TPBA 2

Transdisciplinary Play-Based Assessment 2

2ND EDITION

Toni Linder
with invited contributors

TPBA Play-Based TPBI TPBC™

Transdisciplinary Play-Based Assessment 2nd Edition

TPBA Play-Based TPBI TPBC™

Toni Linder, Ed.D.
Professor
Morgridge College of Education
University of Denver
Colorado

with invited contributors

PAUL H. BROOKES PUBLISHING CO®

Baltimore • London • Sydney

Other products available in the TPBA Play-Based TPBI TPBC™ system include:

- ***Transdisciplinary Play-Based Intervention, Second Edition (TPBI2),*** by Toni Linder, Ed.D., with invited contributors
- ***Administration Guide for TPBA2 & TPBI2,*** by Toni Linder, Ed.D., with invited contributors
- ***TPBA2 & TPBI2 Forms,*** by Toni Linder, Ed.D.
  a shrink-wrapped package of 5 complete tablets, each including key forms for TPBA2 and TPBI2
- ***TPBA2 & TPBI2 Forms CD-ROM,*** by Toni Linder, Ed.D.
  a CD-ROM of printable forms for TPBA2 and TPBI2
- ***Observing Kassandra: A Transdisciplinary Play-Based Assessment of a Child with Severe Disabilities, Revised Edition,*** produced and written by Toni Linder, Ed.D.
  a 50-minute DVD with workbook and forms tablet
- ***Read, Play, and Learn!®: Storybook Activities for Young Children,*** by Toni Linder, Ed.D., with invited contributors
  the transdisciplinary play-based curriculum that includes a *Teacher's Guide* and individual manuals of lesson plans based on popular children's story-books, packaged in modules of 8

  Visit www.readplaylearn.com for excerpts, sample materials, and more information about *Read, Play, and Learn!®*

To order, contact Paul H. Brookes Publishing Co.:

by phone:	800-638-3775
	410-337-9580 (outside the U.S.A.)
by fax:	410-337-8539
by web:	www.brookespublishing.com
by mail:	P.O. Box 10624 Baltimore, MD 21285-0624, U.S.A.

· P A U L · H ·
BROOKES
PUBLISHING Co.®

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

www.brookespublishing.com

Typeset by Integrated Publishing Solutions, Grand Rapids, Michigan.
Manufactured in the United States of America by Sheridan Books, Inc., Chelsea, Michigan.

For companion products to *Transdisciplinary Play-Based Assessment, Second Edition (TPBA2),* including *Transdisciplinary Play-Based Intervention, Second Edition (TPBI2)*; *Administration Guide for TPBA2 & TPBI2*; *Observing Kassandra* (DVD, workbook, and forms tablet); *TPBA2 & TPBI2 Forms* (tablets and CD-ROM); and *Read, Play, and Learn!®* (the *Transdisciplinary Play-Based Curriculum*), see p. ii. Visit www.brookespublishing.com and www.readplaylearn.com for more information.

This volume contains activities and suggestions that should be used in the classroom or other environments only when children are receiving proper supervision. It is the teacher's or the caregiver's responsibility to provide a safe, secure environment for all children and to know each child's individual circumstances (e.g., allergies to food or other substances, medical needs). The authors and publisher disclaim any liability arising directly or indirectly from the use of this book.

Library of Congress Cataloging-in-Publication Data

Linder, Toni W., 1946–
Transdisciplinary play-based assessment / by Toni Linder ; with invited contributors. – 2nd ed.
p. cm.
Includes bibliographical references and index.
ISBN-13: 978-1-55766-871-4 (spiral bound)
ISBN-10: 1-55766-871-X
1. Transdisciplinary Play-Based Assessment. I. Title.
RJ51.T73L56 2008
618.92–dc22 2007032714

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

2012 2011 2010 2009 2008

10 9 8 7 6 5 4 3 2 1

Contents

About the Authors

Toni Linder, Ed.D., Professor, Child, Family, and School Psychology Program, Morgridge College of Education, University of Denver, University Park, Denver, Colorado 80208

Dr. Toni Linder has been a professor in the Child, Family, and School Psychology program in the Morgridge College of Education since 1976. Dr. Linder has been a leader in the development of authentic assessment for young children and is nationally and internationally known for her work on *Transdisciplinary Play-Based Assessment* and *Transdisciplinary Play-Based Intervention*. In addition, she developed *Read, Play, and Learn!® Storybook Activities for Young Children: The Transdisciplinary Play-Based Curriculum* (1999), an inclusive literature- and play-based curriculum for preschool and kindergarten learning and development. Dr. Linder also is the Director of the Play and Learning Assessment for the Young (PLAY) Clinic at the University of Denver, where professional and student teams conduct transdisciplinary play-based assessments for young children and their families. Dr. Linder consults widely on assessment, intervention, early childhood education, and family involvement issues. She has conducted research on a variety of topics, including transdisciplinary influences on development, parent–child interaction, curriculum outcomes, and the use of technology for professional development in rural areas.

Tanni L. Anthony, Ph.D., Supervisor and State Consultant on Visual Impairment; Director, Colorado Services for Children with Combined Vision and Hearing Loss Project, Colorado Department of Education, 201 East Colfax Avenue, Denver, Colorado 80203

Dr. Anthony serves as a state consultant in visual impairment for the Colorado Department of Education. She also serves as the Director of the Colorado Services for Children for Children with Combined Vision and Hearing Loss Project. She is a nationally recognized trainer and author on topics specific to young children with visual impairment or deafblindness. Dr. Anthony has consulted internationally on program design of early intervention services for children with visual impairment and their families. She has worked on federal projects to design training materials for both preservice and inservice courses for personnel working with young children with sensory loss. Dr. Anthony received her Ed.S. degree from the University of Northern Colorado and her doctorate from the University of Denver in Child and Family Studies and Interdisciplinary Leadership.

Anita C. Bundy, Sc.D., OTR, FAOTA, Professor, Occupational Therapy, Faculty of Health Sciences, University of Sydney, P.O. Box 170, Sydney, New South Wales, Australia 2041

Professor Bundy's professional training is as an occupational therapist. She has taught and practiced in pediatrics for more than 30 years. Her research emphasizes children's play including the use of play to promote physical activity, mental health, and parent–child interactions. She is the author of two assessments related to play, the *Test of Playfulness,* which examines children's approach to play, and the *Test of Environmental Supportiveness,* which examines the contributions of caregivers, playmates, space, and objects to play. She also is the primary editor for *Sensory Integration: Theory and Practice* (2nd ed.), published by F.A. Davis, and is the author of several chapters in that book.

Renee Charlifue-Smith, M.A., CCC-SLP, Senior Instructor, Speech-Language Pathologist, JFK Partners, Department of Pediatrics, University of Colorado School of Medicine, 4900 East 9th Avenue, Denver, Colorado 80262

Renee Charlifue-Smith is a faculty member in the Department of Pediatrics at the University of Colorado School of Medicine. She is Director of the Speech-Language Pathology Department and is the coordinator of the ENRICH Early Intervention Team at JFK Partners. She has been a speech-language pathology consultant on a variety of federally funded demonstration, research, and training projects. Her special interests include early intervention, autism spectrum disorders, and motor speech disorders.

Jan Christian Hafer, Ed.D., Professor, Department of Education, Galludet University, 800 Florida Avenue NW, Washington, DC 20002

Jan Christian Hafer specializes in family-centered early education in the Department of Education at Gallaudet University, Washington, DC. Her scholarly interests include play, assessment of young deaf and hard-of-hearing children, and signing with hearing populations.

Forrest Hancock, Ph.D., Early Childhood Consultant, 2305 Pebble Beach Drive, Austin, Texas 78747

Dr. Hancock is an early childhood consultant in the Central Texas area. She has been an educator in general and special education for 40 years, and her experience has spanned teaching students and practitioners from the elementary to university levels. Dr. Hancock earned her master's degree in language and learning disabilities at Texas State University and her doctorate in early childhood special education from The University of Texas at Austin where she later taught graduate courses in early language development. She develops and presents professional development trainings for preschool educators and administrators, early intervention service coordinators, and early intervention specialists, and she supports first-year special education teachers seeking certification.

Cheryl Cole Rooke, M.A., CCC-SLP, Senior Clinical Instructor, Speech-Language Pathology, JFK Partners, University of Colorado Denver Health Sciences Center, 4900 East 9th Avenue, Denver, Colorado 80220

Ms. Rooke is a faculty member at the University of Colorado Health Sciences Center and has been working as a pediatric speech-language pathologist since 1994. She has substantial experience in transdisciplinary early childhood interventions, parent training, pediatric diagnostics, and the treatment of language-based learning disabilities. Her interests include child language development, social communication, autism, motor speech development, dyslexia, and parent education. Ms. Rooke currently participates on the University's Autism and Developmental Disorders diagnostic teaching team, provides family-based transdisciplinary services to infants and toddlers through the ENRICH team, teaches parent training programs, and works with children with autism. She has also worked as a speech-language specialist in the Denver Public Schools and as a private therapist working with children with reading disabilities.

1

A Review of the Transdisciplinary Play-Based System

The first edition of Transdisciplinary Play-Based Assessment (1990) presented a comparison of assessment by a multidisciplinary team using traditional approaches and transdisciplinary play-based assessment (TPBA) using a team conducting a play assessment together. Over the years, many people have commented on how the vignette presented in the beginning of the book opened their eyes to what their assessments might be like for the children they assessed. The vignette is presented again in this revised edition to illustrate how different the assessment process can be for children and families. Chapter 1 in the A*dministration Guide* discusses why theory, research, and legislation are now dictating that assessment of young children should be natural, functional, and responsive to child and family needs.

TRADITIONAL ASSESSMENT

Imagine yourself as a 3-year-old child who has been referred to a developmental center for assessment because of suspected developmental delays. Both your mother and father have come with you to a place called "the Center."

When you walk in the door, a woman meets you and takes you to her office. You sit on your mom's lap while the woman behind the desk asks your mom and dad questions about your birth and your first 3 years of life. Your mom and dad sound worried and your mom even cries when she talks about you. You feel sad and think that something about you must be making her cry.

After a while, another woman comes to take you to "play some games." Your mom and dad tell you to go with the "nice lady" and it will be fun. The nice lady takes your hand. You walk down the hall with her to a small room with a table and two wooden chairs and some pictures on the wall. You don't see any games anywhere. Then the lady pulls out a suitcase and starts to put things like blocks and puzzles in front of you. She then asks you to do certain things with them. At first this is fun, but after a while the lady asks you to do some things that are not so much fun. It's hard. You tell her this, but she just keeps putting things that are not fun in front of you. She also asks you questions that you can't answer. You want to go back to your mommy and daddy, but the lady keeps saying that you'll be finished soon. "Soon" is a long time. Finally, the lady says that you're all done playing games. You feel relieved! This lady doesn't know much about how to have fun!

After a necessary potty break and a few tears, the lady lets you see your mommy and daddy. But not for long. Here comes another lady to take you to another little room with another table and chairs and different pictures on the wall. This lady doesn't talk much. She just keeps putting pictures in front of you and asking you what they are. Many of the pictures are things that you have seen, but you just don't know what to call them. So you look down at the floor and up at the pictures on the wall. You pull on your shirt and wiggle a lot. You wish this lady would quit with the pictures. You've seen more than enough pictures. Then the lady gets out another suitcase, only it's a different color. She pulls out a couple of toys at a time and tells you what she wants you to do with them. Some of these are neat toys, and you'd really like to play with them. Every time you start to do something other than what the lady told you to do, however, she takes the toys away. This lady sure is stingy. You are getting tired, so you put your head down on the table. The lady makes you sit up. Finally, she is through. She takes you back to your mommy and daddy and tells them that you were "somewhat resistant."

Mom and Dad look worried, so when they ask, you tell them you had fun playing games with the ladies. That was a mistake. In the car they tell you that you are coming back tomorrow for some more games! When you tell them you don't want to go back, you didn't like the ladies, they say tomorrow you will play with another nice lady.

Wrong. The next day a man comes out to meet you. He says you are going to play some more fun games. You are not convinced. This time you go to a big room with many stairs and boards that wobble and boards that don't wobble and hanging nets and balls and all kinds of neat stuff. You think that maybe this will be fun! You run and jump and climb the stairs and are generally having a great time. Then the man puts you up on a big ball and tries to make you fall off. At least that is how it feels, though the man keeps saying he won't let you fall. You don't trust him. You want your mommy and daddy, so you cry. Then the man makes your arms and legs go different directions and bounces you around some. This doesn't seem fun any more. The man is nice enough. He just doesn't know when to stop! You cry louder, and finally the man says, "We've had enough for today." He's right about that.

You go back to your mommy and daddy who are still sitting with that worried look on their faces. They tell you that they will take you to get a hamburger for being so good. You don't tell them that you weren't really that good. They don't need to know everything.

TRANSDISCIPLINARY PLAY-BASED ASSESSMENT

You are still the same 3-year-old child who has been referred for evaluation due to suspected developmental delays. As you enter the Center, you are greeted by the same woman who came out to your house to talk to your mommy and play with you. This time, however, she takes you to a large room containing many different toys. A playhouse is in one corner, an area with blocks and cars is in another, a table with puzzles and little toys is in another, and a water table with toys is in another. Wow! All your favorite things!

Hey! This place is neat! Mommy is holding your hand, but you let go and run to the dollhouse area. It has a sink, refrigerator, and stove just like at home, only smaller. And it has dolls and beds and dishes and telephones. You look in the refrigerator. There's a birthday cake with candles! Suddenly you notice another lady next to you.

She says, "Oh, you found the birthday cake!" She doesn't even seem to mind when you take the cake out of the refrigerator and pull out all of the candles. "Maybe we should invite some babies to a party," she says. "Yeah!" You pick up a doll and give her a piece of cake. The lady does the same thing with her baby. She says her baby is hungry. You say your baby is hungry. too. Well, actually, you say "ungy," but she seems to understand. She pours more "milk" in your baby's cup. You and the lady play together in the house. Sometimes she does what you do, and sometimes you look at her and do what she does. You think she is a nice lady.

All of a sudden you remember your mommy and daddy. You look around and see them sitting there watching you. They are talking to the other lady. A man is also watching you and he has a video camera. You say "hi" to Mommy and Daddy. The lady hands you a telephone and tells you Mommy and Daddy are on the phone. You talk to Mommy and Daddy, who say, "Hi, are you having fun playing?" Then you talk to the lady who is playing with you. The two of you have lots of fun dressing the dolls for bed, brushing their teeth, combing their hair, and putting them to bed. Every once in a while you check to see if Mommy and Daddy are still there. They are.

A little boy comes into the playhouse. You don't know who invited him, but he wants to play with the toys, too. The play lady says he wants to play with you. As long as he doesn't take your doll, it's okay with you. He plays with the dishes and cooks. He pours juice and gives you some. You take it but go back to putting your doll to bed. The play lady gives the boy some dishes and he puts them on the table. He says that dinner is ready, so you go to the table with your baby. You feed your baby. The boy talks to you, but you don't answer. You just don't feel like talking to him. After a while he wanders off to play somewhere else. That's okay with you.

Then the play lady goes over to the water table with her doll and starts to wash her doll. That looks like fun, so you go, too. You wash the doll for a while, and then you play with the water wheel, boats, funnels, and other fun stuff. When you get tired of this, you go over to see what's in the block area. This is fun, too. You and the play lady build bridges, drive cars over a road, put gas in your cars, have a car crash, and get the cars fixed. This place sure has nice toys.

