lifestyle. Clearly, motor development interests many people for many reasons.

The range of topics, issues, and concerns related to motor development would draw quite an audience. Indeed, even though we rarely see a television program devoted solely to motor development (although Discovery Health airs a program dedicated to infancy and early development), many of the stories on radio, on television, in newspapers, and in magazines are related to physical

growth and aging and motor development. Whether for sport, dance, or everyday tasks, we value our ability to move and interact with our environment throughout our entire lives.



Chapter Objectives

This chapter will

- ▲ define motor development,
- ▲ distinguish developmental issues from other issues,
- ▲ describe some of the basic tools used by researchers in motor development, and
- ▲ introduce a model to guide our discussion of motor development.

DEFINING MOTOR DEVELOPMENT

Our imaginary television program's story segments have probably given you a rough idea of what motor development is. Let's now be more exact and give the field some boundaries, much as a television producer would do in order to decide which story segments are appropriate for the motor development program and which are not.

Development has several defining characteristics. First, development is a continuous process of change in functional capacity. Think of functional capacity as the capability

to exist—live, move, work—within the real world. This is a cumulative process. Living organisms are always developing, but the amount of change may be more noticeable, or less noticeable, at various points in the life span.

Second, development is related to (but not dependent on) age. As age advances, development proceeds. However, development can be faster or slower at different times, and rates of development can differ among individuals of the same age. Individuals do not necessarily advance in age and advance in development at the same rate.

Third, development is sequential change. One step leads to the next step in an orderly and irreversible fashion. This change is the result of interactions within the individual and interactions between the individual and the environment. All individuals of a species undergo predictable patterns of development, but the result of development is always a group of unique individuals.

Individuals function in a variety of arenas, including physical, social, cognitive, and psychological. Hence, we use terms such as **cognitive development** or **social development** to address the process of change in particular arenas. Social scientists often specialize in the study of one aspect of development.

We use the term **motor development** to refer to the development of movement abilities. Those who study motor development study developmental change in movement behavior and the factors underlying those changes. This includes both the process of change and the resultant movement outcome. Not all change in movement is development. For example, if a tennis teacher elicits a change in a student's forehand stroke by changing the student's grip on the racket, we do not call the change motor development. Rather, we use the term **motor learning** for movement changes that are relatively permanent but related to experience rather than age. We use the term **motor behavior** when we prefer not to distinguish between motor learning and motor development, or when we want to include both.

Motor control refers to the nervous system's control of the muscles to permit skilled and coordinated movements. In recent years, researchers in motor development and in motor control have found much in common. Understanding how the nervous system and movement abilities change with age informs our knowledge of motor control, and so we now see much overlap in motor development and control research.

Undoubtedly, you have heard the term *development* paired with *growth*, as in "growth and development." **Physical growth** is a quantitative increase in size or magnitude. Living organisms experience a period of growth in physical size. For humans this growth period starts with conception and ends in late adolescence or the early 20s. Changes in the size of tissues after the physical growth period (e.g., an increase in muscle mass with resistance training) are described with other terms. The phrase *growth and development* thus includes change in both size and functional capacity.

The term *maturation* also is paired with the term *growth*, but it is not the same as development. **Maturation** connotes progress toward physical maturity, the state of optimal functional integration of an individual's body systems and the ability to reproduce. Development continues long after physical maturity is reached.

Physiological change does not stop at the end of the physical growth period. Rather, it can occur throughout life. Physical change tends to be slower after the growth period but nevertheless remains prominent. The term **aging** can be used in a broad sense to refer to the process of growing older regardless of chronological age, or the changes that occur with the passage of time that lead to a loss of adaptability or function and eventually to death (Spirduso, 1995).

The physiological processes of growth and aging fall on a continuum of life span development. Although some motor development students might be more interested in one portion of the continuum than another, motor development as a field still concerns

Motor development is the sequential, continuous age-related process whereby movement behavior changes.

Motor learning refers to the relatively permanent gains in motor skill capability associated with practice or experience (Schmidt & Lee, 1999).

Motor control is the study of the neural, physical, and behavioral aspects of movement (Schmidt & Lee, 1999).

Physical growth is an increase in size or body mass resulting from an increase in complete, already formed body parts (Timiras, 1972).

Physical or physiological **maturation** is a qualitative advance in biological makeup and may refer to cell, organ, or system advancement in biochemical composition rather than to size alone (Teeple, 1978).

Aging is the process occurring with the passage of time, leading to loss of adaptability or full function and eventually to death (Spirduso, 1995).

? Scan a daily newspaper for stories related to motor development. What criteria did you use to determine whether a story fit this topic?

change in movement across the life span. Understanding what drives change in one part of the life span often helps us understand change in another part of the life span. That process of examining change is part of adopting a developmental perspective.

