The Cephalocaudal Pattern (growth principle)

- The **cephalocaudal pattern** is the sequence in which the greatest growth always occurs at the top – the head – with physical growth in size, weight, & feature differentiation gradually working its way down from top to bottom.
Aspects of the Cephalocaudal Pattern

- The cephalocaudal pattern also occurs in the head area, because the top parts of the head – the eyes & brain – grow faster than the lower parts.
- The head constitutes the majority of the body during prenatal development & early infancy.
- Sensory & motor development proceed according to the cephalocaudal principle.

The Proximodistal Pattern (growth principle)

- The proximodistal pattern refers to the sequence in which growth starts, at the centre of the body & moves outward towards the extremities.
The Brain

- The Brain's Development
- The Brain’s Hemispheres

Definition of a Neuron

- A nerve cell that handles information processing at the cellular level

The Brain’s Development

- At birth, the newborn’s brain is about 25% of its adult weight.
- By age 2, the brain is about 75% of its adult weight.
- Newborns have all of the neurons they will ever have – about 100 billion.
- The primary motor areas of the brain develop earlier than the primary sensory areas etc.
- The most dramatic changes in the brain in the 1st years of life are the spreading connections of dendrites to each other.
Myelination

- **Myelination** is the process of encasing axons with fat cells.
- Myelination insulates the nerve cells and helps nerve impulses travel faster.
- **A myelin sheath** (a layer of fat cells) encases most axons.
- Myelination for visual pathways occurs rapidly after birth and is completed by age 6 months.
- Auditory myelination is not completed until 4–5 yrs of age.
- Some aspects of myelination continue into adolescence.

Definition of Synapses

- Tiny gaps between neurons where connections between axons & dendrites take place.

Measuring the Brain’s Activity in Research on Infant Memory

- To date, technology has not been useful or useable in imagining the brains of babies.
- **Nelson’s (1999)** research is pioneering informative infant-brain research using 128 electrodes attached to babies’ scalps.
- Newborns produce distinctive brain waves that reveal they can distinguish their mother’s voices from another woman’s, even while they’re asleep.
Measuring the Brain’s Activity in Research on Infant Memory (cont’d)

Nelson identified that by age 8 months, babies can distinguish a picture of a wooden toy they were allowed to feel, but not see, from pictures of other toys. This finding coincides with the development of the hippocampus.

The Brain’s Hemispheres

- The cerebral cortex, the highest level of the brain, is divided into 2 halves, or hemispheres.
- Each hemisphere is involved in various & specialized functions of thinking, feeling, & behaviour.

The Brain’s Hemispheres (con’t)

- Extensive research on the brain’s hemispheres has focused on language.
- At birth, the hemispheres have already started to specialize.
- Newborns show greater electrical brain activity in the left hemisphere than the right hemisphere when listening to speech.
Definition of Lateralization

- **Lateralization** is the specialization of functions in one hemisphere of the cerebral cortex or the other.

Early Experience and the Brain

- Starting shortly after birth, a baby’s brain produces trillions more connections between neurons than it can possibly use.
- The brain eliminates connections that are seldom or never used – continuing at least until 10 yrs of age.
- Current belief is that the infant’s brain is waiting for experiences to determine how connections are made.

Early Experience and the Brain

- Before birth, genes appear to direct how the brain establishes basic wiring patterns.
- After birth, environmental experiences are important & affect the brain’s development.
Sleep and Health

- Sleep Patterns and Arrangements
- SIDS
- Nutritional Needs and Feeding
- Malnutrition in Infancy

Sleep Patterns

- Newborns sleep 16–17 hours a day with individual variations.
- Most 1-month-olds begin sleeping longer at night.
- Most 4-month-olds usually have moved closer to adult like sleep patterns.
- Researchers have found cultural variations in infant sleeping patterns exist.