Your mommy and daddy tell you they are leaving to get a cup of coffee and they'll be right back. You watch them go and are a little worried, but you don't mind staying here with the play lady. After a few minutes Mommy and Daddy come back, and Daddy comes over to play with you. You show him the cars, and you both drive them and crash them off bridges and laugh. Then Mommy comes over to show you some things at the table. The two of you put puzzles together. Some of them are hard and Mommy helps you. Mommy is a good helper. Then you and Mommy draw pictures, count the lines you drew and read a book. It's fun to have Mommy and Daddy playing too.

When you're all done with your pictures and puzzles, the play lady takes all of you to another room with stairs, boards that wobble, boards that don't wobble, hanging nets, balls, and tricycles. You run and jump and climb up and down the stairs. The play lady throws the ball to you and your daddy and mommy. You get the play lady to follow you up and over and through things. This play lady sure is a good sport! When she looks all worn out, you give her a rest. You try to ride the tricycle, but it's too hard. The play lady and your daddy toss you around in the air. You play with a big ball, and you and Daddy take turns bouncing and rolling on it.

After everyone is all worn out, including you, all of you go back to the playroom. There is a snack of crackers and juice in the middle of the table and the little boy is there. The play lady lets you pour the juice and put yellow cheese on the crackers. You give some to the boy and take some for yourself. You try to give some to Mommy and Daddy, but they don't seem too interested. The play lady talks to you and the boy. You ask the boy if he wants more. He seems to be a pretty nice boy after all.

After you're all done eating and drinking, the play lady says it's time to go. You are tired, but you'd still like to play with those cars some more. The play lady says maybe another day. That sounds good to you. How about tomorrow?

ALMOST 20 YEARS LATER

Although much has changed since 1990, rigid testing procedures are still used, and even required, in some states. TPBA is the same in many ways, but it has evolved as well. Now TPBA may be done just as easily in the home, in a classroom, or in a community setting. Parents may be the primary play facilitators more frequently, and they will have more involvement before, during, and after the assessment. The process, however, remains much the same: a child- and family-friendly assessment resulting in practical, meaningful information.

Whereas the *Administration Guide for TPBA2 & TPBI2* describes the total TPBA process and administration, including discussion of how to obtain preliminary information, presentation of strategies for talking to families and facilitating play with children, and ways to summarize data and integrate them into a report, this volume, *Transdisciplinary Play-Based Assessment, Second Edition* (TPBA2), includes detailed chapters with research and literature describing significant aspects of each domain. These chapters are extensive, providing a review of the literature for each of the subcategories as well as guidelines for observation and interpretation of information obtained. Extensive Age Tables are also provided, noting age ranges for acquisition of skills and the outer ages by which time a skill should be demonstrated. These chapters provide the heart of the TPBA2 assessment process. They should be read carefully so that the rationale for the TPBA2 Observation Guidelines and the implications for services and intervention needs are fully understood. The third volume of this system, *Transdisciplinary Play-Based Intervention, Second Edition* (TPBI2), presents a process for planning, implementing, and evaluating intervention for children from birth to 6 years of age who need supports to enhance their development by providing a framework for conceptualizing intervention strategies and a means for monitoring and evaluating the effectiveness of the strategies selected.

2

Sensorimotor Development Domain

with Anita C. Bundy

Generally, children move because they have thought of something they want to do. In a way, this indicates that movement underlies thought. In fact, we so often solve problems by manipulating objects or scratching out notes that some contemporary philosophers (Clark, 1997; Rowlands, 1999) have suggested that action is *a part of* thought. Movement has many functions; it enables growth and expression across developmental domains (e.g., cognitive, emotional, social), supports relationships, and is a major source of joy. Thus, we examine whether children's motor skills enable them to do what they need and want to do every day.

The ability to move skillfully is supported by the maturity and integrity of the sensory-neurological and musculoskeletal systems. This is why the movements of a confident 12-year-old ice hockey player differ significantly from those of a 5-year-old who has donned skates and walked onto the ice for the first time. Similarly, the attempts of an infant with cerebral palsy to stand will look quite different from those of his typically developing twin.

Children's capacities aside, task demands and environmental conditions also play a major role in determining what actions look like and how difficult they are. Any child will find it easier to pick up a drinking glass when it is dry than when it is coated with soapy water. Similarly, it is easier to kick a ball in the context of friendly competition than in the midst of a championship soccer game.

The sensorimotor domain in Transdisciplinary Play-Based Assessment (TPBA2) examines the status of children's motor skills and some underlying functions that support movement (i.e., posture, muscle tone). Specifically, the sensorimotor domain examines the following subcategories: 1) functions underlying movement; 2) gross motor activity; 3) arm and hand use; 4) motor planning and coordination; 5) modulation of sensation and its relationship to emotion, activity level, and attention; and 6) sensorimotor contributions to daily life and self-care.

Knowledge of the definitions of the words used to describe motor skills is important. *Sensorimotor,* the general term used to describe the content of this domain, acknowledges the dependence of all movement on vision, hearing, and touch. For example, the simple act of reaching requires vision to guide the hand to the object and the sense that arises from the muscles (proprioception) to orient the hand for grasping. *Motor planning,* or the process of organizing purposeful movements, is particularly reliant on sensation that tells us where the body is in space. The modulation of sensation, which leads to actions that are in proportion to the sensory experience, is also a form of sensorimotor competence.

Several subcategories divide the broad classification of sensorimotor. For example, we distinguish between gross and fine motor skills. *Gross motor* refers to large movements like running, throwing, and climbing, whereas *fine motor* includes small movements like grasping or pointing. Movements of the arms and hands may be classified as either gross (e.g., throwing) or fine (e.g., grasping) motor. Although the small movements of the lips, tongue, and eyes are fine motor, they are also even more specifically *oral motor* and *oculomotor.* The terms *visual motor* and *eye–hand coordination* also pertain to the eyes, specifically to the coordination of eye and hand movements. (See Chapter 3 for a discussion of the research, development, and observation of vision, and Chapter 6 for a discussion of hearing and guidelines for screening and modification of TPBA for children with hearing impairments.)

I. Functions Underlying Movement

While watching a child play, we observe skilled movements defined by the context in which they occur, as well as functions that underlie those movements. Two important and interrelated functions thought to set the stage for, or interfere with, movement are posture and muscle tone.

I. A. How well does posture support action?

Posture is fundamental to all movements because it provides a means of stabilizing the body so that the limbs can act in concert with one another and with the body (Sugden & Keogh, 1990). Postural control is composed of two components: *postural orientation* and *postural stability* (Shumway-Cook & Woollacott, 2001).

Postural orientation enables children to maintain an optimal relationship with the environment. Being upright works best for most tasks, especially those involving hand use. Postural orientation also enables children to maintain optimal relationships among body segments, particularly the head and trunk. Generally, that means the head and trunk are in line with one another, although neither is held rigid. Both are stable and, yet, can be moved freely.

Postural orientation requires the integration of sensation from several sources: muscles, joints, skin, the ears (including both hearing and the sense of movement), and the eyes. Each sense plays a role in adopting and maintaining postures. For example, when sitting on the floor, a child gets information through pressure on the skin covering the legs and buttocks to tell her that she is in contact with the floor. The absence of pressure over other body parts (e.g., belly) provides additional information. Cues from muscles and joints inform the child that her hips are bent to 90 degrees. Cues from the eyes and ears tell her that she is upright.

Postural stability, the second component of postural control, is synonymous with balance; it enables children to maintain the body position within specific boundaries (base of support; Weisz, 1938) known as *stability limits* (Shumway-Cook & Woollacott, 2001).

When children move outside their stability limits, they establish a new base of support and a new position by extending one or more limbs and then moving the body over the limbs into the new position. These movements may be intentional. For example, a child may chose to move from sitting on a chair to hands and knees by "falling" to one side, extending the arms, moving weight over the arms, and derotating the lower body so that the knees come into contact with the floor. Establishing a new base of support also may occur unintentionally as, for example, when reaching too far in the sitting position, losing balance, and extending a limb to keep from landing on one's face.

Explaining Postural Control

Physical and occupational therapists have traditionally adopted a neuromaturation model to explain postural control (Alexander, Boehme, & Cupps, 1993; Campbell, Vander Linden, & Palisano, 2000; Piper & Darrah, 1994). In the neuromaturation model, postural reactions appear in a well-defined sequence enabled almost entirely by development of the central nervous system. Therapists using the neuromaturation model describe three components of an automatic postural mechanism: righting (head and trunk movements that enable a child to remain upright and assume new body positions), protective extension (extension of a limb to prevent falling), and balance (compensatory reactions of the head and trunk that keep the center of gravity over the base of support) (Bobath, 1985; Shumway-Cook & Woollacott, 2001). Each of these responses is the responsibility of progressively "higher" centers within the nervous system.

Although both the neuromaturation model and systems-based models such as the one described by Shumway-Cook and Woollacott (2001) can be used to explain developing postural reactions, the latter have greater contemporary appeal. They incorporate multiple factors (not simply the developing central nervous system) into their explanation for the acquisition of skills. Systems theorists explicitly consider both the task and the environment as equal partners in determining what actions look like (Reed, 1989; Shumway-Cook & Woollacott, 2001; Thelen, 1995; Thelen & Smith, 1994).

Unlike the neuromaturation model, systems approaches (compatible with TPBA) also address the *anticipatory* or *proactive* components of posture rather than simply its *reactive* roles (e.g., regaining balance). When a child *prepares* to catch a ball, the same muscles are activated as in the *compensatory* movements that enable that child to remain upright *following* a backward push (Nashner & McCollum, 1985, cited in Reed, 1989). Anticipatory postural sets establish a supporting framework for many voluntary, goal-directed movements. The ability to anticipate is a critical feature of postural control (Reed, 1989; Shumway-Cook & Woollacott, 2001).

Several considerations are relevant to the question of how well posture supports task performance. First, it is easiest to manipulate objects in an upright position in which both hands are free. Second, whereas sitting and standing are easier poses to maintain than prone (on belly) in terms of resisting gravity, they require better balance.

Although it is difficult to play with toys while prone or on hands and knees, these positions tell us a lot about postural control. They require good extension to counteract gravity, and to attain good body alignment, flexion must balance extension. When children have difficulty maintaining these positions with good alignment, we question postural control.

The development of postural control occurs first in the head and neck and gradually develops through the trunk and limbs. Postural responses are influenced by vision, movement, touch, and sensation from the muscles (Shumway-Cook & Woollacott, 2001), as well as by what the child wants to do. Coordinated postural responses in the neck begin to appear at about 2 months of age. By 4–6 months, the infant is able to use information from vision and movement to extend the neck, back, and hips while lying on his or her belly (Piper & Darrah, 1994). In the neuromaturation model, this position is known as the *Landau* or *pivot prone.*

The postural control necessary for sitting will not occur until 6–7 months of age. At this point and onward, touch and resistance from the support surface play a major role in postural control (Shumway-Cook & Woollacott, 2001). This is another example of the marked influence of sensation on balance.

By 8–10 months, most children are standing while holding on. Children generally are not able to free both hands while standing until 11–14 months, the time at which they begin walking. Even at the onset of walking they will balance with their arms for some weeks to come (Piper & Darrah, 1994). Running and walking place new demands on posture as the child needs to anticipate faster and more often in order to avoid obstacles, change directions, and stop.

Changing positions requires alignment of the head, trunk, and limbs. When body segments are not well aligned, children get stuck and cannot move out of a position. Sometimes children "sink into" a supporting surface and lose body alignment. Without good alignment, they also will find it difficult to use the arms and hands to reach for a toy.

I. B. How well does muscle tone support posture?

Muscle tone is the force that muscles use to resist being lengthened; it is typically felt as stiffness. Tone often is tested by moving a limb passively and assessing the degree of resistance (Shumway-Cook & Woollacott, 2001). However, in TPBA we assess tone, as all other functions, primarily through observation.

A certain amount of muscle tone is necessary for all action. Tone provides the base for an anticipatory postural set as well as for compensatory reactions that occur from changing position or losing balance. Tone also enables all limb movements: reaching, walking, running, kicking, and so forth.

The precise contribution of *normal* tone to movement and posture can be difficult to observe. However, abnormal tone results in poor control of movement and clearly limits what some children can accomplish, so observing the effects of abnormal tone is relatively easy.

Abnormal tone varies widely in appearance. Tone can be too high, too low, or apparently "fluctuating" (i.e., in the presence of tremors or involuntary movements) (Sugden & Keogh, 1990). Abnormal muscle tone is a part of many neurologically based disabilities (e.g., cerebral palsy, Down syndrome, dyspraxia).

When muscle tone is too high, there is increased resistance to movement and movements look stereotyped and lack variability. The more difficult the task, the more tone is likely to increase; this will be true in all involved limbs, not just the limb in use. The most common patterns of high tone include limbs on one body side or all four limbs; when tone is increased on both body sides, it generally is higher in one side than the other, and when all four limbs are involved, the legs may be more involved than the arms.

Children with increased muscle tone have difficulty initiating, sustaining, and terminating movement (Stamer, 2000). Consequently, they move slowly and appear to get stuck in certain postures. Some children seem to have difficulty moving in any direction, whereas others have greater difficulty moving in one direction than the other. Generally, children find it easier to flex the arms than to extend them and to extend the legs rather than flex them.

Researchers have suggested that some children who look as though they have high muscle tone may actually be voluntarily "[using] increased stiffness as a compensatory strategy to control posture and prevent unwanted or uncontrolled movement in other areas of the body" (Nashner, Shumway-Cook, & Olin, 1983; Stamer, 2000, p. 66). For example, a child who has tremors may stiffen his trunk and arms in an attempt to reduce the tremors and make reaching more accurate. Another child may stiffen her legs and walk on her tiptoes to counteract the effect of instability in her hips. Children can use stiffness to help themselves become more functional.

Abnormally low muscle tone is characterized by increased range of movement and unusually flexible postures (Dubowitz, 1980, cited in Stamer, 2000; Sugden & Keogh, 1990). Consequently, the movements of children with low tone look unusual. For example, they may move into sitting from lying on the stomach by spreading the legs wide and pushing up with the head or hands (Sugden & Keogh, 1990). Children with low tone may have difficulty initiating and completing movements, and their movements may be poorly graded (e.g., too hard, too fast). They may sustain positions (e.g., head erect, sitting, standing) by sinking into the support surface, "stacking" one body part on another, or locking joints, as their bodies are poorly aligned. Stamer (2000) indicated that these unusual movements and postures are the result of difficulties with muscle contraction, balancing muscles on opposite sides of joints, and recruiting muscles to work together. Children with low tone in the limbs generally also have decreased tone in the trunk.

Some children with slightly low muscle tone will develop new symptoms after the first year of life. Ataxia, a type of cerebral palsy characterized by tremors and a wide base of support in sitting and standing, is one possibility. Children with ataxia often are fearful of moving and have poor balance. Thus, their wide base of support and tendency to remain close to the ground serve them well. Despite their fear, they often seem to move a lot and may be labeled as overly active. To move they depend on visual fixation, which means they cannot scan the environment and, thus, often trip over or bump into objects. Furthermore, their movements are very poorly coordinated and poorly organized; they have difficulty initiating movements but then overshoot the target. Their abilities seem very inconsistent from day to day and situation to situation. Many children with ataxia have tremors in their arms, head, and eyes (Stamer, 2000).

Fluctuating tone, another symptom that begins as low tone, is characterized by highly complex, purposeless, uncontrolled, and seemingly involuntary movement (Stamer, 2000; Sugden & Keogh, 1990). The term *fluctuating* probably came from observations of alternating contractions of muscles on either side of joints in the trunk or limbs. Children who have these writhing or rotary motions generally have a diagnosis of athetoid cerebral palsy. Their movements occur with unnecessary force and may be initiated in a direction opposite of that of the intended movement. Their posture usually is very asymmetrical and they have profound difficulty with weight bearing and head control.