A MODEL FOR STUDYING MOTOR DEVELOPMENT

It is useful to have a model or plan for studying the change in movement that occurs over the life span. A model helps us include all the relevant factors in our observation of motor behavior. This is particularly true as we think about the complexity of motor skills and how our skills change over the life span. For this textbook, we adopted a model associated with a contemporary theoretical approach known as the ecological perspective (see chapter 2). We find that this model helps us make sense of developmental changes by providing a framework for observing change. We believe this model—Newell's constraints model—will help you better understand motor development across the life span.

Newell's Model

Karl Newell (1986) suggested that movements arise from the interactions of the organism, the environment in which the movement occurs, and the task to be undertaken. If any of these three factors change, the resultant movement changes. We can picture the three factors as points on a triangle with a circle of arrows representing their interaction (figure 1.2). Because we are concerned only with human movement here, we use the term *individual* instead of *organism*. In short, to understand movement, we must consider the relationships between or among the characteristics of the individual mover, his surroundings, and the purpose or reasons for his moving. From the interaction of all these characteristics, specific movements emerge.

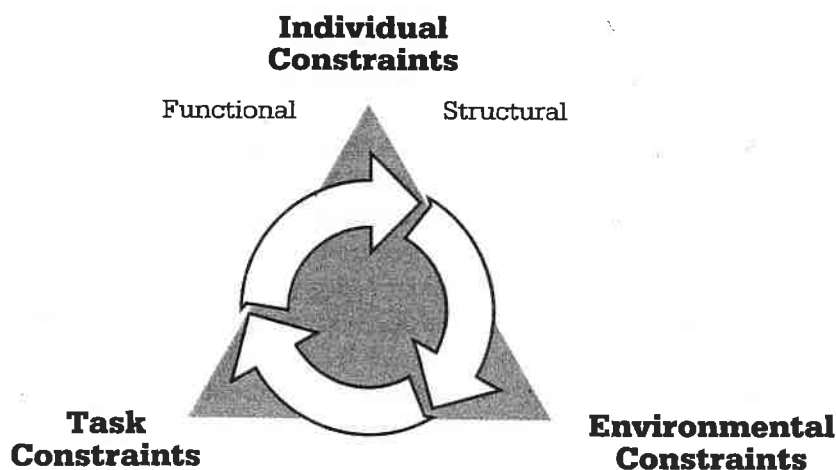


Figure 1.2 Newell's model of constraints.

Picture the different ways an individual can walk: a toddler taking her first steps, a child walking in deep sand, an adult moving across an icy patch, and an older adult trying to catch a bus. These examples illustrate that changing one of the factors often results in a change in the interaction with one or both of the other factors; hence, a different way of walking arises from the interaction. For example, being barefoot or in rubber-soled shoes might not make a difference in your walking across a dry tile floor. Your walk might change notably if the floor is wet and slippery. The *interaction* of individual, task, and environment changes the movement.

Why is Newell's model so helpful in studying motor development? Because the individual is always undergoing age-related changes. This constantly changes the interaction with environment and task and subsequently changes the way individuals move. In other words, constraints not only affect each other but can also be affected and change based on their interactions. If the environment or the task, or both, also changes, the interaction is changed to an even greater extent. Newell's model reflects the dynamic, constantly changing interactions in motor development.

Newell calls the three factors we placed on the points of our triangle **constraints**. A constraint is somewhat like a restraint—it *limits or discourages*, in this case, movement—but at the same time it *permits or encourages* other movements. It's important not to consider constraints as negative or bad. Constraints simply provide channels from which movements most easily emerge. A riverbed acts as a constraint. It restrains the river water from flowing anywhere and everywhere, but it also channels it to follow a specific path. Movement constraints are characteristics that shape movement. They restrain and channel movement to a particular time and place in space; that is, they give movement a particular form.

Individual constraints, the top point on our triangle, are a person's own unique physical and mental characteristics. For example, height, limb length, strength, and motivation can all influence the way individuals move. Consider the swimmer with a disability in figure 1.3. The disability constrains, but does not prevent, this individual's ability to swim; it simply modifies the form with which the swimmer performs his strokes. Individual constraints are either structural or functional.

▲ **Structural constraints** are slow to change but obviously do change with growth and aging. Examples include height, weight, muscle mass, and leg length. As we discuss these changes throughout the text, we will see how structural factors constrain movement.

▲ **Functional constraints** can change in a short time. Examples include motivation, memory, and attentional focus. You might be motivated to run several miles in cool weather but not in hot, humid weather. This functional constraint shapes your movement to running, walking, or even sitting.