REM (Rapid Eye Movement) Sleep

- REM is a recurring sleep stage during which vivid dreams commonly occur.
- Adults spend about 1/5th of their night in REM sleep.
- Infants spend about 50% of their sleep in REM sleep & it begins their sleep cycle.
- By 3 months the % of REM sleep falls to 40%, & it no longer starts their sleep cycle.
- REM sleep is thought to promote the brain’s development in infancy.
Shared Sleeping

- Cultural variations exist in newborns’ sleeping arrangements.
- Some child experts believe shared sleeping is beneficial with regard to promoting breast feeding, responsiveness to infant crying, & detection of dangerous breathing pauses.
- The risk of SIDS increases if the person sharing the bed with the infant is a smoker or had been using drugs or alcohol.

SIDS

- Sudden infant death syndrome is a condition that occurs when infants stop breathing, usually during the night, & die without apparent cause.
- According to Health Canada (2002), an average of 3 infants a week die because of SIDS.
- SIDS rates among Aboriginal people are 3 x’s higher than the national rate.
- It is recommended to place infants on their backs to sleep in order to reduce the risk of SIDS.

Nutritional Needs and Feeding

- Human milk, or alternative formula, is the baby’s source of nutrients & energy for the first 4 - 6 months of life.
- Growing consensus is that breast-feeding is better for the baby’s health.
**Benefits of Breast Feeding**

- Appropriate weight gain
- Fewer allergies
- Prevention or reduction of gastrointestinal & respiratory infections also acute & recurrent otitis media (middle ear infections)
- Denser bones in childhood & adulthood
- Reduced risks for childhood cancer & breast cancer in mothers & their female offspring
- Lower incidence of SIDS


---

**Malnutrition in Infancy**

- Weaning from breast milk to inadequate nutrients, such as unsuitable & unsanitary cow’s milk formula, can lead to conditions called marasmus & kwashiorkor.
- Even if it’s not fatal, severe & lengthy malnutrition is detrimental to physical, cognitive, & social development.

---

**Marasmus**

- **Marasmus** is a wasting away of body tissue in the infant’s first year, caused by severe protein-calorie deficiency.
- Infants become grossly underweight & muscles atrophy.
Kwashiorkor

- Kwashiorkor is a condition caused by a deficiency in protein in which the child's face, legs, and abdomen swell with water.
- Vital organs collect nutrients and deprive other parts of the body of them.
- Hair becomes thin, brittle, and colourless.
- Listless behaviour occurs.

Motor Development

- Reflexes
- Gross Motor Skills
- Fine Motor Skills
- Dynamic Systems Theory

Reflexes

- Reflexes are genetically carried survival mechanisms that govern the newborn’s movements.
- Reflexes may serve as important building blocks for subsequent purposeful motor activity.
The Sucking Reflex

- The **sucking reflex** occurs when newborns automatically suck an object placed in their mouth.
- Enables newborns to get nourishment before they have associated a nipple with food.
- Disappears after 3–4 months.
- [Link](http://vad.mhhe.com/provided_module.cfm?ModuleID=216) (Birth and the Newborn: “Sucking Reflex at 2 Weeks”)

The Rooting Reflex

- The **rooting reflex** occurs when the infant’s cheek is stroked or the side of the mouth is touched.
- In response, the infant turns its head towards the side that was touched in an apparent effort to find something to suck.
- Disappears after 3–4 months.
- [Link](http://vad.mhhe.com/provided_module.cfm?ModuleID=216) (Birth and the Newborn: “Rooting Reflex at 2 Weeks”)

The Moro Reflex

- A **neonatal startle response** that occurs in response to a sudden, intense noise or movement.
- When startled, a newborn arches its back, throws back its head, & flings out its arms & legs.
- The newborn then rapidly closes its arms & legs to the centre of the body.
- Disappears after 3–4 months.
The Grasping Reflex

- The grasping response occurs when something touches the infant’s palms.
- Infant responds by grasping tightly.
- Replaced around the end of the third month by voluntary grasps, often produced by visual stimuli.

http://vad.mhhe.com/provided_module.cfm?ModuleID=216 (Birth and the Newborn: “Grasping Reflex at 2 Weeks”)

Physical Development in Infancy

Gross Motor Skills

- Gross motor skills involve large muscle activities, such as moving one’s arms & walking.
- Gross motor changes are the most dramatic & observable changes in the infant’s 1st yr of life.
- The month at which gross motor milestones occur varies by as much as 2-4 months.