To make matters more confusing, individual children may have more than one type of abnormal tone. For example, increased tone in one or more limbs is often seen in the company of decreased tone in the trunk. Furthermore, the type of abnormal tone may change as children develop. As noted earlier, children who will be diagnosed later with athetoid cerebral palsy and who appear to have fluctuating tone often have very low tone as infants. Finally, children's muscle tone, whether normal or abnormal, often differs when they are in different states or when they are moving. For example, the tone of a child at rest appears lower than that of a child who is excited (Stamer, 2000).

USING THE OBSERVATION GUIDELINES TO ASSESS FUNCTIONS UNDERLYING MOVEMENT

I. A. How well does posture support action?

During TPBA, examiners should watch how well posture supports gross and fine motor skills. Which developmental positions do children assume and how well do they maintain them while engaged in play? The team should also observe children's abilities to keep the head and trunk in line and to move freely. Can they prepare for the inevitable perturbations that occur when they reach for or get ready to catch a ball, and how do they react when something unexpected happens (e.g., gentle jostling)? The team members also need to gauge whether children are able to catch themselves when they fall.

I. B. How well does muscle tone support posture?

The team should observe for the effects of muscle tone on appearance and actions. Is there evidence of decreased muscle tone in the trunk or limbs? Children with low tone appear to have "mushy" muscles. Their posture is poor and they have difficulty resisting gravity. For example, a child may have difficulty controlling his head. When he rises to sitting from lying down, he may lead with his chin rather than his forehead, causing his head to drop back slightly. Often, children with low tone sit with a rounded back. They may spread their legs widely apart, reflecting their low tone but also providing a very wide base of support. They may get stuck in a position because they sink into the support surface and lose their alignment. They may "lock" joints when in weight-bearing positions to minimize the demand on their muscles. For example, a child may tend to lock her knees when standing and her elbows when on hands and knees.

Is there evidence of increased muscle tone? When muscle tone is too high, children appear stiff. They tend to hold their arms and hands in characteristic postures (i.e., arms bent, hands fisted) and move in stereotypical ways. If they are able to sit, their legs tend to remain drawn together providing a very narrow base, and they may tend to sit on the sacrum rather than squarely on the buttocks. They often stand on their toes. Because of the stiffness in their limbs, they have difficulty initiating movements. However, children who have increased tone in their arms and legs may have decreased tone in the trunk.

Is there evidence of tremors or other involuntary movement that interferes with using the hands and arms? Such movements are often described as "fluctuating tone"; it seems as though someone is rapidly flicking a light switch when controlling a muscle contraction. Children with involuntary movements often have decreased tone in the trunk; they also may have increased tone in some body parts.

Because muscle tone underlies posture, children who have abnormal tone often have poor postural responses. They may lack stability and have difficulty maintaining and moving between positions. They may lose their balance easily and fail to catch themselves when falling.

Alejandra's family sought TPBA for their quiet, shy 6-year-old daughter because of general concerns with her development. Her 4-year-old sister was already able to run and climb better than "Ali" and was beginning to surpass her in other ways, too. Ali's evaluation occurred in a play area covered, in part, with thick mattresses. She found it hard to walk across that area without falling, and her supporting muscle tone was clearly low. She stood with locked knees and a pronounced curve of her lower back; her muscles looked mushy. Ali's difficulties increased markedly when she tried to drag a large heavy bag full of toys across the floor. Her force came from her arms; her trunk did not appear to provide a sturdy base from which to work. Ali's parents reported that she had similar difficulties whenever she walked on a soft or uneven soft surface, especially when carrying large or heavy objects.

Although it is relatively easy for team members to see evidence of Ali's low muscle tone, it is the effect of her tone on her posture and motor skills that is of concern. Ali's low tone is resulting in poor stability in her trunk and limbs. Consequently, she stands in ways that minimize the demand to her muscles; she locks her knees, and there is a pronounced curve in her back. Her poor stability also is a major reason why she has so much difficulty carrying or dragging heavy objects; it also contributes to her poor balance. Because low tone and poor posture underlie many of Ali's difficulties, they will be reflected in her plan. However, her goals will be to improve specific skills (e.g., dragging or pushing heavy objects effectively) rather than the more generic objective of improving balance or building muscle tone.

II. Gross Motor Activity

Gross motor actions are those involving big movements and large muscles. They involve several body parts working together to move the body through space and receive or propel large objects (Burton & Miller, 1998). For example, running is a gross motor activity, as is throwing. The motions are large and employ both the trunk and extremities. The actual definition of *gross motor* is rarely made explicit, perhaps because it reflects the simple dictionary definition of *gross:* "big" (Random House, 2000). However, the definition is reflected in the items included in assessments of gross motor ability (e.g., Bruininks, 1978; Folio & Fewell, 1983).

A caution: Because fine motor movements are so often performed with the hands, gross and fine motor sometimes are linked expressly (and incorrectly) to arms and legs, respectively. That is, sometimes speakers refer to any skill done with the upper extremities as fine motor and any done with the lower extremities as gross motor. The fact that there is no clear distinction between "big" and "small" only adds to the confusion. Reaching provides a good example. Is it a gross motor skill or a fine motor skill? A child standing on tiptoes and straining to get a toy from the top shelf clearly is performing a gross motor task. What about the child seated at a table reaching for a French fry on the plate in front of him or her? Is he or she performing a gross or fine motor action? Thus, for simplicity, in TPBA we have separated all activities where the primary action involves the upper extremities, whether gross or fine motor in nature, into a section titled Arm and Hand Use (Section III); this section follows the gross motor section.

II. A. In general, how do you describe the child's gross motor movements? How much do gross motor problems interfere with function?

When assessing gross motor activity, we begin by looking *in general* at children's actions. Can they do what they want to do (i.e., are their actions effective)? How well (i.e., do the actions reflect efficiency and quality)? How easily (i.e., how much effort do they expend)? How much do they enjoy gross motor play?

Children may be able to accomplish tasks but the quality may not be good, and they may expend a lot of energy doing things that should be quite simple. Running is a good example. When typically developing children (over the age of 5) run, they lean forward and pump their arms rhythmically (Keogh & Sugden, 1985; Seefeldt & Haubenstricker, 1982; Williams, 1983). They can pretty much stop on a dime. They may arrive breathless but recover quickly. Children who have difficulty with running look awkward and move relatively slowly. They fatigue easily, and many of these children will find it difficult to stop without running into something.

In addition, it always is important to ask about the circumstances that affect gross motor skills—both negatively and positively. For example, a child may be able to ride his two-wheeler in the basement but be afraid to ride it on slanted surfaces like the driveway or the hill in front of his house.

We also observe how much children seem to enjoy gross motor play. Children who are fearful of moving or who have been teased because of poor coordination may avoid gross motor actions. Sometimes parents and others mistake a child's difficulties for personal preference (Cermak & Larkin, 2002; Lane, 2002; Reeves & Cermak, 2002).

However, most children, especially boys, favor sensorimotor motor play through at least the preschool years (Clifford & Bundy, 1989).

II. B. What positions does the child play in?

Most children have access to a range of developmental positions. However, they play in only a few. Most typically developing children are able to assume the common play positions by approximately 15 months (Aylward, 1995; Bly, 1994; Case-Smith, 2001; Folio & Fewell, 1983; Piper & Darrah, 1994). These commence with lying on the back with arms and hands free (about 4 months) and further include lying on the belly with forearm support (5 months), reaching while lying on the belly (7 months), sitting reliably with arms free (about 8 months), standing propped against a surface (10 months), standing alone (13 months), and, finally, squatting (15 months) (Piper & Darrah, 1994). Once children are able to sit, it is relatively unusual for them to play in positions that are not upright (Alexander et al., 1993).

In order to play in a particular position, children must maintain it even when disturbed slightly by reaching or turning to look or when someone else bumps into them. They also need at least one, and preferably both, hands free. Children who lack sufficient internal stability to play independently can be supported externally by a chair or other piece of equipment. However, even when a chair is well fitted, it does not replace internal stability. That is, it will not enable the child to shift weight or turn easily. Thus, both play and independence will be limited to a degree.

Children who lack proximal stability or have increased tone in their lower extremities often prefer sitting with their legs in a "W" shape. W sitting has certain advantages. It is easy to assume this position from hands and knees by simply moving backward through the legs without rotating the trunk at all. Furthermore, the position is very stable and both hands are completely free. However, W sitting has certain disadvantages. Most important, it strains the hip and knee joints and may contribute to deformity of the legs, particularly in children who keep their legs bent for prolonged periods of time.

Children's abilities to maintain developmental positions contribute to the development of stability. For example, Alexander and colleagues (1993) described that as the 7-month-old baby rocks on hands and knees, postural stability, strength, and coordination develop, which in turn improves shoulder, pelvic, and hip control.

A similar case can be made for developing control and stability in all developmental positions.

II. C. How independent is the child when moving between positions?

To be independent in play, children must be able to move in and out of positions. Otherwise their options in play are extremely limited. Most typically developing children move frequently from position to position. They move as the play evolves, toys move, or their comfort demands.

Transitions between developmental positions depend on postural alignment (Alexander et al., 1993). They develop as a natural outgrowth of shifting weight. In fact, early transitions (e.g., rolling from belly to back) may occur first because children are unable to grade weight shifts and accidentally "fall" into new positions when they shift too far (Alexander et al., 1993). Gradually, as they gain greater control and stability, transitions become voluntary.

Transitioning from one position to another develops over time. It begins with rolling at 7–9 months of age and includes moving from sitting to hands and knees (8–10 months), from sitting to belly (8–12 months), pulling to stand (8–10 months),

Excerpted from Transdisciplinary Play-Based Assessment, Second Edition
by Toni Linder, Ed.D.

cruising along a low surface (9–13 months), getting down from standing (9–11 months), and standing from squatting or hands and knees (12–15 months) (Piper & Darrah, 1994). No doubt transitioning both reflects and contributes to the development of postural control.

II. D. How does the child move through the environment? How independent is the child? How good is the quality?

There are many ways of moving through the environment, and the play of young children generally incorporates a number of them. For example, children may walk or crawl, they may skip or hop, or they may ride a tricycle or use a walker or a wheelchair. As with developmental positions, however, children use only those actions that make sense in the context of their play. For example, children who can walk rarely revert to crawling except when the play demands it (e.g., pretending to be an animal).

Typically developing children have acquired most locomotion skills by 15 months of age, although many skills (e.g., running and skipping) continue to be refined for months and even years (Burton & Miller, 1998; Folio & Fewell, 1983; Keogh & Sugden, 1985; Williams, 1983). Locomotion begins with pivoting while lying on the belly between 6 and 8 months of age and includes rolling, crawling on the belly (8–9 months), creeping on hands and knees (9–13 months), and walking (beginning about 12 months) (Piper & Darrah, 1994). More advanced locomotion skills develop somewhat later. Some, like running, begin at about a year and a half and are retained through much of life. Others, such as hopping and skipping, begin later (2½–3 years and 4½–5 years, respectively) (Keogh & Sugden, 1985; Seefeldt & Haubenstricker, 1982; Williams, 1983).

Of course, not all means of locomotion are possible or acceptable in all circumstances. For example, a child who can get around quite well riding a tricycle may not be allowed to use it at school or in church. Also, he or she may lack the skills to ride on hilly terrain or in the sand.

Children who have significant motor impairments may not be able to move through all environments independently or safely. Some expend a great deal of effort accomplishing what their peers find to be quite easy. When children have difficulty moving through the environment, we try to determine the cause. Any of a number of factors related to their motor capacity (e.g., postural control, muscle tone, bilateral coordination, motor planning) may contribute. However, the team should also examine the nature of the task and the conditions of the environment to find their role.

II. E. How well does the child use two body sides together? (Bilateral coordination)

The ability to use two sides of the body in a well-coordinated fashion is of major importance to children's sensorimotor functioning. The ability to use a lead hand and an assisting hand together to perform a skilled task in any spatial orientation with respect to the body is a major milestone in the long development of bilateral coordination (Keogh & Sugden, 1985; Williams, 1983). Many bilateral tasks involve the anticipation of future conditions (e.g., catching a ball with two hands). In addition to their bilateral demands, such tasks also are highly reliant on the ability to develop a postural set to support the action and on their motor planning abilities.

Several authors (Keogh & Sugden, 1985; Williams, 1983) have provided information about the development of bilateral limb usage; the following is a summary (Koomar & Bundy, 2002). However, because bilateral demands change so much as a result of body position, the specific task, and the circumstances surrounding the task, little can be said about the ages when children master various aspects of bilateral limb use.

- Bilateral movements develop earlier in the arms than in the legs.
- Bilateral coordination develops from discrete movements to progressively longer sequences.
- Symmetrical movements appear earlier than alternating movements.

While the assessment of bilateral coordination typically focuses on the limbs, especially the upper limbs, the concept actually refers to the entire body, including the trunk. To fully understand this concept, we might think of an imaginary line bisecting the body in the midsagittal plane where the right and left body sides meet. Because limb movements require postural support, one might think of trunk rotation that occurs with crossing the body midline in order to use a limb in contralateral space as reflecting, and contributing to, bilateral coordination.

Of course, if a child has significant differences between the left and right body sides, bilateral coordination will be affected negatively. Large differences between body sides generally reflect differences in muscle tone and postural control. In that case, a child is likely to use one hand for nearly everything and may fail to use the other hand, even to assist.

Another manifestation of poor bilateral coordination occurs in almost the opposite circumstance, when a child does not seem to have developed a clear preference for one hand over the other. That child may use the two hands interchangeably to do a particular task (i.e., eat with a utensil, throw a ball). Some children, especially those who are left handed, typically perform some tasks with the right hand and others with the left. This is *not* a reflection of poor bilateral coordination.

USING THE OBSERVATION GUIDELINES TO ASSESS GROSS MOTOR ACTIVITY

II. A. In general, how do you describe the child's gross motor movements? How much do gross motor problems interfere with function?

Before the team looks in detail at gross motor actions, they should observe them in general. Are children able to perform the actions expected at their chronological age? How good is the quality? How much effort do they expend? Do they enjoy gross motor play?

If gross motor actions seem to be a source of difficulty, the team should try to establish, in general, how great the concerns are. That is, are you looking at a problem that substantially interferes with play and other childhood occupations, or is it a problem that is present but interferes less than some other difficulties? Answering this question gives you a kind of mindset. Many children come for assessment with a number of difficulties. Some interfere with their functioning more than others. Some are more germane to what a particular child or family values. In making decisions about the relative emphases of intervention, the team will weigh each area of development carefully. For example, at some point in her development, the family of a child with relatively more involvement in her legs than her arms may decide to focus intervention on the things that she does best and most easily rather than on walking. Thus, her goals may emphasize arm and hand skill, play, or dressing.

II. B. What positions does the child play in?

When administering TPBA, we "handle" children minimally. We prefer instead to obtain as much information as possible by observing. We emphasize how the child's ability to assume or maintain a position is affected by the play and by the environment. What factors increase the child's abilities? Which decrease them? Can the child develop a postural set in anticipation of events that will affect his ability to remain in a position?

II. C. How independent is the child when moving between positions?

Of course, some children can play only in positions in which they are placed. They cannot move out of that position without help. Then, it is important to find out from caregivers about the positions in which the child usually plays, to place or help the child into those positions, and then observe. Among the things we will observe is how much assistance the child needs to remain in the position (including the assistance of furniture or adaptive equipment) and how well the child can play with toys.

"W" sitting is a common observation. The relative advantages of W sitting from a child's point of view and the disadvantages from caregivers' perspective often lead to battles. Teams must weigh the costs and benefits for each child. When a decision is made to minimize or eliminate W sitting, team members have to work very hard to help the child develop an acceptable alternative (i.e., easy to assume and where hands are free). Besides W sitting, children may assume other unusual positions for playing. Team members always must weigh the benefits and disadvantages to come up with the best solution.

