Early development, sensory integration processes and communication development

(Communicative therapeutic intervention for children with severe impaired development and medical diseases)

Svetlana Kartunova, M.A, SLP, IBCLC
Varna, 2014
What we now about babies?
Uterus between contractions

Uterus during contractions
Video examples

The differences between vaginal and cesarean birth
To examine the effects of maternal cigarette smoking during pregnancy on the developing infant's autonomic regulation:

**Methods:** Heart rate variability (HRV) was assessed for 10 min during late gestation for 21 cigarette-exposed (CE) and 22 nonexposed (NE) fetuses.

**Results:** HRV was significantly lower in fetuses whose mothers smoked cigarettes during pregnancy.
Conclusions: Results show that CE fetuses have lower HRV and disrupted temporal organization of autonomic regulation before effects of parturition, postnatal adaptation, and possible nicotine withdrawal contributes to differences in infant neurobehavioral function.

The First Step – searching mother and eating

video
Kangaroo care

Video example
1 – 4 months  Motor development

- **Rooting and sucking reflexes** are well developed.
- **Swallowing reflex** and tongue movements are immature; inability to move food to the back of the mouth.
- **Grasp reflex.**
- **Landau reflex** appears near the middle of this period; when baby is held in a prone (face down) position, the head is held upright and legs are fully extended.
- Grasps with entire hand; strength insufficient to hold items. Holds hands in an open or semi-open position.
- Movements are large and jerky.
- Raises head and upper body on arms when in a prone position.
- Turns head side to side when in a supine (face up) position; cannot hold head up and line with the body.
- Upper body parts are more active: clasps hands above face, waves arms about, reaches for objects.
4 – 8 months  

Motor development

Reflexive behaviors are changing:

- **Blinking reflex** is well established
- **Sucking reflex** becomes …
- **Moro reflex** - disappears
- When lowered suddenly, infant throws out arms as a …
- **Swallowing reflex** appears and allows infant to …

Picks up objects using finger and thumb (pincer grip).

- Reaches for objects with both arms simultaneously; later reaches with one hand or the other.
- Transfers objects from one hand to the other; grasps object using entire hand (palmar grasp).
- Handles, shakes, and pounds objects; puts everything in mouth.
- Able to hold bottle.
4 – 8 months  Motor development

Sits alone without support, holding head erect, back straightened, and arms propped forward for support

- Pulls self into a crawling position by raising up on arms and drawing knees up beneath the body; rocks back and forth, but generally does not move forward.
- Lifts head when placed on back.
- Can roll over from back or stomach position.
- May accidentally begin scooting backwards when placed on stomach; soon will begin to crawl forward.
- Looks for fallen objects by 7 months

Plays ‘peek-a-boo’ games
- Cannot understand “no” or “danger”
8 – 12 months  Motor development

- Reaches with one hand leading to grasp an offered object or toy.
- Manipulates objects, transferring them from one hand to the other.
- Explores new objects by poking with one finger.
- Uses deliberate pincer grasp to pick up small objects, toys, and finger foods.
- Stacks objects; also places objects inside one another.
- Releases objects or toys by dropping or throwing; cannot intentionally put an object down.
- Beginning to pull self to a standing position.
- Beginning to stand alone, leaning on furniture for support; moves around obstacles by side-stepping.
- Has good balance when sitting; can shift positions without falling.
- Creeps on hands and knees; crawls up and down stairs.
8 – 12 months  Motor development

- Walks with adult support, holding onto adult's hand; may begin to walk alone.
- Watches people, objects, and activities in the immediate environment.
- Responds to hearing tests (voice localization); however, loses interest quickly and, therefore, may be difficult to test formally.
- Follows simple instructions.
- Reaches for toys that are out of reach but visible
- Recognizes objects in reverse
- Drops thing intentionally and repeats and watches object
- Imitates activities like playing drum
- Begins to develop expressive rather than receptive language - child actually responding to what is said to him instead of only receiving and watching the interaction.
The Central Nervous System (CNS), composed of the brain, brain stem, the cranial nerves, the spinal cord and the nerve attachments controls the senses and the reflexes.
What are the Primitive Reflexes?