- The sequence of milestones is uniform.
- In the 2nd yr of life toddlers become more motorically skilled & mobile.

Fine Motor Skills

- **Fine motor skills** involve more finely tuned movements, such as finger dexterity.
- Infants have hardly any control over fine motor skills at birth.
- They do have many components of what later become finely coordinated hand & finger movements.
- Reaching & grasping become more refined during the first 2 yrs of life.
### Sensation and Perception

- **Sensation** occurs when information interacts with sensory receptors – the eyes, ears, tongue, nostrils, and skin.
- **Perception** is the interpretation of what is sensed.

### Sensory and Perceptual Development

- Sensation and Perception
- Visual Perception
- Hearing
- Other Senses
- Intermodal Perception and Perceptual Motor Coupling

### The Development of Fine Motor Skills in Infancy

<table>
<thead>
<tr>
<th>Birth to 6 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 mos.</td>
</tr>
<tr>
<td>3 mos.</td>
</tr>
<tr>
<td>3-4 mos.</td>
</tr>
<tr>
<td>4 mos.</td>
</tr>
<tr>
<td>4-6 mos.</td>
</tr>
<tr>
<td>5-6 mos.</td>
</tr>
<tr>
<td>6-12 months</td>
</tr>
<tr>
<td>6 mos.</td>
</tr>
<tr>
<td>8-10 months</td>
</tr>
<tr>
<td>7 mos.</td>
</tr>
<tr>
<td>9-10 mos.</td>
</tr>
<tr>
<td>8-12 mos.</td>
</tr>
<tr>
<td>10 mos.</td>
</tr>
<tr>
<td>11-12 mos.</td>
</tr>
</tbody>
</table>
Visual Perception

- Acuity and Colour
- Preferences
- Depth Perception
- Visual Expectations

The newborn’s vision is estimated to be 20/400 to 20/800 on the Snellen chart – about 10–30 times lower than normal adult vision (20/20).

By 6 months vision improves to 20/100.

By one year, vision approximates that of an adult.

At birth, babies can distinguish green & red.

By 2 months all colour-sensitive receptors are functioning at adult capacity.

Preferences

- Fantz (1963) discovered that infants look at different things for different lengths of time.
- Fantz found infants preferred to look at patterns rather than at colour or brightness.
- Pattern perception had an innate basis or acquired basis after only minimal environmental experience.
**Depth Perception**

- **Gibson & Walk** (1960) conducted the classic "visual cliff" experiment to assess how early infants could perceive depth.
- Mothers coaxed their infants from across the "cliff" to see if they would crawl on the glass over the drop-off.
- Problems with drawing a conclusion as to how early depth perception is present include the fact that very young infants can't crawl – a requirement of the study.

**Visual Expectations**

- Infants not only see forms & figures at an early age, but develop expectations about future events in their world.
- When presented with a predictable sequence of pictures, 3-month-olds began to anticipate the location of the pictures.
- These infants formed these expectations in less than 1 minute.
- Other studies have demonstrated that by 4 months, infants can recognize where a moving object is when it has left their visual field & can infer where it should be when it comes into their sight again.

**Hearing**

- In the last few months of pregnancy, a fetus can hear sounds (the mother's voice, music, etc.)
- Infants are born with the ability to discriminate speech sounds from any language, but without constant exposure, they lose the ability by their 1st birthday.
Touch
- Newborns respond to touch, particularly with the sucking & rooting reflex.
- An important ability that develops during the first year is to connect information about vision with information about touch.
- Newborns can feel pain.

Smell
- Newborns can differentiate odours.
- Young infants show a preference for the smell of their mother’s breast by six days old.

Taste
- Sensitivity to taste may be present at before birth.
- Two-hour-old newborns made different facial expressions when they tasted sweet, sour, and bitter solutions.
- At 4 months of age, infants prefer salty tastes, which newborns found adverse.
**Intermodal Perception**

- **Intermodal perception** involves the ability to relate & integrate information about 2 or more sensory modalities, such as vision & hearing.
- **Condry, Smith & Spelke (2002)** & others found that infants as young as 3 ½ months not only can coordinate visual-auditory information, but prefer to experience what they see together with what they hear.