II. D. How does the child move through the environment? How independent is the child? How good is the quality?

The TPBA team need not assess each gross motor action that children might be capable of using for locomotion. Rather, the team should evaluate those that occur spontaneously as the child plays. Take note of which actions occur and how closely they match the child's chronological age. Assess their quality. Are the actions similar to those of typically developing peers? Do the actions appear unusual? How safe is the child? How much effort does the child expend? Again, be prepared to emphasize how the child's ability to perform actions is affected by the play and by the environment. What factors increase the child's abilities? Which decrease them?

Bunny hopping (moving hands and then knees together) is a means of locomoting that has many of the same advantages and disadvantages as W sitting. As with W sitting, team members will have to work very hard to help the child develop an acceptable alternative if they wish to eliminate bunny hopping or any other form of locomotion that is effective but possibly detrimental to joints.

II. E. How well does the child use two body sides together? (Bilateral coordination)

In assessing the quality of bilateral coordination, the team should observe for both symmetry and asymmetry. Do the two body sides appear similar in size? Can the child can use them together for tasks that demand both hands or feet (e.g., clapping, pedaling a bicycle)? Because performing gross motor tasks that require use of the hands together at midline can be particularly demanding, the team should try to observe activities that involve this skill. Playing catch with (or rolling) a tennis ball can be a particularly good activity for this; it also allows the team to observe other bilateral skills (e.g., crossing midline). Table-top activities are also good for observing play at midline.

Midline crossing generally occurs together with trunk rotation; they should happen spontaneously but not because the child is asked to do it. The problem is with a tendency not to cross rather than an inability. We see midline crossing and trunk rotation particularly well in ball games when the ball comes relatively near the midline. If the ball is near the extremes of reach, it will be far more natural to catch it with only one hand. Again, table-top activities also work well.

We expect most preschoolers to have developed a preferred hand and we will see that in the context of tasks such as throwing, batting, or sweeping, and also in reaching and skilled or fine motor tasks. Does the child always use the same hand to do the same task?

We also want to be sure that the child has a good assisting hand. That hand holds objects that the preferred hand is acting on. When the skills of the assisting hand are well developed, the child can use it to orient objects for action. This may be easiest to see in the context of activities demanding manipulation.

Sequences of bilateral actions are particularly difficult and we look for opportunities to see how children handle them. Can they maintain rhythmic sequences over multiple repetitions? Clapping and jumping games are particularly good for observing repetitive bilateral actions. Propelling a swing or Sit 'n Spin (Playskool/Hasbro) also serves the same purpose. Symmetrical sequences where the hands or feet are acting in concert are easier than reciprocal sequences (see also TPBA2 Observation Guidelines, p. 45, IV. Motor Planning and Coordination).

Finally, observe activities where the child uses arms and legs together. Running fast, pumping arms and legs, is a good example. The child's actions should appear smooth and easy.

When assessing bilateral coordination, concentrate on observing actions that occur spontaneously. If the team is curious about whether a child can perform a specific action, ask the play facilitator to create a situation in which that action may occur spontaneously. If unable to elicit a particular action, the team should ask the parents if the child is able to perform the action.

William is a charming 4-year-old with a diagnosis of spina bifida. He attends a local preschool with his typically developing peers. William will begin kindergarten in the coming school year. His parents are concerned about how he will get around the school building and grounds. So far, they have avoided getting him a wheelchair, as they are worried that he might lose his motivation for walking. His means of locomotion, as well as other concerns regarding his school placement, are the major impetus for his evaluation.

William is able to creep on hands and knees independently, and this is his primary means of locomotion at home and in preschool. He also uses an adapted tricycle powered with his arms. During TPBA, William went everywhere he wanted to go by creeping. Although he recently began working with his physical therapist on using a walker and standing structure, he cannot use them safely without assistance. The team observed William using his equipment when he arrived. Later, they let him choose the way he got around.

William's family and the team agreed that one important focus of his intervention should be on locomotion in preparation for going to school. They discussed several options. William could use the tricycle in the hallways and on the playground but not in the classroom. Although he could creep in the classroom, and no doubt would some of the time, they all felt that creeping should not be his only means of getting around. They settled on two goals. One goal pertained to an intensive course of physical therapy to gauge the rate of his progress using the equipment. The second goal involved being fitted for a wheelchair. The team agreed that there were times when William would need to get somewhere quickly and when neither the tricycle nor the walker would be practical (e.g., fire drills, class trips). As much as they had been reluctant initially, William's parents completely embraced the decision. William was getting too big for the stroller they used in the community and, besides, they felt neighbor children viewed him as babyish when he rode in it.

William's family found the opportunity to share their fears, thoughts, and common observations with the whole team to be very valuable. They had begun the assessment process adamantly opposed to a wheelchair, a solution that they ultimately embraced. The process changed them and their opinions. They felt supported as full team members and came to see how the chair would be a benefit at home as well as at school.

III. Arm and Hand Use

Together, our arms and hands are our primary means of interacting with objects and an important way of communicating socially; they can be practical, creative, or social. The arm allows the hand to extend into space and orient itself to act on any object. The hand, in turn, can be a platform, a hook, a vise, or a pointer (Henderson & Pehoski, 1995).

With our arms and hands, we act on objects directly: reaching, grasping, manipulating, poking, prodding, and exploring. We also operate tools that, in turn, give our manipulations greater precision or force. We can catch a football in mid air, use a hammer or pliers, thread a needle, or play a flute (Henderson & Pehoski, 1995).

We also gesture, speak, and express emotion with our arms and hands. We can use them to deliver a caress, a slap, or a playful punch. We can say, "I love you," "Come here," or "Go away" (Henderson & Pehoski, 1995).

The hand movements required for precise manipulation are among the most advanced of all motor skills, requiring both conscious control and significant sensory input and feedback. Their complexity is reflected in a long developmental period, continuing into early adolescence (Henderson & Pehoski, 1995). Many types of disabling conditions result in difficulties with arm and hand use.

Because many tasks requiring skilled arm and hand use also have accompanying visual demands (e.g., ball games, arts and crafts), we often simultaneously observe eye–hand (visual-motor) coordination. Children commonly have concomitant difficulty with eye–hand coordination and skilled hand use.

III. A. In general, how do you describe the child's arm and hand use? How much do problems with arm and hand use interfere with function?

The team should begin by examining children's overall arm and hand use. In the general assessment, ask a number of questions. Is the child able to perform desired actions (effectiveness)? How well (efficiency, quality)? How easily (how much effort)?

Children may be able to use their arms and hands to accomplish tasks, but the quality of their movements may not be good and they may expend a lot of energy performing tasks that should be quite simple. Cutting with scissors provides a good example. By age 7, typically developing children are fairly skilled with scissors (Exner, 2001). They automatically insert thumb and middle finger into the loops and cut quickly and rhythmically, opening the scissors in proportion to the thickness of the paper. The assisting hand deftly holds the paper, repositioning it with each snip. Children who have difficulty cutting with scissors often find each step to be a "drama," beginning with the decision of which fingers to insert in the loops. They may have difficulty stabilizing with the little finger side of the hand. The actual cutting motion may be arrhythmic, reflecting variations in the amount of opening of the scissors. The assisting hand presents another kind of problem. Children may be unable to prevent it from opening and closing with the scissors so the paper drops. They may be unable to maintain the timing and rhythm of moving the paper so that there is a lot of stop–start in the cutting.

Another important aspect to observe is how much children enjoy play requiring arm and hand skill. Children who find arm and hand use difficult often avoid toys and activities that require intricate hand and finger movements or skilled use of eyes and hands together. A preference for big motor actions with few skill demands (e.g., roughhousing) over activities requiring precise skill may simply represent choice, especially for boys. However, if it co-occurs with difficulty performing tasks the child needs to do (e.g., self-care, preacademic tasks) or wants to do (e.g., sports), then it may reflect dysfunction (Clifford & Bundy, 1989).

When arm and hand use are a source of difficulty, the team should first establish how great the concerns are. That is, are we looking at a problem that substantially interferes with function, or is it a problem that interferes, but perhaps less than some other difficulties? Or, conversely, is the problem so great that adaptations will be required if the child is to carry out required activities that have a significant arm or hand skill component? For example, does it seem likely that the computer will be the best means for a particular child to write? As in the previous discussion of gross motor actions, answering this question helps with prioritizing and developing intervention plans.

III. B. How well is the child able to reach?

Reaching gets the hand into position to grasp an object. Reach is dependent on vision as well as touch and proprioception (a sense derived from muscles); hence, the term *eye–hand coordination.* The initial reaching movement is accomplished quite quickly and under proprioceptive control; this motion gets the hand to the approximate place where it will contact an object. As the hand moves closer to the object, it slows down and vision becomes more important for shaping the hand and orienting it to the object. The smaller the object, the slower the final approach (Rösblad, 1995).

Timing often is an important part of reach. Timing is particularly significant when the object is moving or is very small. Unless reaching is timed very precisely, it will be unsuccessful (Keogh & Sugden, 1985). As the reach comes to an end, the hand should be in position to act on the object; this requires that it be oriented with respect to the object and the action that will follow. Reaching, orienting the hand, and preparing to act on the object occur simultaneously (Rösblad, 1995). Thus, we will use the term “reach” to refer to the combined functions that get the hand where it is going in order to act on an object.

Very young infants are not able to obtain toys by reaching. However, by about 6 months of age, reaching movements are developing well. That is, the trajectory of movement contains fewer instances of speeding up and slowing down to get the hand near the place where it will contact the object. By 9 months of age, infants can prepare for grasping by adjusting the opening of the hand to match the object size. By 13 months of age, the timing of the opening of the hand is similar to that of adults. Early reaches are bilateral but as children gain postural control and can sit, they are more able to perform unilateral reaches (Rösblad, 1995).

Although little is known about the reaching skills of children whose development is atypical, several factors are likely to affect them, particularly in children with neurological impairments. These include poor postural control, poor timing of movements, and lack of correspondence between vision and proprioception or between proprioception from one body side to another. These difficulties mean that reaching will take longer and be less accurate, especially when the object is not stationary (Erhardt, 1992; Rösblad, 1995).

III. C. How effective is the child’s grasp?

Grasping an object is synonymous with capturing it. Following the capture, the object is manipulated, used, transported, or held. A grasp is efficient when any size object can be captured with an economy of movement and in such a way that it is available for the next action. That sort of efficiency typically will develop over the first 2 years (Case-Smith, 1995).

When infants are first learning to grasp voluntarily, around 20–24 weeks, they use the ulnar (little finger) side of the hand. The thumb has little involvement. Thus, “captured objects" must be relatively large. Following grasp, the object will be in place for holding or transporting but not manipulating (Case-Smith, 1995).

Over the next 18 months, several overlapping aspects of grasp and forearm use will develop to enable an efficient capture. Grasp will move gradually from the ulnar side of the hand to the radial (thumb) side. The thumb begins to be active at about 24 weeks of age. By 36 weeks of age, a "scissors" grasp (i.e., prehension of a small object between the thumb and the side of the first finger) is common. At 40 weeks, the child is able to oppose the thumb against the pads of the fingers in an inferior pincer grasp. Not until children reach their first birthdays are they able to grasp tiny objects deftly between the tips of the thumb and fingers (superior pincer) without the aid of external stability (Case-Smith, 1995).

The efficiency and effectiveness of grasping depends on being able to orient the forearms so that the fingers are facing toward the object. Initially, the child keeps the forearms pronated. At about 28 weeks, the child will be able to supinate the forearm sufficiently to bring objects held between the radial fingers and palm to the mouth (Case-Smith, 1995). With increasing skill, the child will be able to orient the hand and forearm to any position required for deft prehension, and this movement will occur concurrently with reaching.

Another herald of the increasing efficiency of grasp is a decreased need for external stability. At about 20 weeks, the child's only hope for capturing an object is pulling it along the support surface to meet the other hand and squeezing it into that hand. This is not a true grasp. Even at 40 weeks, the child will need to stabilize the forearm on the surface while grasping small objects between the thumb and forefinger (inferior pincer). External support is replaced with increased stability of the hand itself. One example of this is a child's ability to stabilize with the ulnar side of the hand while using the radial side for grasping, which also often occurs in conjunction with the superior pincer grasp at about 1 year of age. Once children no longer need to stabilize the hand externally, they can easily grasp objects in any orientation and from any surface (Case-Smith, 1995).

Grasp also improves as the arches and intrinsic muscles of the hand develop. Several important observations tell us arches are developing. Although not obviously related to grasp, developing arches are visible as children bear weight on their hands. Because of arches, the hand does not appear flat and the child can move over the hands in a weight-bearing position (e.g., when shifting weight or rocking) (Boehme, 1988). More clearly related to grasp, as arches develop, children can bring the fingertips and thumb into opposition and hold objects with relatively extended fingers. Thus, the superior pinch, described above and present by about 1 year, also reflects arch development. This refined grasp, enabled by the presence of arches in the hand, enables the child to grasp more effectively and efficiently (Case-Smith, 1995).

As the child becomes able to control isolated fingers and move the two sides of the hand independently, grasp also becomes more efficient. By 1 year, the child is able to isolate the index finger for poking and can hold two small objects in one hand. These abilities will continue to improve over the next 6 months. Increasingly efficient grasp also means that a child can adapt to the weight and shape of an object to be captured.

We expect 18-month-olds to be able to pick up and hold small, relatively fragile objects (e.g., cracker, paper cup) without crushing them. Two-year-olds are able to adjust their grip to a variety of weights. However, even 8-year-olds continue to have more variable ability than adults (Eliasson, 1995). Similarly, children must learn to adjust their force to match the size of an object; this ability does not begin to develop until age 3 and is not complete until at least 7 years of age (Eliasson, 1995).

III. D. How well does the child release objects?

Captured objects invariably have to be released. Because release follows grasp functionally, it is perhaps not surprising that it also lags behind developmentally. The precursor to release occurs when a child pulls an object out of one hand and into the other or uses an external surface to assist in rolling the object out of the fingers (about 28 weeks of age). That same child has been practicing grasping for 4–8 weeks. Active release will not begin until 40–44 weeks and even then it might best be described as “flinging,” as it often involves elbow and wrist finger movement as well as widely opened fingers (Case-Smith, 1995; Erhardt, 1994).

Only at 1 year, when children can deftly grasp tiny objects, are they beginning to release without fully opening the hand. This is known as “controlled release.” However, for the next 6 months, children must stabilize the forearm against a support surface to release small objects accurately. Not until about age 2 will the child adjust the amount of opening of the fingers to accommodate for the object’s precise size and shape (Case-Smith, 1995; Erhardt, 1994).

III. E. How well does the child isolate finger movements for pointing, poking, and tapping?

By 1 year, children can use the index finger separately from the other fingers to poke at and turn small objects so that they can be captured easily. This skill appears at about the same time as children develop the ability to hold a small object between the thumb and tip of the index finger (Case-Smith, 1995). Both skills are related, as both reflect increased separation of the two sides of the hand and increased ability to skillfully use fingers on the radial (thumb) side of the hand.

Although children are capable of separating the index finger from the others by 1 year, they generally do not use one isolated finger on toys that require any degree of force (e.g., toy piano, cash register) until they are 15–18 months of age. Even then they may prefer to use more than one finger.

Isolated finger use will continue to develop for some time. The ability to use isolated movements of all fingers (e.g., on a keyboard or piano) will not develop until 10–12 years of age and will require exposure and training (Case-Smith & Weintraub, 2002).

Activities that require isolated finger movements generally involve vision; however, once they are learned, they depend more on input from the muscles (Case-Smith & Weintraub, 2002). Most activities that involve isolated movements of multiple fingers are done quickly and sequentially. They involve anticipation and, thus, will involve motor planning.

