Sensorimotor Development and Assessment

Amy D. Gabel, Ph.D., NCSP
Adam Scheller, Ph.D., NCSP

Agenda

- Sensorimotor
  - Impact on learning and general development
  - Developmental Milestones
    - Vision, hearing, fine motor, gross motor, cognition
  - Sensorimotor assessment
  - Screening and comprehensive assessment examples
    - Bayley, DIAL, M-FUN, NEPSY-II

Sensorimotor Functions & Learning

- Most of what children learn and do requires coordination of multiple systems that mediate production of:
  - Speech
  - Smooth and efficient limb & whole body movements
  - Dexterous movements of hands and fingers

Sensorimotor Functions & Learning

- Certain subgroups of learning disabilities have:
  - Motor planning deficits and
  - Deficits in control and regulation of movement
  - Children with severe deficiencies in math abilities perform significantly worse on measures of tactile-perceptual abilities than children with reading/spelling deficiencies

Developmental Milestones - 3 months

- Movement
  - Supports upper body with arms when on stomach
  - Opens and shuts hands
  - Pushes down on legs when feet are on hard surface
  - Brings hands to mouth
  - Grasps and shakes toys
  - Swipes at dangling objects

American Academy of Pediatrics (http://www.healthychildren.org)
Developmental Milestones - 3 months

- Vision and hearing
  - Watches faces
  - Follows moving objects
  - Recognizes familiar objects and people
  - Starts coordinating eyes and hands
  - Smiles at parent voice
  - Begins to babble and imitate some sounds
  - Turns head in direction of sound

American Academy of Pediatrics (http://www.healthychildren.org)

Vision Development

- Birth
  - Babies can see, but don’t have normal adult vision
- Newborn
  - Able to see large shapes, faces, and bright colors
- 3 - 4 months
  - Able to focus on smaller objects and distinguish between colors (red and green)
- 4 months
  - Eyes should be working together and develop depth perception
- 12 months
  - Vision reaches normal adults levels

American Academy of Pediatrics (http://www.healthychildren.org)

Typical Motor Development 12-24 months

- 1 to 1 ½ years
  - creeps up stairs, walks (10-20 min), makes lines on paper with crayon.
- 1 ½ to 2 years
  - runs, kicks a ball, builds 6 cube tower.
- Age 2
  - Walks well, goes up and down steps alone, runs, seats self on chair, becoming independent in toileting, uses spoon and fork, imitates circular stroke, turns pages singly, kicks ball, attempts to dress self, builds tower of six cubes.

American Academy of Pediatrics (http://www.healthychildren.org)

Fine Motor - 1 year olds

- Hand and finger skills
  - Increased ability to use hands, also in coordination with eyes
  - Picking up small objects between thumb and forefinger still a challenge
  - Games developing hand skills include:
    - Building block towers (2-4)
    - Scribbling
    - Picking up balls as they roll
    - Turning knobs
  - These also develop spatial concepts (in, on, under, etc.)

American Academy of Pediatrics (http://www.healthychildren.org)

Fine Motor - 2 year olds

- Hand and finger skills
  - Able to easily manipulate small objects
    - Turn pages (multiple) of a book, pull off shoes, unzip larger zippers
  - Coordinate movements of wrist, fingers, and palm
    - Use cup with one hand
    - Build large tower (6)
    - Turns doorknob
  - Learning to draw
    - Clumsy grip, large sweeping strokes (vertical and circular)

American Academy of Pediatrics (http://www.healthychildren.org)

Fine motor development of preschoolers

- 3 years
  - Makes vertical, horizontal, and circular strokes with crayon
  - Turns book pages one at a time
  - Holds pencil/crayon in writing position
  - Screws and unscrews a lid/bolt
  - Uses fork to stab, self feeding
  - Needs assistance to remove and put on T-shirt
  - Independent with pull-down garments
  - Zips and unzips jacket (cannot insert/remove shank)
  - Buttons large front buttons

American Academy of Pediatrics (http://www.healthychildren.org)
Fine motor development of preschoolers

4 years
- Draws circles and squares
- Draws a person (2-4 body parts)
- Uses scissors
- Begins to copy capital letters
- Puts belt in loop
- Buttons a series of buttons
- Zips and unzips with insert/remove shank
- Snaps or hooks clothing in front

5 years
- Prints some letters
- Copies triangles and other more complex geometric patterns
- Draws a person with a body
- Dresses and undresses without assistance
- Uses fork, spoon, and blunt knife (sometimes)
- Usually cares for all toilet needs