For many professionals, it is important to know whether the student's or client's movement is being shaped by structural or functional constraints. This provides information regarding how much a movement could change in a short time and if a change in an environmental or task constraint would be in order to modify the resultant movements. For example, knowing that young volleyball players cannot block a ball at the net because they are not yet at their adult height would lead a youth sport organizer to change the task by using a lower net height.

Environmental constraints exist outside the body, as a property of the world around us. They are global, not task specific, and can be physical or sociocultural. Physical environmental constraints are characteristics of the environment, such as temperature, amount of light, humidity, gravity, and the surfaces of floors and walls (figure 1.4). Notice that in the earlier example, the functional constraint of motivation actually interacted with environmental constraints, in this case temperature and humidity, to constrain movement.

A **constraint** is a characteristic of the individual, environment, or task that either facilitates or restricts movements.

Individual constraints are a person's or organism's own unique physical and mental characteristics.

Structural constraints are individual constraints related to the body's structure.

Functional constraints are individual constraints related to behavioral function.

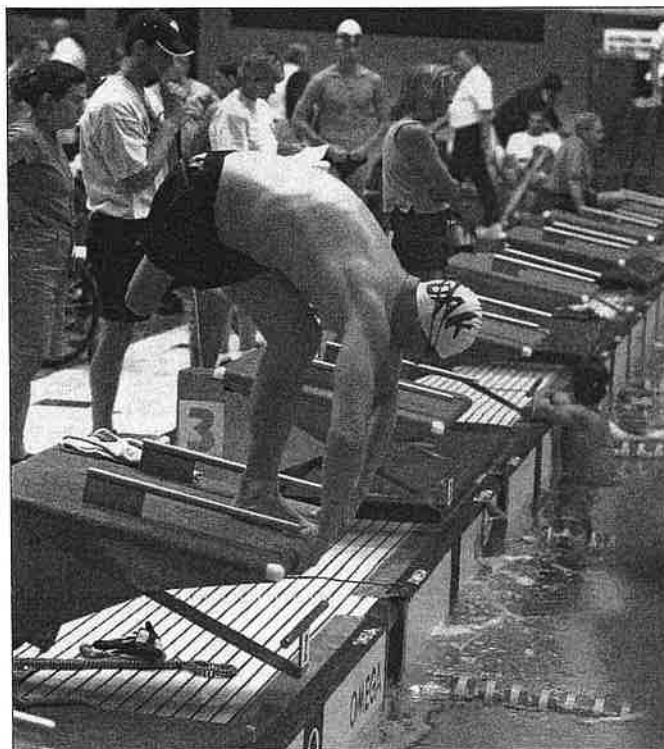


Figure 1.3 This swimmer's disabled limb is a structural constraint that gives rise to a different swimming movement from that of someone without a disabled limb.

Environmental constraints are constraints related to the world around us.

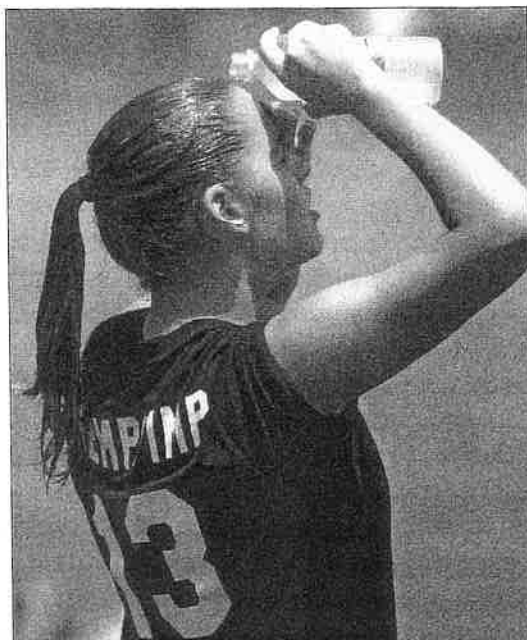


Figure 1.4 A hot and humid environment can constrain the movements of this runner.

Task constraints are goals undertaken within rules and choices of equipment.

height) and a task constraint to allow a certain movement (blocking) to emerge in the game played by our young volleyball players. Examine figure 1.5. You can probably imagine many of the task constraints in this situation. The kicker must pass the ball to a teammate, while protecting the ball from a defender.



Figure 1.5 This soccer player's task is to dribble or pass so that his team maintains control of the ball.

Our sociocultural environment can be a strong force in encouraging or discouraging behaviors, including movement behaviors. A most obvious example is how the change of sociocultural environment in Western society has changed the involvement of girls and women in sport over the past three decades. In the 1950s, society did not expect girls to participate in sport. As a result girls were channeled away from sport.