III. F. How effective is the child’s in-hand manipulation?

Although release is more difficult than grasp, the ability to adjust the placement of an object within that hand prior to use or release is more difficult yet; in fact, it is the most skilled of all hand actions. Fine tuning the position of an object without using external support is known as in-hand manipulation. In keeping with their level of difficulty, in-hand manipulations may not be fully developed until a child is nearly 7 years of age. Even when children are capable of performing certain in-hand manipulations, they may choose not to use them (Exner, 1992, 2001; Pehoski, 1995).

Unlike many other hand skills, in-hand manipulation does not depend much on vision. Rather, touch and proprioception are most important. To be successful at in-hand manipulation requires holding the object tightly enough not to drop it but loosely enough to be able to move it (Pehoski, 1995).

Three basic types of in-hand manipulations have been described (Exner, 1992, 2001; Pehoski, 1995). The first involves using the thumb to move an object from palm to fingertips or fingertips to palm. This is known as *translation.* Children use translations, for example, when moving coins or food into or out of "storage" in the palm (Exner, 1992, 2001; Pehoski, 1995).

The second type of in-hand manipulation involves rotating an object between the fingers and thumb. When the object is rotated just a little, it is called a *simple rotation.* Simple rotations occur, for example, when repositioning a crayon held initially with the sharpened end pointing to the little finger side. When an object is rotated more than 180 degrees, a complex rotation is used. A complex rotation can be seen, for example, when a child holding a crayon in the palm of the hand with the sharpened end on the thumb side turns it (within the hand) to the typical position for drawing (Exner, 1992, 2001; Pehoski, 1995).

Finally, when an object is moved a small distance linearly, the in-hand manipulation is known as a *shift.* Shifts occur, for example, when moving the fingers down a crayon toward the point or when fanning playing cards (Exner, 1992, 2001; Pehoski, 1995).

Each type of in-hand manipulation may be done with or without "stabilization" (i.e., simultaneously holding another object in the ring and little fingers). Clearly, in-hand manipulation with stabilization is more difficult than without, and it develops later (Exner, 1992, 2001; Pehoski, 1995).

Even among the three basic types of in-hand manipulation (i.e., translation, rotation, and shift), there is a hierarchy of difficulty associated with the timing of emergence. Finger to palm translations are the easiest, appearing in some instances as young as 12–15 months of age when the child repositions a cracker or toy. Palm to finger translations and simple rotations (e.g., opening a jar lid) emerge between 2 and 2½ years. Shifts and complex rotations are more difficult; most 4- or 5-year-olds are capable of doing them, but they may not be seen reliably until about 6½ years. Even once young children are capable of these difficult skills, they do not necessarily *choose* to use them unless asked specifically. Skill at in-hand manipulation continues to develop through 12 years of age (Case-Smith & Weintraub, 2002; Exner, 1992, 2001; Pehoski, 1995).

Not all objects are equal when it comes to in-hand manipulation. A child who is able to manipulate one object in a particular way may not be able to use the same manipulation on an object of a different size or shape. In general, small objects are easier to manipulate than either large or tiny objects. Tiny objects require precise control with the fingertips, and large objects require skilled use of several fingers (Exner, 1992, 2001; Pehoski, 1995).

III. G. How good are the child's constructional abilities?

Constructional play involves putting things together. Placing toys in a container, stacking blocks, putting pegs in a peg board, and doing puzzles are common examples. Constructional play makes use of all the hand skills we have described above; it also relies heavily on vision and visual perception, touch, proprioception, and cognition. Children begin stacking blocks at about 1 year of age. Toddlers can stack multiple blocks and do simple puzzles and pegboards. By age 3 or 4, children build elaborate three-dimensional structures and put together interlocking puzzles. Construction continues to develop for many years and is reflected in crafts and school projects (Case-Smith & Weintraub, 2002).

III. H. How effectively does the child use tools?

Children use all kinds of tools—from hammers to pencils and tweezers. The purpose of tools differs widely from banging and making noise to drawing and cutting. Thus, it is not surprising that the hand skills required to use tools also vary widely from the very gross movements used on a hammer to precise finger movements used for writing. In addition to hand skills, tool use depends heavily on vision. Because force is involved, proximal stability also is important.

Striking one object with another happens when batting, hitting, or hammering. In each of these cases, children use the striking implement as though it is an extension of the arm to impart force to another object. Hammering develops very early. By 1 year of age, children bang with a spoon on the table surface, and by 1½–2 years they can use sticks and toy hammers. The movements required for such play are gross and unrefined. Initially, banging occurs from movements at the shoulder (Case-Smith & Weintraub, 2002).

Striking with a bat or toy golf club is done with a sidearm movement (Williams, 1983). Guidelines exist with regard to ages and stages associated with striking, a skill that appears by age 2 and is relatively mature by age 5 (Williams, 1983) but continues to be refined until 8 or 9 (Seefeldt & Haubenstricker, 1982). The motor requirements for striking are quite similar to those of throwing. The child must move the limbs to contact the object and finish at the time they contact it. They also must generate sufficient postural control to support their limb movements (Keogh & Sugden, 1985).

Drawing, writing, and cutting with scissors also are important examples of tool use that begin very early and continue across the life span. They involve precise finger movements. The contributions of vision, touch, and proprioception will continue to be significant; cognition also is increasingly important.

Two-year-olds scribble with a marker or crayon (Ziviani, 1995). By age 3, they copy lines and circles and can copy a cross (Folio & Fewell, 1983). They may hold the marker between the thumb and first two fingers (as adults do) but their movements will not be from the fingers until they are 4 or older. They may also be able to snip with scissors (Case-Smith & Weintraub, 2002), but scissors skills will continue to develop through age 6.

Difficulties with handwriting often contribute to referrals to specialist teams. Handwriting is a very complex function because it is dependent on cognitive abilities, such as sensorimotor; this is well beyond the scope of this section. However, while grasping a pencil with the thumb and first two fingers and writing with finger movements (dynamic tripod) is the most desirable pencil grasp, numerous other grasps are acceptable. Poor pencil grip alone is not a reason for concern (Ziviani, 1995).

USING THE OBSERVATION GUIDELINES TO ASSESS ARM AND HAND USE

III. A. In general, how do you describe the child's arm and hand use? How much do problems with arm and hand use interfere with function?

Before looking in detail at arm and hand skills, the team members should observe them in general. Are children able to perform the actions expected at their chronological age? How good is the quality? How much effort do they expend? Do they enjoy play involving arm and hand use?

If arm and hand skills seem to be a source of difficulty, the team should try to establish, in general, how great the concerns are. That is, are we looking at a problem that substantially interferes with play and other childhood occupations, or is it a problem that is present, but interferes less than some other difficulties? Is the problem so great that we need to consider adaptive equipment to minimize the motor demands associated with play and school?

III. B. How well is the child able to reach?

Reaching is easy to observe in the context of TPBA. Children reach virtually every time they attempt to acquire any object. The most relevant factors seem to be accuracy and directness of movements. Good postural support for reach also is critical. Can the child reach with both arms simultaneously? When only one arm is required, can he or she use either arm equally well? How accurate is he or she at getting the hands precisely to the place where the object is located? Is he or she apt to knock into the object? Is the reaching direct or characterized by extraneous movements? As the hand approaches the object, is the palm facing it? Does the child's posture support reaching?

III. C. How effective is the child's grasp?

Grasp also is easy to observe, as it occurs every time a child picks up an object. If children have access to objects of numerous sizes and shapes, then examiners should take the opportunity to observe the ways in which tasks affect grasp. Several factors are relevant. First, how is the forearm oriented? Are the fingers and palm pointing directly to the object? Where in the hand is the object captured? Is it held by the fingertips and thumb or by fingers against the palm? Which fingers are used: ring and little finger or index and middle finger? Is the thumb active? Does the hand appear flat or nicely arched? How does the size of object affect grasp? Can the child isolate the two sides of the hand? Can he or she hold more than one object in his or her hand at a time? Observe how much external stability is required. Can the child pick up objects without having to rest the hand on the table? How does the size of the object affect the need for external stability? Finally, observe the quality of grasp. Does it appear easy and efficient?

III. D. How well does the child release objects?

Every time a child places an object, throws it, or drops it into a container, the team can observe release. If the child has access to objects of varying sizes and shapes, and the circumstances of release vary, examiners will have the opportunity to observe how objects and tasks affect release. Probably the most important aspect of release is accuracy. That is, does the object land where it was intended to go? When release is well developed, the child will be able to release accurately and easily even as his arm moves (carry).

The size and shape of the target and whether it is moving or stationary also will have a marked effect on release. The child's ability to grade the opening of the hand so that it is in proportion with the size of the object also will affect accuracy. In very young or relatively unskilled children, the team should be particularly concerned with the degree to which release is voluntary. Can the child release without using one hand to pull the object out of the other? Without the need for an external surface (e.g., table top, mouth, body part)? Without flinging it?

III. E. How well does the child isolate finger movements for pointing, poking, and tapping?

Pointing and poking appear similar but have completely different purposes and therefore will be seen under very different circumstances. Children point when they want to show something to another person or request something. They poke for the purpose of positioning small objects so that they can be grasped easily or to explore small spaces. The team should observe whether children are able to separate the index finger from the others to poke and point. Are the remaining fingers folded out of the way? Do the actions appear easy and smooth?

The ability to isolate all of the fingers for tasks such as keyboarding develops only with instruction and practice. It is not apt to be developed until at least 10 years of age.

III. F. How effective is the child's in-hand manipulation?

In-hand manipulations occur when children need to reposition objects that have been grasped so that they can be used. Pencils, crayons, and pegs are particularly good for eliciting certain in-hand manipulations spontaneously. Depositing coins into a bank or other small objects into containers with small openings also provides opportunities to see spontaneous in-hand manipulation. For very young children, a cookie or cracker placed in the palm may provide adequate reason to perform an in-hand manipulation. When children are successful with in-hand manipulation, they reposition the object by using the fingers and thumb of one hand without using an external surface (e.g., the other hand, the mouth, table top). During TPBA, team members should focus on which in-hand manipulations the child uses spontaneously. If a member wants to see one in-hand manipulation in particular, make sure that the play activity demands it. Try not to disrupt the play session unnecessarily by asking the child to perform these difficult actions without good reason. In-hand manipulations are difficult and children may choose not to perform them even when they are capable of doing so. Thus, verbal requests, and even demonstration, may be necessary in some cases.

III. G. How good are the child's constructional abilities?

Activities that involve construction and tool use are favorites of many children and many children's toys promote them. Examiners are, of course, interested in the quality of the finished construction (e.g., is it well organized; if it is copied, how well does it match the model) as well as the arm and hand skills described above. However, in addition to sensory and motor skills, construction and tool use also depend on cognition. Thus, Observation Guidelines related to cognition also are relevant (see Chapter 7).

III. H. How effectively does the child use tools?

When observing constructional abilities, the team members should be interested in how effectively and efficiently children are able to use the materials. How easy is construction, and does the child seem to find constructional tasks enjoyable? Because construction is the basis for many common play and school activities, ease and enjoyment are very important.

Devon is a bright, mischievous 6-year-old boy with a diagnosis of athetoid cerebral palsy. He is integrated into the first grade class in his home school where he uses a number of strategies for expressing what he has learned (e.g., pointing and an electronic communication device). He has several good friends in the class. Despite his limited verbal ability, Devon and his friends have devised a number of activities that they enjoy doing together. The impetus for Devon's TPBA was, in part, based on his family's concerns about Devon's arm and hand use. Whereas most children interact with objects and communicate by using their arms and hands, Devon's arm use is characterized by involuntary movements and very delayed skills for grasp and release. His family is beginning to wonder whether Devon will ever use his hands in a functional way. They do not want his creative abilities to be hindered unnecessarily by his poor upper extremity use. They are wondering whether they should begin to focus on use of the computer and other devices rather than on developing better arm use.

During TPBA, Devon chose to play with action figures. However, when he reached for them, his movements were erratic and characterized by involuntary rotary movements. He could not aim his hand directly at a figure. However, Devon was very determined to play with the figures and his motions became gradually more refined until his hand landed on the toy. Devon's parents reported that this reaching is typical of his approach to any toy with which he is highly motivated to play.

Excerpted from Transdisciplinary Play-Based Assessment, Second Edition
by Toni Linder, Ed.D.

When Devon contacted the action figure, his hand was oriented thumb down. Although that meant that he could grasp the figure between his thumb and forefinger, his fingertips were not involved and he could not rotate his forearm so that he could see it. Thus, although he captured the figure, he could not really use it, nor could he control the force with which he grasped it. Again, Devon's parents reported that this was typical of his grasp of similar objects.

Following the assessment, the team thought carefully about intervention. They reasoned that Devon was unlikely to develop refined grasp, release, or in-hand manipulation and that his cognitive and creative abilities far outstripped his hand skills. Thus, they felt that intervention would more effectively work toward other means for expressing himself and "manipulating" objects (e.g., virtual reality). However, given the great pleasure Devon got from manipulating his action figures, they also agreed to continue work on reach and gross grasp to support his preferences for play.

IV. Motor Planning and Coordination

Accomplishing a task involves more than simply executing it. At the very least, it also requires an idea of what to do and a plan for carrying it out. The idea is a major determinant of what actions look like. Motor planning allows the actions to happen in a well-coordinated manner. Planning is especially important in tasks that a child has not mastered. Poor motor planning manifests as poor coordination and shows up in a number of different ways (Case-Smith & Weintraub, 2002; Rodger et al., 2003; Smits-Engelsman, Wilson, Westenberg, & Duysens, 2003). For example, children with poor motor planning frequently have difficulty using the two sides of the body together in a well-coordinated fashion, and they may also have postural difficulties (Geuze, 2003; Johnston, Burns, Brauer, & Richardson, 2002; Wann, Mon-Williams, & Rushton, 1998).

IV. A. Does the child have good ideas for using toys?

Children who have good ideas are easy to spot. They often lead the play, even at a very young age, turning clothes poles into swords and an old shoe into a Thanksgiving turkey. In creating the idea, children "size up" toys and situations and envision what they can *do*; thus, the tie with motor planning. The idea often comes from past experience in the same or a similar situation. Having an idea is dependent, in large part, on cognitive ability and memory. When children have difficulty formulating an idea, they may have difficulty learning how to use new toys or recognizing similarities among toys or objects (Cermak & Larkin, 2002; Keogh & Sugden, 1985; Reeves & Cermak, 2002; Sugden & Keogh, 1990; Williams, 1983).

IV. B. How well does the child initiate, terminate, and sequence actions?

Children with poor motor planning may have difficulty initiating actions, seen as false starts. Terminating actions may be equally problematic, as a child may knock over a milk carton or run into a classmate or the wall. Problems with changing direction when running or even writing letters on lined paper may be related.

Difficulty with sequencing actions is a major characteristic of planning difficulties (Cermak & Larkin, 2002; Reeves & Cermak, 2002). Some children have difficulty even with simple action sequences, such as moving around the corner of a jungle gym.

Performing smooth sequences of repetitive actions also can be particularly difficult for children with poor motor planning. For example, they may turn the wheel on the

Sit 'n Spin once or twice but lose the rhythm quickly. Similarly, they may hop a few times in a relatively coordinated fashion but be unable to continue all the way across the "pond" (floor). The more structure the task imposes, the harder it is. Hopping from one "lily pad" (Hula Hoop) to another may require numerous pauses to reorient the body, especially if the lily pads are not arranged in a straight line (Reeves & Cermak, 2002).

In addition to sequencing actions, children with motor planning difficulties also are likely to have difficulty sequencing tasks. For example, intending to take a toy outside, a child may fail to pick it up from its resting place beside the door hinge *before* opening the door, making the toy inaccessible.