Preschool Movement: 3 years

- Movements are more fluid, no longer need to concentrate on mechanics of many gross motor (standing, running, jumping, walking)
- Tiptoes, standing on one foot, catching a ball may still be difficult
- More interest in structured games rather than just running around
- Movement conveying thoughts and emotions that are too difficult for language (“flying” with arms spread)
- Coordination developing, but supervision still necessary to prevent injury
- Difficult to predict actions or speed, so vulnerable to “dangerous” tasks

Preschool Movement: 4 to 5 years

- Coordination and balance of an adult
- Eager to show new skills!
- Water remains a danger, even if she can swim due to reduced fear coupled with increased fear when something goes wrong (i.e. keeping afloat, water in nose)

Cognitive Development

How do we measure (see) cognitive development in young children?
- Behavior/Action
  - Motor output
  - Verbal output

6 Months
- Plays with single object - banging it

9 months
- Relational acts emerge (e.g., placing spoon in cup; placing lid on pot)

2 years
- Symbolic play (e.g., pretend to drink from a cup)

36 months
- Symbolic play more complex (e.g., pretend to call someone on make-believe telephone
Typical Cognitive Development
12-24 months

- **Play**
  - Relational acts (e.g., placing a spoon in a cup; putting a lid on a pot).
  - By 2 years, incorporate symbolic or pretend play - pretend to drink from a cup, put dolls to bed.

- **Information Processing**
  - Child searches for object that has been completely hidden from view.
  - By 2 years, child is able to find a hidden toy even after it has been displaced from the original point of disappearance.

Sensorimotor Development:
Key Concepts - Areas for Assessment

- Tactile discrimination
- Kinesthetic processing
- Fine motor coordination
- Visuomotor coordination
- Coordination of rhythmic, sequential movement
- Processing basic tactile information
- Imitating hand positions
- Producing repetitive and sequential movement sequences
- Using a pencil with speed and precision
- Producing rhythmic hand movement sequences

Consider the Referral Question and Age of Youngster

- At what stage of assessment are you?
  - Developmental Surveillance
  - Screening
  - Progress Monitoring
  - Evaluation for Special Services

Early Childhood Assessment

- Different for ages 0-8 years
- Different because young children learn in experiential, concrete, hands-on ways

Assessment of Infants

- Focus on
  - biological homeostasis,
  - autonomic regulation, and
  - organizational properties of behavioral development
Assessment: Infancy to Early Childhood

- Initial focus: neurological reflexes and postural reactions that can be elicited in the newborn
  - central nervous system integrity
- Persistence of primitive reflexes and postural reactions or asymmetry in response tend to suggest central nervous system problems.
  
  Zafeieriou, 2003

Added Focus (More Recent)

- Behavioral attributes of the infant,
  - organizational state
  - the ability to interact with the environment
- WHY???
  - infant is an active learner from birth and that his or her ability to change states or control his or her state in response to internal and external stimuli facilitates that learning

Assess Regulation and Organization of Behavior (Younger)

- DYSREGULATION
  - Sleep
  - Negative Emotionality
  - Eating
  - Sensory Sensitivity

Sensory Profiles and Neuroscience

- Modulation
  - Habituation
  - Sensitization
- High thresholds
  - May miss information
  - Lengthy response time
- Low thresholds
  - Unable to focus on salient cues
  - Overly reactive - too quickly or too frequently

Sensory Integration

- Children need to be able to manage sensory stimuli to be available for learning
- Dunn’s Model of Sensory Processing
  - Interaction between neurological thresholds and behavioral responses
  - Based on a continuum of sensory processing patterns and responses
    - Passive or active

Dunn’s Model of Sensory Processing

- Interaction between individual neurological thresholds and behavioral responses
  - Yields four patterns
- Based on a continuum of sensory processing patterns and responses
  - Passive - react in accordance with sensory input
  - Active - control sensory input
Definitions and Descriptors

<table>
<thead>
<tr>
<th>Sensory Processing Pattern</th>
<th>The degree to which the person...</th>
<th>Descriptor</th>
<th>Neurological Threshold</th>
<th>Self-Regulation Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Registration</td>
<td>misses sensory input</td>
<td>Bystander</td>
<td>High</td>
<td>Passive</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>detects sensory input</td>
<td>Sensor</td>
<td>Low</td>
<td>Passive</td>
</tr>
<tr>
<td>Seeking</td>
<td>attracts sensory input</td>
<td>Seeker</td>
<td>High</td>
<td>Active</td>
</tr>
<tr>
<td>Avoiding</td>
<td>is bothered by sensory input</td>
<td>Avoider</td>
<td>Low</td>
<td>Active</td>
</tr>
</tbody>
</table>