Primitive reflexes are automatic survival responses to stimuli (Sensory Input) which develop during uterine life and should be fully present at birth.
Anatomy of Primitive Reflexes:

- Within the brainstem
  - Oldest part of the brain (Reptilian or Pre-Cortical) => Midbrain => Cortical
  - Automatic vs Volitional
  - Stimulus elicited
  - Survival / Instinctual

As higher brain centers mature or the PR’s Integrate more voluntary Postural Reflexes and Cortical development occurs
Function of the Reflexes:

- Present in all of us as part of our central nervous system (CNS) at birth and are involuntary movements.
- Primitive reflexes have a limited life span - to help a newborn survive the first 9 months to a year of life.
- Integration of these reflexes lead way to postural reflexes or higher neural ability for voluntary control.
Approximate Emergence and Duration of Primitive and Postural Reflexes

<table>
<thead>
<tr>
<th>PREGNANCY</th>
<th>FIRST YEAR</th>
<th>SECOND YEAR</th>
<th>THIRD YEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conception</td>
<td>Birth</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* Moro</td>
<td>E-9 weeks</td>
<td>I 2-6 months</td>
<td></td>
</tr>
<tr>
<td>* Palmar</td>
<td>E-11 weeks</td>
<td>I 2-7 months</td>
<td></td>
</tr>
<tr>
<td>* Plantar</td>
<td>E-11 weeks</td>
<td>I 2-7 months</td>
<td></td>
</tr>
<tr>
<td>* Asymmetrical Tonic Neck</td>
<td>E-18 weeks</td>
<td>I 4-6 months</td>
<td></td>
</tr>
<tr>
<td>* Spinal Galant</td>
<td>E-18 weeks</td>
<td>I 9-11 months</td>
<td></td>
</tr>
<tr>
<td>* Suck</td>
<td>E-24-28 weeks</td>
<td>3-4 months</td>
<td></td>
</tr>
<tr>
<td>* Rooting</td>
<td>E-24-28 weeks</td>
<td>3-4 months</td>
<td></td>
</tr>
<tr>
<td>* Tonic Labyrinthine</td>
<td>E-12 weeks</td>
<td>I 3-36 months</td>
<td></td>
</tr>
</tbody>
</table>

# Babinski | E - birth | I - transforms Adult Babinski |
# Head Righting | E - 2-3 months | I - life |
* Landau | E - 3-10 months | I - 36 months |
# Amphibian | E - 4-6 months | I - life |
# Segmental Rolling | E - 6-10 months | I - life |
# Symmetrical Tonic Neck | E - 9-11 weeks | I 9-12 months |
# Transformed Tonic Neck | E - 6-8 months | I - life |

Key to abbreviations
E emerges around
I integrated around
* Primitive Reflexes
# Postural Reflexes

The central nervous system (CNS) maturity can be measured by the presence or absence of reflexes.

During key stages neural development will determine when a reflex emerges and when it integrates (or becomes inhibited).
What are Retained Primitive Reflexes?

- These are primitive reflexes that remain and do not integrate, therefore postural reflexes do not develop fully.
- Thus the body remains under the influence of involuntary responses instead of voluntary.

Retained Primitive Reflexes cause:

- Difficult voluntary movements and Balance
- Irregular Visual Perception
- Irregular Auditory Processing
- Irregular Sensory Perception

Attention, Balance and Coordination: The A.B.C. of Learning Success
Sally Goddard Blythe
The Moro Reflex is when the entire body responds to sudden changes in vestibular, movement, auditory, visual or tactile stimuli.

- Develops at nine weeks in utero
- Integrates between two and four months of age
More Specific Retention Symptoms of Retained Reflexes:

**Moro Reflex**
- Aggressive
- Overactive (Ready-Fire-Aim)
- Overemotional (Weeping Anger)
*Learning Difficulty
- “Can’t Turn Off”
- Hypersensitive to sense (sound, taste, touch, vision, balance)

**Fear Paralysis Reflex**
- Oppositional Defiance
- “The Screaming Child”

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The Tonic Labyrinthine reflex is elicited when there is a change of head position forward or backward thru mid-plane.

Provides the basis for upper trunk control leading to normalized muscle tone throughout the body regardless of head position.

Balance, posture, and coordination results from the mastery of head control.
More Specific Retention Symptoms of Retained Tonic Labyrinthine Reflex:

- Poor Judgment of Balance, Space, Distance, Depth & Motion
- Motion Sickness
- “Floppy” or “Rigid” Child
- Fatigue when Neck Flexed
- Learning Difficulty

www.seed.org
Asymmetrical Tonic Neck Reflex

- The ATNR is activated by spontaneous and passive head turning from side to side
- Develops during the third month in utero
- Integrates between three to nine months
More Specific Retention Symptoms of Retained Asymmetrical Tonic Neck Reflex:

- Easily Distracted
- Poor Pencil Grip, Excessive Grip
- Missing Visual Reading Fields When reading
- Difficult Distance Perception
- Difficult tasks involving both sides of Body
- Poor Ball Skills
- Learning Difficulty

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The Spinal Galant Reflex is activated by touch on the side of the spine.