IV. C. How good are the child's spatial and temporal abilities?

Difficulty with meeting the spatial and temporal demands of motor tasks is another major characteristic of poor motor planning. Spatiotemporal demands are in direct proportion to the movement of the child, the size of the target, and the target's relative movement in the environment (Keogh & Sugden, 1985; Sugden & Keogh, 1990).

Demands are minimized when a relatively still child acts on a large, stable object. For example, the spatiotemporal demand for a child sitting on the floor and rolling a ball toward a wall is not very great. However, demands are increased when the child must catch a ball. They change only a little when the child catches a beach ball thrown directly at her but quite a bit more when she must run to intercept a softball thrown to right field (Keogh & Sugden, 1985; Sugden & Keogh, 1990).

Children who have poor motor planning often have difficulty catching or kicking a ball. They fail to move the hands or foot to the proper location in time to intercept it. Consequently, they may trap the ball against the body in order to "catch" it or stop it before kicking. From a spatiotemporal perspective, riding a bicycle is a reasonably difficult task. Whereas propelling the bike is easy, avoiding obstacles is much harder. The faster the child is riding, the greater the spatiotemporal demand. Environmental conditions like rain or wind gusts only add to the difficulty as they make the task less predictable (Ayres, 1985; Keogh & Sugden, 1985; Reeves & Cermak, 2002; Sugden & Keogh, 1990; Williams, 1983).

IV. D. Does the child seem to have a good sense of the body? Of objects as an extension of the body?

Many children who have poor motor planning lack an innate understanding of the relationships among their body parts and the precise location of their bodies in space (i.e., body scheme). They may position themselves poorly on furniture or equipment, resulting in awkward or unsafe actions. They often appear to be "fighting," rather than working with, play objects and equipment. Furthermore, they may not adjust the size of the body effectively and efficiently when moving into small spaces, especially when carrying objects. Either they fail to arrange body parts so that they are "small enough" to fit or they "shrink" the body excessively, expending more energy than necessary (Reeves & Cermak, 2002).

IV. E. How well does the child organize clothing and personal space?

Perhaps reflecting their poor body scheme, children with motor planning difficulties often appear disheveled and their clothing awry. Their apparent disorganization of self also may extend to the play space (Ayres, 1972, 1985; Cermak & Larkin, 2002; Reeves & Cermak, 2002).

IV. F. Does the child generate appropriate force?

Generating the proper amount of force needed for a task provides a barrier for many children with poor motor planning. Frequently, they generate too much force, performing actions too hard or too fast. Exaggerated force results in broken toys and implements; it also leads to fatigue. In contrast, some children with motor planning difficulties fail to generate enough force to perform tasks successfully. They appear weak; their drawings or writing may be illegible (Ayres, 1972, 1985; Reeves & Cermak, 2002).

IV. G. Does the child perform actions in response to verbal request or demonstration?

The ability to perform motor tasks in response to a verbal request or modeling also reflects planning. However, in addition to or instead of the problems described above, those children may have language- or vision-based difficulties (Cermak & Larkin, 2002; Reeves & Cermak, 2002).

USING THE OBSERVATION GUIDELINES TO ASSESS MOTOR PLANNING AND COORDINATION

Motor planning occurs in the context of skilled activity that children have not yet mastered; it occurs in many play situations. Motor planning has many facets and children can be relatively better at some than at others. As with all abilities represented in TPBA, the team should try to observe motor planning as unobtrusively as possible.

When motor planning is good, actions appear smooth and well coordinated; they easily meet the demands of the task. When such is not the case and there is no other obvious reason, motor planning may be a problem. Poor motor planning results in poor coordination and delayed skill development. However, motor planning difficulties can be subtle. Thus, their assessment may require a skilled observer, such as an occupational or physical therapist, who is knowledgeable about what motor skills children have at particular ages and how well they are expected to perform those skills. Children with poor motor planning often have low muscle tone and poor posture; those Observation Guidelines also may be useful, as are those pertaining to gross motor ability and arm and hand use.

Assessing planning is a special challenge with young children and children who have cognitive limitations. Even though children may be unable to make their bodies do what they want them to do, their motor planning is not abnormal unless their problems are greater than those that can be accounted for by age or cognitive limitation (e.g., cerebral palsy) (Cermak & Larkin, 2002).

IV. A. Does the child have good ideas for using toys?

Having an idea is one important aspect of planning. Like all facets of planning, we see ideation most clearly when children encounter unfamiliar objects. If the team members only observe a child playing with his or her favorite toys, they may be simply observing well-learned actions or a script, perhaps borrowed from television, video, or another person. The teams should find out whether children have good ideas for using novel toys and whether they capitalize on features of the environment.

Similarly, children's ideational abilities are best seen when *they* lead the play. When examiners always suggest the next task or determine exactly how tasks will be done, children have little opportunity to demonstrate their ideational abilities. Ideation draws heavily on cognition. Thus, Chapter 7 also provides related Observation Guidelines.

IV. B. How well does the child initiate, terminate, and sequence actions?

Sequencing also is difficult for children with poor motor planning. We observe whether children perform actions in a logical sequence. Sequencing in this context refers to sequences *within* a movement (e.g., shifting weight *before* attempting to move around the corner on the jungle gym). It is closely related to timing, because the sequence of actions must be completed with precise time. For example, logical sequencing allows a child to get her hands to the place where she needs them to be when the ball arrives.

Children with poor motor planning often find it difficult to maintain a rhythm. Perhaps that is, in part, because of the sequential nature of rhythmic actions. Observe whether they can hop or clap repeatedly and rhythmically. Can they propel a scooter board or a Sit 'n Spin for several seconds? Can they keep time to music?

IV. C. How good are the child's spatial and temporal abilities?

The team should be particularly interested in children's abilities to meet the spatial and temporal demands of a task. How precisely do they move hands, feet, and the whole body? Do they initiate and terminate actions easily? Does the hand or foot make contact optimally with objects, or does the child frequently knock things over or make contact awkwardly?

Children who have poor motor planning invariably have difficulty with timing especially in the context of anticipatory actions. For example, a very young child or a child with poor motor planning may begin to extend his arms to catch a ball when the ball is at the optimal point for catching. By the time his hands get to that point, the ball will have moved beyond it. Likely, the ball will hit him in the chest and he will trap it there.

The team should look at several varieties of anticipatory actions, including those that involve the child moving as well as the target moving. Tasks that involve both target and child moving are the most difficult; the faster either moves, the harder the task. Can children intercept stationary objects when moving (e.g., kick a ball)? Can they intercept a moving object when standing still? When walking or running? Many anticipatory tasks are performed with both hands or both feet. Thus, the Observation Guidelines for bilateral coordination found in the gross motor activity section (II. E) also are relevant here.

IV. D. Does the child seem to have a good sense of the body? Does the child seem to have a sense of objects as an extension of the body?

Planning how to carry out an action seems to depend on a sense of where the body is in space (i.e., body scheme). *Body scheme* is an abstract idea and not directly observable. Rather, the team should observe behaviors that suggest how good it might be. Do children use objects with ease? That is, do they work with objects or does it appear as though they are fighting them? Do they position themselves in the middle of chairs or riding toys? Or do they always look precarious or awkward? Can they move easily into, out of, and around in small spaces (e.g., tunnel, climber)?

IV. E. How well does the child organize clothing and personal space?

Although the relationship to motor planning is not clear, children who have poor planning often are surrounded by disorganization. Their clothes appear disheveled; buttons may not be aligned with the proper buttonholes and shirt tails may be chronically untucked. The space where they play is chaotic, as are their closets and desk space. Of course, there are many reasons beyond those associated with motor planning for disorganization; cognition and emotional-social factors certainly play a role.

IV. F. Does the child generate appropriate force?

Likely related to poor body scheme, children with poor motor planning often have difficulty generating the proper force for an action. For example, they may stomp around the room, sounding more like an elephant than a child. They may break toys because they use too much force. Their knuckles may turn white from exertion when gripping a pencil. No wonder they tire easily! Conversely, they may use so little force that actions are ineffective. Their drawings and writing may be illegible because they are so faint. They may be unable to push a chair across the floor or pull on a turtleneck.

IV. G. Does the child perform actions in response to verbal request or demonstration?

Movement in response to a command or a model also requires motor planning. Like ideation, such actions are dependent on cognition. Thus, the Observation Guidelines in Chapter 7, again, are relevant. We pay close attention to whether imitation or verbal commands are easier. Although games such as Simon Says or Red Light, Green Light may be a good way to observe motor planning, asking children to imitate an action or move in a particular way can be very disruptive to play.

Five-year-old Andrew came for TPBA just before starting school. His preschool teacher had been worried about him for some time, but his parents, Ralph and Jill, believed he was simply immature. Andrew's pediatrician concurred until he watched Andrew really *struggle to undress for an examination. Following his observations and further discussion with Jill, the physician recommended evaluation in a local outpatient facility.*

Andrew chose to ride a scooter board during his evaluation. He was positioned on his stomach, pretending to make his "magic carpet" fly. Andrew had some difficulty getting on the scooter independently. He tended to place his body more to the right of the scooter. However, he seemed unaware of the problem until the scooter tipped. Even then, he did not realize that his positioning had caused the problem, and his play partner had to reposition him. When Andrew propelled his scooter all the way across the room, his play partner asked him if he could turn the scooter around and go the other way. Andrew got off of the scooter, turned it around, and got back on facing the direction he had been going initially. Even when he approached the wall, he seemed confused by what had happened. He and his play partner joked that she had "tricked him."

When Andrew played at a table laid out with art materials, his fine motor difficulties became evident. He "white knuckled" the kindergarten pencil and erased so hard that he put a hole in the paper. He tried to cut out some squares of colored paper to make a collage but resorted to tearing the paper instead. He had trouble separating his index finger to spread the paste on the paper. After 10 minutes, paper and paste were everywhere but where they were supposed to be.

The team translated Andrew's difficulties as reflecting poor motor planning. In fact, when they discussed their observations, they noted that most areas in the sensorimotor domain had several items that reflected concern. In contrast, their observations in the emotional-social, cognitive, and language domains were primarily listed as strengths. Putting all the pieces together, Ralph and Jill suddenly had a whole new perspective on many of Andrew's behaviors. The team developed goals for helping prepare Andrew for school. They were able to develop strategies for meeting those goals that utilized Andrew's many strengths and addressed his limitations.

V. Modulation of Sensation and Its Relationship to Emotion, Activity Level, and Attention

Sensory modulation refers to the ability to process and respond to sensation in a manner that is consistent with the level of the sensation present in the activity and the environment (Lane, 2002). Neural modulation of sensation is thought to be tied to emotion, arousal, and activity level. Although the links are primarily theoretical or statistical, new research is helping to identify the physiological (sympathetic nervous system) underpinnings of sensory modulation deficits (Mangeot et al., 2001; McIntosh, Miller, & Hagerman, 1999; Schaaf, Miller, Seawell, & O'Keefe, 2003). When children have good abilities to modulate, their responses to sensations generated by caregivers, playmates, and within the play space (e.g., touch, noise) do not seem unusual or unexpected. Their easy interpretation of incoming sensation contributes to adaptive interactions with objects and people. Thus, sensory modulation is critical to children's engagement in play and other daily life activities (Lane, 2002).

V. A. How well can the child regulate responses to sensory experiences? What effect do sensory experiences have on the child's emotional responses?

Dunn (1999) described children who have difficulty with sensory modulation as having thresholds that are either higher or lower than those of most children. In Dunn's conceptualization, children who have a high threshold to sensation need a great deal of input before they will respond, whereas those with a low threshold need very little. However, children who have altered thresholds do not necessarily act in accordance with them. That is, children with high thresholds *may* underreact to sensation but they also may appear to *seek* it, as though acting counter to the natural tendency of their nervous systems, perhaps in an attempt to help the central nervous system to modulate. Many responses to poor sensory modulation take the form of emotional responses (Cohn, Miller, & Tickle-Degnen, 2000; Lane, 2002; Mangeot et al., 2001; McIntosh et al., 1999; Schaaf et al., 2003).

When children with high thresholds are in situations where little sensation is available, their behavior is likely to become more pronounced. That is, those who are acting as expected given their high thresholds will appear quieter and more withdrawn, whereas children acting counter to expectation will seek sensation more actively. Conversely, situations with high levels of sensation are apt to be easier for any child with a high threshold. Children who usually appear quiet and withdrawn may appear to wake up, whereas those who typically seek sensation may appear calmer. (See the example of Peta, p. 33.)

Similarly, children with *low thresholds* may appear overly sensitive or, if they are acting counter to expectations, they may avoid sensation and become overly rigid in their behavior. Many children with attention-deficit/hyperactivity disorder fit the former description, whereas the latter applies to many children with autism. When children with low thresholds are in situations with a lot of sensation, their behavior is apt to become more pronounced, with those acting as expected becoming increasingly sensitive, perhaps reacting with fight or flight, and those acting counter becoming more withdrawn and rigid acting. In contrast, situations with minimal sensation will be easier for both groups with lowered thresholds. Children who typically act in accord with their thresholds are likely to appear calmer and those who generally act counter to their thresholds may become more accepting and less rigid (Dunn, 1999).

Put another way, Dunn (1999) described four groups of children; two who *appear* overly active and two who appear relatively inactive, but for very different reasons. One overly active group and one underactive group is behaving in the way that would be expected given their central nervous systems' reaction to sensory information; the other two groups are acting in unexpected ways.

One overly active group has a lower threshold to sensation; that is, children in that group are overly sensitive to sensation. Those children tend to run around, theoretically because they have failed to modulate incoming sensation and their arousal levels are quite high. We would expect those children to respond very emotionally to certain types of sensation. The second group that *appears* overly active actually has a *high* threshold. They also have failed to modulate incoming sensation but their arousal levels would be quite low if they did *not* run around seeking sensation. We might expect them to act as though they are very excited (Dunn, 1999).

The explanation for the less active group is similar to that proposed above. Some of those children have a high threshold to sensation. They appear not to notice or register sensation. As expected, their arousal levels are likely to be low and they appear uninterested, withdrawn, and overly tired. Other children actually have low thresholds; they are avoiding sensation to keep themselves under control, and they may appear rigid and resistant to change (Dunn, 1999). Some physiological support exists for this latter group (McIntosh et al., 1999).

V. B. What effect do sensory experiences have on the child's activity level?

If the observations and speculations of Dunn (1999) and others (Cohn et al., 2000; DeGangi, 2000; Lane, 2002; Mangeot et al., 2001; McIntosh et al., 1999; Schaaf et al., 2003) are correct, then clearly there is a relationship between modulation and arousal. In turn, activity levels, attention, and emotional responses appear to be related to level of arousal. However, as we noted earlier, those relationships may be very complex.

Children who do not modulate well may have increased or decreased levels of arousal. Generally, thresholds for sensory reception are inversely related to arousal levels, but emotional reactions are congruent with arousal. That is, children with lowered sensory thresholds who overreact to sensation often also have increased arousal and are likely to respond very emotionally. Conversely, children with increased thresholds who require a lot of input before reacting are apt to have decreased arousal levels and to show little emotion (Dunn, 1999). However, both increased and decreased arousal levels may lead to either increased or decreased activity levels. These hypothesized relationships are shown graphically in Figure 2.1.

The relationships among modulation, arousal, and activity level are not purely linear. That is, arousal levels likely affect sensory thresholds and level of activity probably influences arousal. These hypothesized relationships also are shown graphically in Figure 2.1.