Individual Differences - Critical

Bayley-III (Comprehensive or Screener)

Bayley Subtests
- Cognitive*
- Receptive Communication
- Expressive Communication
- Fine Motor
- Gross Motor
- Social-Emotional*

Bayley Composites
- Language
- Motor

* Composite score equivalents available

Motor Scale
- Motor Scale composed of:
  - Fine motor subtests
  - Gross motor subtests
- Some items from the BSID-II Motor Scale and Mental Scale moved to fine or gross motor skills
- Items provide:
  - coverage across age
  - greater content coverage (e.g., increased focus on quality of movement).

Fine Motor
- Comprised of 66 items:
  - Prehension (seizing/grasping)
  - perceptual-motor integration
  - motor planning and speed
  - visual tracking
  - reaching
  - object grasping
  - object manipulation
  - functional hand skills
  - responses to tactile information
Gross Motor

Comprised of 72 items:
- Movement of the limbs and torso
- Static positioning (e.g., sitting, standing)
- Dynamic movement, including locomotion & coordination
- Balance
- Motor planning

DIAL-4 (Screening)

M-FUN (Comprehensive/Program Planning)

- Use M-FUN to...
  - Assess functional motor skills in natural contexts (classroom, home, and community)
  - Assess educationally relevant abilities related to motor skills and self-care
  - Assess mild to moderate impairments
  - Measure progress over time

Three Key Features

1. Identify motor delays in preschoolers
2. Test tasks assess motor requirements of early school activities
3. Assesses aspects of function and participation

1. Assess motor delays in preschoolers

- Visual motor, fine motor, gross motor abilities
- Neurological Foundations Profile

2. Test tasks assess motor requirements of early school activities

- Early school activities: drawing, writing, cutting, taping, jumping, ball play
- Uses a multidimensional approach to examining children’s motor skills
3. Assess aspects of function and participation

- Incorporates current requirements & expectations for assessment

### NEPSY-II Sensorimotor Subtests (Comprehensive)

<table>
<thead>
<tr>
<th>SUBTEST</th>
<th>AGES</th>
<th>SCALED (PRIMARY) SCORES</th>
<th>PROCESS SCORES</th>
<th>BEHAVIORAL OBSERVATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fingertip Tapping</td>
<td>5 - 16</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Imitating Hand Positions</td>
<td>3 - 12</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Manual Motor Sequences</td>
<td>3 - 12</td>
<td>✓</td>
<td>--</td>
<td>✓</td>
</tr>
<tr>
<td>Visuomotor Precision</td>
<td>3 - 12</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

### NEPSY-II Fingertip Tapping

How fast can child imitate repetitive finger tapping or sequential finger tapping with preferred and nonpreferred hands?

### NEPSY-II Imitating Hand Positions

This subtest is designed to assess the ability to imitate hand and finger positions by using visuospatial analysis, motor programming, and kinesthetic feedback.

The child copies hand and finger positions demonstrated by the examiner.

### NEPSY-II Manual Motor Sequences

**Motor deficits causing poor performance:**
- Organizing and sequencing movements.
- Sustaining rhythm and sequence throughout series.
- Manual motor coordination causing lack of fluid movement, but not affecting sequence.

### NEPSY-II Visuomotor Precision

**Motor deficits causing poor performance:**
- Graphomotor control
- Poor overall fine motor coordination

**Executive function disorder causing inability to:**
- Inhibit impulsive responses
- Plan ahead
- Estimate difficulty of track
- Monitor ongoing execution
Wrapping it up

Keys to Effective Early Childhood Assessment

- Flexibility
- Rapport
- Knowledge
- Well-functioning team
- The ability to have FUN

Monitor Your Behaviors

- Be entertaining to maintain attention
- Try side-by-side seating for younger children
- Warn for transitions
- Use soft, quiet but firm voice
- Use appropriate levels of language
- Tell the child the behaviors you expect (in their language)
- Be alert to changes in behavior to change your own style

Webinar questions or comments?
adam.scheller@pearson.com
amy.gabel@pearson.com

www.pearsonassessments.com