- Develops at twenty weeks in utero
- Integrates between three to nine months

[http://library.med.utah.edu/pedineurolologicexam/html/newborn_n.html](http://library.med.utah.edu/pedineurolologicexam/html/newborn_n.html)
More Specific Retention Symptoms of Retained Spinal Gallant Reflex:

- Delayed Sitting
- Abnormal Gait/Posture
- Poor Bladder/ Bed Wetting
- “Ant’s in Pants” Child
- Learning Difficulty

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Symmetrical Tonic Neck Reflex (STNR)

The STNR is activated by the flexion and extension of the head causing a reciprocal movement of arms and legs as seen when the head is flexed the arms will bend and the legs straighten.

- Develops between six to eight months
- Integrates between nine to eleven months

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More Specific Retention Symptoms of Retained Symmetrical Tonic Neck Reflex:

- Poor posture due to a decrease in muscle tone, especially in the spinal muscles.
- Tendency to slump or have difficulty sitting at a desk.
- Poor hand eye coordination. Poor finger to nose pointing. Difficulties with far-near vision (e.g. looking from workbook to the board in a classroom).
- Slowness at copying tasks.
- Poor impulse control (poor frontal lobe integration).
- Tendency to be long sighted.

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More Specific Retention Symptoms of Retained Reflexes:

**Palmar Reflex**
- Poor Manual Dexterity (Thumb)
- Speech Difficulties
- Manual Tasks Inhibit Talking
- Difficult writing (w/Mouth Motion)

**Plantar Reflex**
- Trouble w/Gait, Run, Toe Walk

**Rooting/Suck Reflex**
- Difficult Chew, Speech and Dribble
- Often w/ Car & Sport Injury, Dental
Language development begins in the womb

Infants less than an hour old can show the difference between the language of their parents and a foreign language.
Social interactions can extend the range of sensitive periods for learning.

Brainard, 2002

“My research shows facial imitation at birth and deferred imitation soon thereafter. … Infants can even imitate facial gestures they have never seen themselves perform. Infants have an abstract mental code, we call it a supramodal code, that unites acts seen and acts done within the same framework.” A. Meltzoff, 2007
Babies can communicate many of their needs and wants before they start talking, and how you respond can help them learn the words and phrases they will use later.
The first year of life is critically important for language development, even though many babies do not say any words during this period.

How, and how much, you talk to your children from birth to age three has a huge influence on their language skills in school.
Four important factors are common to all age groups:

1. Rhythmicity - the child's ability to produce rhythmic movement patterns

First seen in infants when they suck - allowing for coordination between breathing, sucking, and swallowing

Rhythmicity continues through each stage of development.
Four important factors are common to all age groups:

2. Stability - the child's ability to hold the body steady

Stability is first provided by physical characteristics and motor patterns that are present at birth.

* One of the earliest forms of stability is the pads of fat (sucking pads) inside the infant's cheeks. This compensates for an early lack of voluntary motor skills. *The sucking pads help to...???

* Sucking pads are predominant during the first three months and disappear as the child gets older
Four important factors are common to all age groups:

3. Physiological Flexion - the fetal position

Provides stability for sucking.
  * Physiological Flexion causes the entire body to flex or bend into a natural stable position.
Four important factors are common to all age groups:

4. Separation of Movement (also called dissociation) - the child's ability to move one part of the body without moving other parts.

Separation of movement appears as the child's stability increases, allowing mature chewing patterns to develop.

-Example: ...???
Pre-requisite skills

Just as children must crawl before they walk, and drink from a bottle before a cup, children develop pre-requisite speech skills through feeding, and sound play.

Mouthing toys, chewing, babbling, and swallowing are all important factors in preparing the musculature for speech production.
The baby isn’t the small model of adult
Major anatomical differences include:

- **The oral cavity** is smaller than in the adult
- **The tongue fills the mouth** and rests more anteriorly (at the front of the mouth)
- **The soft palate, tongue and epiglottis** approximate (touch)
- **The lower jaw** (mandible) is small and pulled back
- **Anterior movement of the pharyngeal wall** is much **greater**
- **The larynx is higher and pharynx shorter** causing less hyo-laryngeal excursion (elevation and depression of the larynx and hyoid bone thus leading to **epiglottic inversion** - one of the four system in place to protect the airway) in infants
- **Sucking pads** exist
Anatomical differences

http://a248.e.akamai.net/7/248/432/20101213121747/www.msdlatinamerica.com/ebooks/HeadNeckSurgeryOtolaryngology/files/de66452a251c0eed91ef63fc5bc51beb.gif
Growing, Motor development and Stability of the mandible
Jaw stability is the foundation for speech production and feeding management.

Three diagnostic terms are consistently used in the literature and in therapy programs targeting the jaw:

- **dissociation/differentiation**
- **grading/control**
- **fixing** (i.e., associative movements or lack of dissociation and grading)
Oral-motor, hearing and vestibular mechanisms

Space, balance and speech
Cranial nerves

- Sensor and motor divisions of:
  - n. trigeminus
  - n. vagus

5 out of 12 cranial nerves pass through this area.
What sense is involved with the speech process? If the sensory integration affects speech?