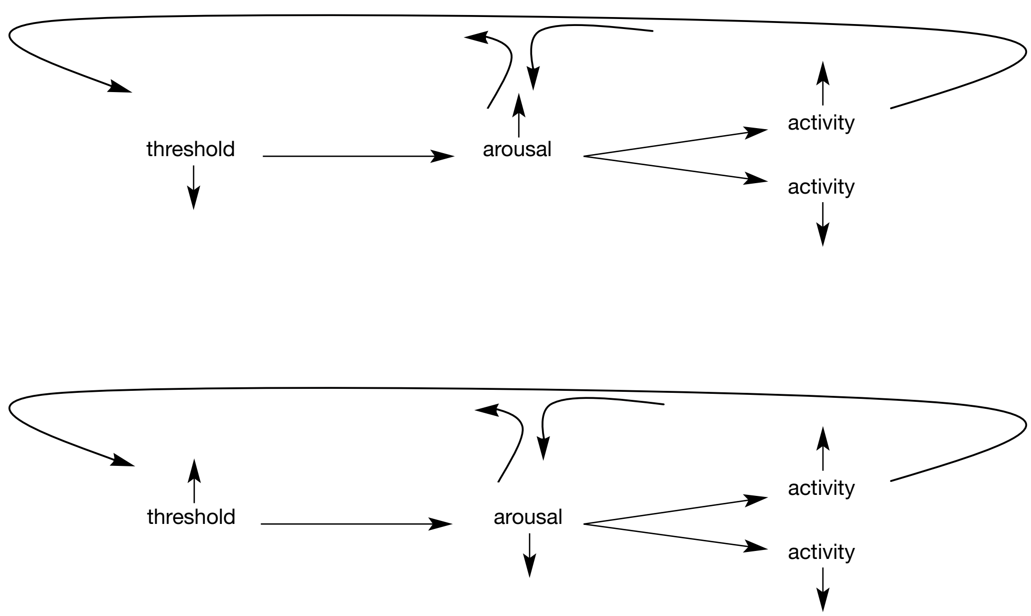

Figure 2.1. Hypothesized relationships among modulation (thresholds), arousal, and activity level.

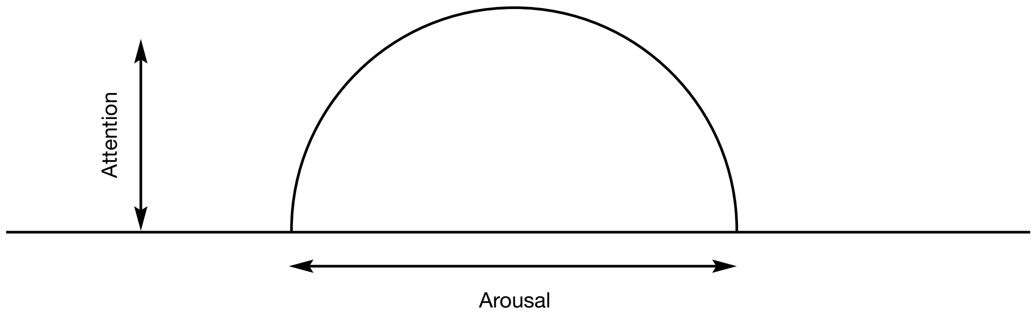

Figure 2.2. Hypothesized relationship of attention to arousal (*Source:* Hebb, 1949, 1955).

V. C. What effect do sensory experiences have on the child's attention?

Children's abilities to attend also are related to modulation and arousal, although as mentioned previously, that relationship is neither simple nor linear. Hebb (1949, 1955) and later Kerr (1990) described relationships between performance and arousal, which seem applicable here because attention is a necessary component of performance and seems likely to covary with it. Hebb (1949, 1955) described this relationship as an inverted U. When this is applied to attention, we would say that a certain amount of arousal is necessary for optimal attention but that too much arousal leads to a decreased ability to attend. This relationship is shown in Figure 2.2.

More recently, Kerr (1990) proposed a slightly more complex relationship between arousal and performance, believing that each individual's interpretation of optimal level of arousal would be unique. Thus, we may hypothesize that children's abilities to attend will covary with level of arousal but that children will differ with respect to the amount of arousal necessary to support optimal attention.

USING THE OBSERVATION GUIDELINES TO ASSESS MODULATION OF SENSATION AND ITS RELATIONSHIP TO EMOTION, ACTIVITY LEVEL, AND ATTENTION

The complexity of the relationships among modulation, arousal, and activity level make discrete observation of these phenomena difficult. However, in administering the sensorimotor section of TPBA, the team should focus on how sensory experiences and modulation seem to affect activity level, emotional reactions, and attention. We remember, however, that many factors can cause children to have abnormal emotional reactions, activity levels, and attention deficits; poor sensory modulation is only one of those factors. This same caution also applies to stereotypic or repetitive behaviors, which may be related to abnormal sensory processing but also may be a means for seeking attention, communicating, and attempting to avoid doing something (Durand & Crimmins, 1992). The Observation Guidelines associated with emotional and social development (see Chapter 4) also may provide particularly relevant information for interpreting these phenomena.

Sometimes during TPBA, children respond to sensation (e.g., light or unexpected touch; dirty hands; textures of food, clothing, or toys; movement, sounds, sights, tastes, or smells that would not bother others) in ways that are out of proportion to the experience (often too much) and nonproductive. (Although it is somewhat less common, some children's response may be unexpectedly little given the degree of activity in the environment.) Reactions that are out of proportion provide opportunities to experiment with types and quantities of sensation to try to help the child modulate. Watch carefully to see whether the reaction is in the expected direction. If a child had been overly active, emotionally reactive, or unable to focus attention, is she now a little more focused and less active or emotionally reactive and vice versa? If not, the child may be acting counter to her sensory thresholds or trying, unsuccessfully, to modulate for herself.

Team members are again reminded that discriminating between children who are acting in accord with, and those acting counter to, their sensory threshold levels can be a real challenge. Considering the possibility that a child's overt actions may be a mirror image of, rather than identical to, the child's sensory thresholds may shed light on the situation and open up possibilities for observation during TPBA assessment. Generally, it seems a good rule to begin with the assumption that children are acting in accord with threshold levels but to continually keep in mind that you may be wrong.

In general, slow repetitive movement (from rocking or gentle swinging), deep pressure (from being wrapped or lying underneath a heavy conforming surface), quiet sounds, and dim lights are calming, whereas their opposites are more stimulating (Koomar & Bundy, 2002). See Richter and Oetter (1990) for additional suggestions. Because sensation is very powerful, when altering it, teams should rely on a team member who is trained in sensory integration. Resistance to movement from jumping or moving heavy objects seems to be a particularly useful means for helping children to modulate. With resistance, children who are overly responsive and active will calm, but children who are underresponsive will perk up (Koomar & Bundy, 2002).

V. A. How well can the child regulate responses to sensory experiences? What effect do sensory experiences have on the child's emotional responses?

Poor modulation can be associated with either increased *or* decreased emotional reactivity. Overreaction seems more common and is certainly easier to see. Children who overreact easily become angry or upset in response to noise, touch, or other sensations that would not bother most people. In contrast, some children who are underreactive may appear inordinately "even-tempered."

V. B. What effect do sensory experiences have on the child's activity level?

As with emotional reactivity, poor sensory modulation may be associated with either increased or decreased activity. Activity level often parallels emotional reactivity. Thus, a pattern of both increased activity and emotional reactivity is common. Although decreased activity levels and emotional reactivity also may be seen, they may be less common and likely are less disruptive at home and school.

V. C. What effect do sensory experiences have on the child's attention?

Poor sensory modulation can contribute to difficulties maintaining an optimum level of arousal. In turn, less than optimal arousal may lead to difficulty with paying attention. Too little arousal tends to manifest as lethargy, whereas too much may result in anxiety. Both are accompanied by less than optimal attention. Thus, whether they over- or underreact to sensation, when children have difficulty modulating sensation, they are likely to have difficulty paying attention (Lane, 2002).

Eight-year-old Peta had a diagnosis of poor sensory modulation. Her story was typical. Her mother, Ruth, complained that Peta had only one outfit that she was willing to wear to school. Ruth found this behavior particularly troubling as she feared that Peta's teacher would think that her family could only afford one set of clothes. To keep Peta looking presentable, her mother washed Peta's clothes nightly. Although Peta's history *suggested that she was defensive to touch (i.e., overreacting; seemingly lowered threshold), her play partner suspected that, in general, Peta's threshold for sensory experiences actually was very high (i.e., tendency to underreact), because Peta was unusually quiet and undemanding. She seemed to lack any enthusiasm for messy play with shaving cream or jumping into a big vat filled with small plastic balls, activities that brought her peers great joy.*

Peta's play partner, a therapist with considerable training in sensory integration, devised some experiences to provide Peta with intense movement, including roughhousing and swinging rapidly. Peta immediately perked up and became more animated; she laughed and became much more engaged in the game and with her play partner. Although Peta's mother feared that Peta would become overstimulated, that never happened. In fact, after the evaluation finished, Peta settled into a corner with the book she had brought, waiting contentedly for her parents.

Peta had originally come for TPBA because of her mother's concerns over Peta's reactions to clothing and her parents' and teacher's complaints about her distractibility and inattentiveness. Reportedly, her father had many of the same issues and neither parent wanted Peta to experience what her father had gone through. Because Peta's play partner was very skilled at helping Peta to modulate sensation, the team, including her parents, saw a side of Peta that they would not have otherwise seen. This is particularly true because Peta's mother had grown up in a large and chaotic family. She valued calm and quiet and carefully monitored the activity levels of her two children. Suddenly Peta's distractibility took on new meaning and the team was able to devise successful strategies for helping her attend to, as well as for decreasing her negative reactions to, clothing. Prior to sitting down to do focused tasks, Peta engaged in active play (e.g., jumping, running). She often chewed gum while reading or drawing. Peta's family also found CDs of peppy music that seemed to help her stay on task. She used headphones when the music might disturb others.

VI. Sensorimotor Contributions to Daily Life and Self-Care

Every day, children use sensorimotor skills to perform a myriad of tasks and activities at home, in day care, at preschool, in school, at the park, at a friend's house, or wherever they find themselves. However, we are at risk for losing something very special if we dissect the tasks associated with play, or dressing, or any childhood occupation to the level of contributing skills. As usual, the sum is greater than the parts. Nonetheless, daily life activity *reflects* children's skills and it is in this spirit that TPBA has been created. There probably is no finer window on all aspects of childhood than play.

The sensorimotor domain of TPBA provides an in-depth look at one kind of skill that contributes to daily life activity. Because it is conducted primarily while children play, TPBA will not show us all the skills that children possess or all the activities they can accomplish. Rather, it provides a glimpse at the skills children *use* when they engage in the occupation they enjoy most—play. TPBA also involves a snack. Thus, it provides an opportunity to see skills associated with some aspects of eating. There also may be opportunities to observe some dressing tasks as children often wear outdoor clothing that can be removed. Furthermore, some children like to play barefoot, and removing socks and shoes can be a natural part of the assessment.

In the Age Table (see p. 51) that accompanies this chapter, we have offered milestones associated with a selection of play and daily life activities. The list is not meant to be exhaustive because the purpose of TPBA is to observe skills in the context of play and a snack, not to see children perform every daily life task appropriate to their age. Thus, it is not necessary to seek information on all the milestones provided. Furthermore, when particular daily life tasks are of concern to children and families, it may be necessary to seek more in-depth information about those tasks than will be gained in the course of TPBA.

We also remember that, although daily life activities have been described under the sensorimotor domain, accomplishing these activities requires skills from all the domains. If a child cannot perform one or more of these tasks, then we examine contributing skills from across all the domains to see if we can uncover the reasons. We also must consider the contribution of the environment and the tasks, because these are equally important in determining children's success in meeting the challenges of daily life.

VI. A. How well does the child eat a simple snack?

Snack time presents opportunities to observe in three interrelated areas. These include oral motor, self-feeding, and behavior.

Oral-motor skills are the first of these to appear. Although many skills are not fully mature until age 2 (or older), a great deal happens in the first year. Two functions are particularly relevant: 1) coordination of sucking, swallowing, and breathing; and 2) biting and chewing (Case-Smith & Humphry, 2001; Klein & Morris, 1999; Morris & Klein, 1987).

Coordinating breathing with sucking and swallowing depends on the control of jaw, tongue, and lip movements. This control, in turn, depends on the type of food and the child's position (Case-Smith & Humphry, 2001).

Many typically developing children are first introduced to a cup with a spout at about 6 months of age. Over the next 6 months, they will gradually develop increased lip and jaw control and transition to exclusive use of the cup for meals. However, they will be about 2 years of age before they can efficiently drink from a cup by providing a seal with the lips, not the teeth, while their tongue tip is elevated when swallowing (Case-Smith & Humphry, 2001; Klein & Morris, 1999; Morris & Klein, 1987).

Biting and chewing begin at 4–5 months of age as an up–down movement of the teeth accompanied by rhythmical extension and retraction of the tongue; these work fairly well for pureed or soft food. Slowly, lateral movements of both jaw and tongue emerge. At 9 months, children can transfer food from the center of the tongue to either side for chewing. Increasing stability of the jaw and mobility of the tongue and lips mean that by 1 year of age children have a sustained and graded bite, can lick their lips, and can retrieve food from the lower lip by drawing it inward. By 2 years of age, children have circular rotary jaw movements and can eat most meats and raw vegetables (Case-Smith & Humphry, 2001; Klein & Morris, 1999; Morris & Klein, 1987).

For self-feeders, most snacks offered during TPBA will involve finger feeding and drinking from a cup. If utensil use is a particular concern, team members should incorporate a snack that requires a spoon (a fork and even a knife also may be relevant).

Children begin to develop the ability to drink independently from a cup and feed themselves finger food during the second half of the first year. By the time they are 1 year old, they can feed themselves part of a meal and drink from a spout cup (Haley, Coster, Ludlow, Haltiwanger, & Andrellos, 1992). By 1½ years they can drink well from an open cup, but they may drop the cup. Before 2, they can hold the cup well, lift, drink, and replace (Coley, 1978). By 3, the basic components of using a spoon are intact (Henderson, 1995). However, most children cannot eat soup with a spoon until they are between 4 and 6 years of age (Coley, 1978).

Drawing from old but apt sources (e.g., Gesell & Ilg, 1946; Hurlock, 1956), Henderson (1995) eloquently summarized the development of self-feeding behavior as a combination of acquiring skill and learning to conform to cultural standards.

Henderson indicated that children are 3 or 4 before they can eat and talk at the same time. They are almost 10 before they are entirely independent, using a knife and fork deftly and paying good attention to table manners!

VI. B. How well does the child perform simple dressing tasks?

As with self-feeding, the development of dressing and undressing depends on hand skills as well as postural stability. Although a child can pull off socks easily with a fisted hand, putting them back on requires strength and bilateral coordination. Undressing is easier than dressing and most children can remove all but pullover garments, and possibly shoes, by the time they are 2 (Henderson, 1995).

Most children are able to dress completely (with the exception of fasteners) by the time they are 5½ (Key, 1936, cited in Henderson, 1995). The most rapid period of learning dressing skills seems to begin at about age 1½. Most dressing requires finger dexterity and planning sequences, and these skills are not all mastered until about 6½ years of age (Henderson, 1995). Separating zippers, back buttons, and shoelaces are the last of the common fasteners to be mastered.

In addition to motor skills, cognition and motivation play enormous roles in the development of dressing skills. Experience also plays an important part.

USING THE OBSERVATION GUIDELINES TO ASSESS SENSORIMOTOR CONTRIBUTIONS TO DAILY LIFE AND SELF-CARE

Self-care represents a set of complex tasks that develops over time; it includes eating, dressing, toothbrushing, hair combing, blowing the nose, and many more tasks. As with play, self-care involves and requires much more than simply motor skills. Cognition, behavior, language, and emotions all come into play. Snack is a part of TPBA; thus, the team always has a chance to observe feeding and eating. Similarly, children commonly take off and put on at least one piece of clothing during the assessment (e.g., shoes and socks, jacket), providing opportunities to observe simple dressing skills. The team will need to learn about the child's performance on other self-care tasks through interview of the parents.