Task constraints are also external to the body. They are the goals, rules, and equipment we use. For example, using a strung racket rather than a wood paddle changes the game played on an enclosed (racquetball) court. Notice that our youth sport organizer mentioned previously, by lowering net height, used the interaction of a structural individual constraint (body

Throughout this discussion of motor development we demonstrate how changing individual, environmental, and task constraints shapes the movement that arises from their interaction. Newell's model will guide us in identifying the developmental factors affecting movements, help us create developmentally appropriate tasks and environments, and help us understand individual movers as different from group norms or averages.

Changing Views on the Role of Constraints

It is important to recognize that in the history of motor development research, certain researchers and practitioners focused primarily on individual factors to the exclusion of others. For example, in the 1940s it was assumed that an individual constraint, specifically the structural constraint of the nervous system alone, shaped movement

in infants and children (see chapter 2). Later, in the 1960s, developmentalists commonly believed that environmental and task more than individual constraints shaped movement. Only recently have motor developmentalists focused on all three types of constraints simultaneously.

Obviously, when one or two types of constraints are deemphasized, so is the rich effect of the three constraints interacting to shape movement. This limits the resulting view of the emerging movement. In our survey of motor development we identify the effects of these

various viewpoints on the importance of the three constraints. Sometimes what we know about an aspect of motor development is influenced by the perspective of the researcher who studied that behavior. It is much like seeing the color of a flower change as we try on sunglasses with different colored lenses. We might “color” our conclusions about motor development as we emphasize one type of constraint and deemphasize other types.

Newell’s model is more global than most models previously used in the study of motor development. We can better account for the complexity of age-related change in movement with this model through the interactions of individual, environment, and task. Keep the model in mind throughout our survey of motor development.

? Knowing how height and body size change with growth, how would you adapt the game of basketball (especially the task through the equipment used) so that movements (shooting, dribbling, passing) remain nearly the same during the growth years?

HOW DO WE KNOW IT IS CHANGE?

We’ve established that age-related change is fundamental in the study of motor development and the developmental perspective. Developmentalists are focused on change. How do we know, though, that a change is age-related and not a fluctuation of behavior or a product of our measuring instrument? One way to determine developmental change is to carefully observe individuals’ movements, then describe differences between people or observation times.



You can gain some experience in observing movement by downloading Lab 1.1 Observation As a Tool of Inquiry from the Student Resources section at www.HumanKinetics.com/LifeSpanMotorDevelopment.

In addition, behavioral scientists use statistical techniques that can identify significant change. We sometimes discuss these in the context of a research study. For now, let’s focus on the straightforward technique of picturing change by graphing an aspect of development over time. We can then see whether a trend is *emerging*.

Picturing Change

When we picture age-related measurements by graphing, we traditionally put time or age on the horizontal axis. It can be measured in days, weeks, months, years, or decades, depending on our frame of reference. A measurement of interest in infancy might be plotted in days or weeks, but a measurement of interest over the life span may be plotted in years or decades.

The measurement is plotted on the vertical axis. Usually we arrange the measurements so that “more” or “faster” or “more advanced” is higher on the scale. A typical graph of the measurement of growth in childhood would look like figure 1.6. It is common to take a measurement periodically and plot its value at a given chronological age. We assume that change has occurred consistently in the time between our measurements, so we often connect our data points to make a line. When we graph change using a developmental perspective, we should not make the assumption that “more” is always “better.” Individuals move in a variety of ways that are qualitatively different. Some ways of moving may result in longer throws or faster runs, but that does not imply that children who do not move this way are in error or are wrong. It simply means that these children move at a different or lower developmental level.

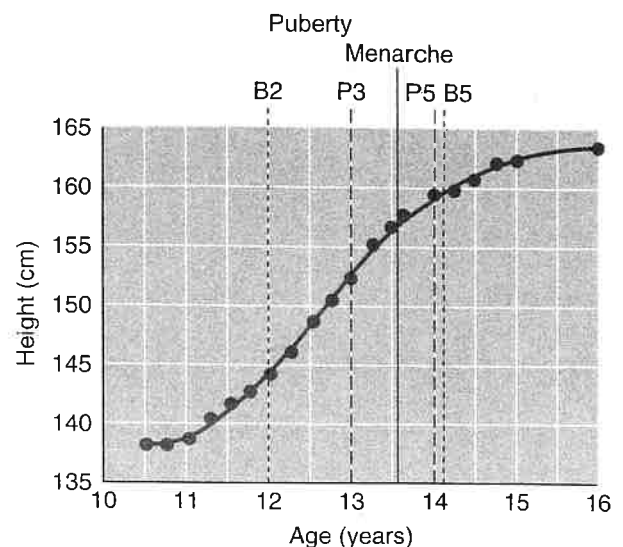


Figure 1.6 A typical graphical representation of growth in childhood.

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