- **hearing**. Auditory input from other and auditory feedback from our own speech.

- **Sight** - visual - facial expressions and gestures.

- **sense of touch** (tactile sense) - the articulators, the flow of breath, the vibration in the larynx and the resonance chambers of the pharynx, nose and mouth.

- **taste** and **smell**
The sixth and seventh senses

Proprioception - the body's position in relation to itself, and movement of the body's parts.
Joints - bent or extended,
muscles - contracting or relaxing

Proprioception is crucial to fine motor coordination.
The proprioceptive and tactile systems work together - HOW???

Who is faster??
The sixth and seventh senses

The vestibular system - sense of balance.

The vestibular system works with the visual system to enable us to keep our eyes focused on an object while we are in motion.
Sensory Integration

Five neurosensory systems:

- Auditory
- Visual
- Vestibular
- Proprioceptive
- Tactile

developed by A. Jean Ayres, PhD
Definition

“Sensory integration is the neurological process that organizes sensations from one’s body and from the environment, and makes it possible to use the body to make adaptive responses within the environment. To do this, the brain must register, select, interpret, compare, and associate sensory information in a flexible, constantly-changing pattern”

A. Jean Ayres, 1989
An Individual defined as having SPD concerns exhibits variations of sensory activity in:

- Frequency
- Intensity
- Duration

Observed as either as a Hypersensitivity or a Hyposensitivity
The Sensitivity of the Seven Senses in SPD

**Hypersensitive - requires less stimulation**
- Avoids sounds
- Overwhelmed by intense visual
- Object to textures and gag
- Avoid textures and being touched
- Avoids odors
- Rigid and uncoordinated
- Apprehensive running, climbing and swinging

**Hyposensitive - requires more stimulation**
- Appears to ignore sound
- Appears uninterested by visual
- Tastes inedible objects
- Chews and presses into objects
- Unaware of unpleasant odors
- Limp and clumsy
- Craves rocking, twirling and fidgets
Symptoms of Defensiveness

- Has a narrow or limited interests
- Fear movement and heights, or get sick from exposure to movement or heights
- Be very cautious and unwilling to take risks or try new things
- Respond to being touched with aggression or withdrawal
- Responds negatively to certain sounds
- Be very picky eaters and/or overly sensitive to food smells
- Will only wear certain kinds of clothes, sensitive to tags.
Symptoms of Modulation Disorder

- Difficulty tolerating or adjusting to even minor changes in routine
- Disregard or impaired ability to interact with others
- Disrupted sleep and wake cycles
- Attention problems either easily distracted, or fixated on one activity with difficulty shifting focus
- Feel uncomfortable in busy environments, such as sports events, malls
Under registration

- Handles people or objects roughly
- Unawareness of touch or pain, or touching others too often or too hard (which may seem like aggressive behavior)
- Taking part in unsafe activities, such as climbing too high
- Fatigues easily and appears unmotivated
Effects of Sensory Processing

- **Sensory processing is the result of** the ability to regulate arousal, organize behavior and modulate sensation as a result of its affect on the environment…

- **Knowing how one’s body in space** and the ability to deal with the environment allow us to move

- **Bilateral integration form and space perception**, praxis and body scheme are all a result of the development of posture

So praxis is the result of good sensory processing when the sensory and motor systems work together
The speech is a fine motor activity. Which muscles are involved?

work together with precise coordination and sequencing

What is this?

chest
neck
larynx
pharynx
jaw
tongue
lips
face
Sensory integration and speech

The brain coordinates and controls all of these, while at the same time...
Sensory integration and speech

What else?

Oral and Verbal Praxis
Neuroplasticity and Rehabilitation

1. Body parts can compete for representation in the brain and use of a body part can enhance its representation.
2. The premotor cortex can substitute for the motor cortex to control motion.
3. The contralesional hemisphere can take over motor control if all else fails.

Neuroplastic mechanisms can be facilitated and this is a good basis for intervention.

Example: Stroke patient
Neuroplasticity

- The brain’s natural plasticity provides the opportunity to improve how the brain functions.
- Applying the neuroplasticity theory allows us to utilize sound therapy to stimulate the sensory channels with the appropriate input with sufficient frequency, intensity and duration.
What is Sensory Integration Therapy?

- Active Participation
- “Just Right Challenge”
- “Adaptive Response”
- Self Directed
Goals and Outcomes of Sensory Integration Therapy

- Improve attention to task, participation and learning
- Increase independence in self care tasks
- Decrease fear and anxiety
- Improve communication
- Improve ability to adapt to change/flexibility
- Increase socialization
- Increase self confidence
- Improve ability to explore choices in their environment, community integration
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