VI. A. How well does the child eat a simple snack?

Snack time provides an opportunity to see sensorimotor, cognitive, and emotional-social skills in action. The team should observe oral-motor skills, self-feeding ability, food likes and dislikes, and table manners. If the child is unable to do what is expected, then the task is to determine what seems to be interfering.

Oral-motor skills are the most basic observations made during snack time. The team wants to know first if the child is safe and then if the child's skills are adequate for handling all types of food. Different types of food, ranging from semisolids to hard substances that fracture when a piece is bitten off to highly resistant substances, present different challenges to a child's oral-motor skills. Of course, it is not practical to serve all types of food at snack time. Thus, if team members question a child's ability, they may have to seek additional information from interview.

Having gotten the food into the mouth, the team is interested in how well the child chews and swallows and whether any food is lost. Watching the movement of the lower jaw provides some information about whether the child can use the tongue to move food side to side and chew in a rotary pattern or whether the movement is only up and down, which represents a less mature pattern.

If the child is a self-feeder, then the team will want to observe how well the child uses dishes and utensils to "capture" food and bring it to the mouth. Again, it may be impractical to include all utensils in snack time. The child's use of a glass or cup can be observed easily. If use of utensils is a particular question, then team members may want to arrange suitable snack food.

Regardless of whether the child is a self-feeder, the team will want to acquire information about how long it takes for the child to eat a meal, the child's food likes and dislikes, and table manners. Observation in all of these areas may need to be supplemented by interview. If the child has negative responses to foods, then the pattern of those responses may provide evidence for poor sensory modulation (e.g., a child who dislikes textures or resistive foods such as meat). If the child has an excessively narrow range of likes and dislikes or his or her table manners are poor, then the child may be difficult to include in family or school routines and celebrations.

VI. B. How well does the child perform simple dressing tasks?

As with snack time, putting on or taking off clothing provides an opportunity to see sensorimotor, cognitive, and emotional-social skills in action. Is the child able and willing to perform the skills expected at that age? How much assistance is required? How much time is required? Does the child refuse to dress? Are the amount of time and assistance acceptable in the circumstances? Does the child tolerate a wide variety of clothing? Are his or her likes and dislikes acceptable in the situation? (Some children are particularly fussy about the arrangement of their socks or the tags in their clothing. If their negative responses fit a pattern, then they may provide evidence for poor sensory modulation.) It's a bit of a problem to provide an example as self-care and play are really the culmination of lots of skills—not simply sensorimotor. All of the above examples illustrate how particular motor skills affect play in particular.

Clearly, not all aspects of play or other activities of daily living (ADL) can be observed as a part of TPBA. Although a great deal of information regarding these areas can be gained through parent interview, they are what children do every day. When children cannot perform an age-appropriate ADL independently, someone else must do it for them, thus placing an additional burden on caregivers. When children cannot play, they miss out on an important source of joy and learning. Thus, play and ADL are particularly important to the welfare of children and their caregivers. Children for whom these areas are of particular concern may need further evaluation.

CONCLUSION

In the sensorimotor domain of TPBA, we have examined six subcategories related to action. These are

1. Functions underlying movement
2. Gross motor activity
3. Arm and hand use
4. Motor planning and coordination
5. Modulation of sensation and its relationship to emotion, activity level, and attention
6. Sensorimotor contributions to daily life and self-care

The seventh subcategory of the sensorimotor domain is vision. This will be addressed in Chapter 3.

Functions underlying movement provide examiners with a look at children's posture, balance, and muscle tone. Gross motor activity refers to whole-body actions. We have recommended making a general qualitative assessment of children's abilities and then focusing on several important areas: the developmental positions in which children play and how independent they are in moving between those positions, locomotion, and bilateral abilities.

Sensorimotor actions form the basis for many important daily life events. Some contemporary philosophers have even argued that action is a critical part of cognition (Clark, 1997; Rowlands, 1999). Thus, knowledge of sensorimotor abilities forms a crucial basis for intervention with many children.

In Chapter 3, Tanni L. Anthony expands the sensorimotor domain to incorporate vision, providing the Observation Guidelines for this subcategory. As most professionals have received little, if any, training in vision development, and vision specialists may not be included on assessment teams unless requested, it is important for all professionals to become more adept at observation of visual skills and visual-motor abilities.

REFERENCES

Alexander, R., Boehme, R., & Cupps, B. (1993). *Normal development of functional motor skills: The first year of life.* Tucson, AZ: Therapy Skill Builders.

Aylward, G.P. (1995). *Bayley Infant Neurodevelopmental Screener–Manual.* San Antonio: Harcourt Assessment.

Ayres, A.J. (1972). *Sensory integration and learning disorders.* Los Angeles: Western Psychological Services.

Ayres, A.J. (1985). *Developmental dyspraxia and adult onset apraxia.* Torrance, CA: Sensory Integration International.

Bly, L. (1994). *Motor skills acquisition in the first year.* Tucson, AZ: Therapy Skill Builders.

Bobath, B. (1985). *Abnormal postural reflex activity caused by brain lesions* (3rd ed.). London: Heinemann Physiotherapy.

Boehme, R. (1988). *Improving upper body control: An approach to assessment and treatment of tonal dysfunction.* Tucson, AZ: Therapy Skill Builders.

Bruininks, R.H. (1978). *Bruininks-Oseretsky test of motor proficiency: Examiner's manual.* Circle Pines, MN: American Guidance Service.

Burton, A.W., & Miller, D.E. (1998). *Movement skill assessment.* Champaign, IL: Human Kinetics.

Campbell, S.K., Vander Linden, D.W., & Palisano, R.J. (Eds.). (2000). *Physical therapy for children* (2nd ed.). Philadelphia: W.B. Saunders.

Caplan, F. (Ed.). (1973). *The first twelve months of life* (3rd ed.). New York: Perigee Books/Putnam.

Case-Smith, J. (1995). Grasp, release, and bimanual skills in the first two years of life. In A. Henderson & C. Pehoski (Eds.), *Hand function in the child: Foundations for remediation* (pp. 113–135). St. Louis: Mosby.

Case-Smith, J. (Ed.). (2001). *Occupational therapy for children* (4th ed.). St. Louis: Mosby.

Case-Smith, J., & Humphry, R. (2001). Feeding intervention. In J. Case-Smith (Ed.), *Occupational therapy for children* (4th ed., pp. 453–488). St. Louis: Mosby.

Case-Smith, J., & Weintraub, N. (2002). Hand function and developmental coordination disorder. In S.A. Cermak & D. Larkin (Eds.), *Developmental coordination disorder* (pp. 157–171). Albany, NY: Delmar.

Cermak, S.A., & Larkin, D. (2002). *Developmental coordination disorder.* Albany, NY: Delmar.

Clark, A. (1997). *Being there: Putting brain, body, and world together again.* Cambridge, MA: The MIT Press.

Clifford, J.M., & Bundy, A.C. (1989). Play preference and play performance in normal preschoolers and preschoolers with sensory integrative dysfunction. *Occupational Therapy Journal of Research, 9,* 202–217.

Cohn, E., Miller, L.J., & Tickle-Degnen, L. (2000). Parental hopes for therapy outcomes: Children with sensory modulation disorders. *American Journal of Occupational Therapy, 54,* 36–43.

Coley, I.L. (1978). *Pediatric assessment of self-care activities.* St. Louis: Mosby.

DeGangi, G. (2000). *Pediatric disorders of regulation in affect and behavior: A therapist's guide to assessment and treatment.* San Diego: Academic Press.

Dubowitz, V. (1980). The floppy infant (2nd ed.). *Clinics in Developmental Medicine Series: No. 76.* London: Mac Keith Press.

Dunn, W. (1999). *Sensory profile: User's manual.* San Antonio: Harcourt Assessment.

Durand, V.M., & Crimmins, D.B. (1992). *Motivation Assessment Scale.* Topeka, KS: Monaco & Associates.

Eliasson, A.-C. (1995). Sensorimotor integration of normal and impaired development of precision movement of the hand. In A. Henderson & C. Pehoski (Eds.), *Hand function in the child: Foundations for remediation* (pp. 40–54). St. Louis: Mosby.

Erhardt, R.P. (1992). Eye-hand coordination. In J. Case-Smith & C. Pehoski (Eds.), *Development of hand skills in the child* (pp. 13–27). Bethesda, MD: American Occupational Therapy Association.

Erhardt, R.P. (1994). *Developmental hand dysfunction: Theory, assessment, and treatment* (2nd ed.). Tucson, AZ: Therapy Skill Builders.

Exner, C.E. (1992). In-hand manipulation skills. In J. Case-Smith & C. Pehoski (Eds.), *Development of hand skills in the child* (pp. 35–46). Bethesda, MD: American Occupational Therapy Association.

Exner, C.E. (2001). Development of hand skills. In J. Case-Smith (Ed.), *Occupational therapy for children* (4th ed., pp. 289–328). St. Louis: Mosby.

Folio, M., & Fewell, R. (1983). *Peabody Development Motor Scales and Activity Cards.* Austin, TX: PRO-ED.

Geuze, R.H. (2003). Static balance and developmental coordination disorder. *Human Movement Science, 22,* 527–548.

Haley, S.M., Coster, W.L., Ludlow, L.H., Haltiwanger, J.T., & Andrellos, P.J. (1992). *Pediatric evaluation of disability inventory.* Boston: New England Medical Center Hospital, Inc. and PEDI Research Group.

Hebb, D.O. (1949). *The organization of behavior.* New York: John Wiley & Sons.

Hebb, D.O. (1955). Drives and the CNS (conceptual nervous system). *Psychological Review, 62,* 243–254.

Henderson, A. (1995). Self-care and hand skills. In A. Henderson & C. Pehoski (Eds.), *Hand function in the child: Foundations for remediation* (pp. 164–183). St. Louis: Mosby.

Henderson, A., & Pehoski, C. (Eds.). (1995). *Hand function in the child: Foundations for remediation.* St. Louis: Mosby.

Johnston, L.M., Burns, Y.R., Brauer, S.G., & Richardson, C.A. (2002). Differences in postural control and movement performance during goal directed reaching in children with developmental coordination disorder. *Human Movement Science, 21,* 583–601.

Keogh, J.F., & Sugden, D.A. (1985). *Movement skill development.* New York: Macmillan.

Kerr, J.H. (1990). Stress and sport: Reversal theory. In J.G. Jones & L. Hardy (Eds.), *Stress and performance in sport* (pp. 107–131). Chichester, England: Wiley.

Klein, M.D., & Morris, S.E. (1999). *Mealtime participation guide.* San Antonio: Therapy Skill Builders.

Koomar, J., & Bundy, A.C. (2002). Creating direct intervention from theory. In A.C. Bundy, S. Lane, & E. Murray (Eds.), *Sensory integration: Theory and practice* (pp. 261–309). Philadelphia: F.A. Davis.

Lane, S. (2002). Sensory modulation. In A.C. Bundy, S. Lane, & E. Murray (Eds.), *Sensory integration: Theory and practice* (pp. 101–122). Philadelphia: F.A. Davis.

Mangeot, S.D., Miller, L.J., McIntosh, D.N., McGrath-Clarke, J., Simon, J., & Hagerman, R.J. (2001). Sensory modulation dysfunction in children with attention-deficit-hyperactivity disorder. *Developmental Medicine and Child Neurology, 43,* 399–406.

McIntosh, D.N., Miller, L.J., & Hagerman, R.J. (1999). Sensory-modulation disruption, electrodermal responses, and functional behaviors. *Developmental Medicine and Child Neurology, 41,* 608–615.

Morris, S.E., & Klein, M.D. (1987). *Pre-feeding skills.* San Antonio: Therapy Skill Builders.

Nashner, L., Shumway-Cook, A., & Olin, O. (1983). Stance posture control in select groups of children with cerebral palsy: Deficits in sensory organization and muscular coordination. *Experimental Brain Research, 49,* 393–409.

Pehoski, C. (1995). Object manipulation in infants and children. In A. Henderson & C. Pehoski (Eds.), *Hand function in the child: Foundations for remediation* (pp. 136–153). St. Louis: Mosby.

Piper, M.C., & Darrah, J. (1994). *Motor assessment of the developing infant.* Philadelphia: W.B. Saunders.

Random House. (2000). Random House Webster's College Dictionary, 2nd revised and updated edition. New York: Author.

Reed, E.S. (1989). Changing theories of postural development. In M.H. Woollacott & A. Shumway-Cook (Eds.), *Development of posture and gait across the life span.* Columbia, SC: University of South Carolina Press.

Reeves, G.D., & Cermak, S.A. (2002). Disorders of praxis. In A. Bundy, S. Lane, & E. Murray (Eds.), *Sensory integration: Theory and practice* (2nd ed., pp. 71–100). Philadelphia: F.A. Davis.

Richter, E., & Oetter, P. (1990). Environmental matrices for sensory integrative treatment. In S. Merrill (Ed.), *Environment: Implications for occupational therapy practice, a sensory integrative perspective.* Rockville, MD: American Occupational Therapy Association.

Rodger, S., Ziviani, J., Watter, P., Ozanne, A., Woodyatt, G., & Springfield, E. (2003). Motor and functional skills of children with developmental coordination disorder: A pilot investigation of measurement issues. *Human Movement Science, 22,* 461–478.

Rösblad, B. (1995). Reaching and eye-hand coordination. In A. Henderson & C. Pehoski (Eds.), *Hand function in the child: Foundations for remediation* (pp. 81–92). St. Louis: Mosby.

Rowlands, M. (1999). *The body in mind: Understanding cognitive processes.* Cambridge, England: Cambridge University Press.

Schaaf, R.C., Miller, L.J., Seawell, D., & O'Keefe, S. (2003). Children with disturbances in sensory processing: A pilot study examining the role of the parasympathetic nervous system. *American Journal of Occupational Therapy, 57*(4), 442–449.

Seefeldt, V., & Haubenstricker, J. (1982). Patterns, phases, or stages: An analytical model for the study of developmental movement. In J.A.S. Kelso & J.E. Clark (Eds.), *The development of movement control and coordination* (pp. 309–318). Chichester, England: Wiley.

Shumway-Cook, A., & Woollacott, M.H. (2001). *Motor control: Theory and practical applications* (2nd ed.). Philadelphia: Lippincott Williams & Wilkins.

Smits-Engelsman, B.C.M., Wilson, P.H., Westenberg, Y., & Duysens, J. (2003). Fine motor deficiencies in children with developmental coordination disorder and learning disabilities: An underlying open-loop control deficit. *Human Movement Science, 22,* 495–513.

Stamer, M. (2000). *Posture and movement of the child with cerebral palsy.* San Antonio: Therapy Skill Builders.

Sugden, D.A., & Keogh, J.F. (1990). *Problems in movement skill development.* Columbia, SC: University of South Carolina Press.

Thelen, E. (1995). Motor development: A new synthesis. *American Psychologist, 50,* 79–95.

Thelen, E., & Smith, L.B. (1994). *A dynamic systems approach to the development of cognition and action.* Cambridge, MA: The MIT Press.

Wann, J.P., Mon-Williams, M., & Rushton, K. (1998). Postural control and coordination disorders: The swinging room revisited. *Human Movement Science, 17*(4–5), 491–514.

Weisz, S. (1938). Studies in equilibrium reaction. *Journal of Nervous and Mental Diseases, 88,* 150–162.

Williams, H.G. (1983). *Perceptual and motor development.* Englewood Cliffs, NJ: Prentice Hall.

Ziviani, J. (1995). The development of graphomotor skills. In A. Henderson & C. Pehoski (Eds.), *Hand function in the child: Foundations for remediation* (pp. 184–193). St. Louis: Mosby.