---

**Perceptual-Motor Coupling and Unification**

- There is an increasing belief that perceptual and motor development do not occur in isolation from one another but, rather, are coupled.
- Individuals perceive in order to move & move in order to perceive.
Piaget’s Sensorimotor Stage

- Object Permanence
- Causality
- Critiques

According to Piaget’s theory, children have schemes. Schemes are cognitive structures that help individuals organize & understand their experiences. Mental development in this early age is characterized by the infant’s ability to organize & coordinate sensations with physical movements and actions.

Piaget’s Description of Sensorimotor Thought

- Ability to organize and coordinate sensations with physical movements
- Is nonsymbolic through most of its duration
- Consists of six substages of cognitive development
- Object permanence develops
Sensorimotor Stage

- Piaget's sensorimotor stage is divided into 6 sub-stages:
  - Simple Reflexes
  - Primary Circular Reactions
  - Secondary Circular Reactions
  - Coordination of Secondary Circular Reactions
  - Tertiary Circular Reactions
  - Internalization of Schemes

Object Permanence

- Object permanence is Piaget’s term for understanding that objects & events continue to exist, even when they cannot directly be seen, heard, or touched.
Causality

- Piaget was interested in infant’s knowledge of cause & effect.
- He concluded that young infants comprehend that the size of a moving object determines how far it will move a stationary object if it collides with it.

Critiques of Piaget’s Sensorimotor Stage

- Piaget began a new way of looking at infants by describing how their main task is to coordinate sensory impressions with their motor activities.
- Piaget’s work may have oversimplified infant cognitive development.
- Piaget’s explanations for the cause of change are somewhat debated.
- Researchers now believe that Piaget wasn’t specific enough about how infants learn about their world & that infants are far more competent than Piaget envisioned.
Learning, Memory, and Intelligence

- Conditioning
- Habituation
- Imitation and Memory
- Measuring Infant Intelligence

Conditioning

- **Operant conditioning** has been helpful to researchers in their efforts to determine what infants perceive.
- If an infant’s behaviour is followed by a rewarding stimulus, the behaviour is likely to recur.
- Studies have demonstrated that infants can retain information from the experience of being conditioned.

Habituation

- **Habituation** is the process by which infants become uninterested in a stimulus & respond less to it after it is repeatedly presented to them.
Imitation and Memory

- Meltzoff (2000) believes infants’ imitative abilities to be biologically based because they can imitate a facial expression within a few days after birth.
- Imitation involves flexibility, adaptability, & intermodal perception.

Deferred Imitation

- Deferred imitation is imitation which occurs after a time delay of hours or days.
- Meltzoff found that 9-month-old infants could imitate actions they had seen performed 24 hours earlier.
- Piaget believed that deferred imitation didn’t occur until about 18 months of age.

Memory

- Implicit memory involves retention of a perceptual-motor variety that is involved in conditioning tasks.
- Explicit memory is the ability to consciously recall the past.
Memory in Infancy

- Rouvee-Coulier (2001) suggest that infants as young as 2–6 months can remember some experiences through 1 1/2 to 2 yrs of age.
- Mandler (2000) believes that explicit memory occurs in the 2nd half of the 1st year.
- Most adults cannot remember anything from the first 3 years of life, a phenomenon referred to as infant amnesia.
- One explanation of infant amnesia focuses on the maturation of the brain, especially in the frontal lobes, which occurs after infancy.

Measuring Infant Intelligence

- Infant developmental scales differ from those used to assess older children in that they are necessarily less verbal, contain more perceptual motor items, & include measures of social interactions.
- Arnold Gesell developed a measure used as a clinical tool to help sort out potentially normal babies from abnormal infants.
- The current version of the Gesell test has 4 categories: motor, language, adaptive, personal-social development.

Developmental Quotient (DQ)

- Developmental Quotient – an overall developmental score that combines subscores in the four categories
  - Motor
  - Language
  - Adaptive
  - Personal-social
The Bayley Scales of Infant Development (Nancy Bayley)

- **The Bayley Infant Development Scales** are widely used in the assessment of infant development.
- The current version has 3 components:
  - A mental scale
  - A motor scale
  - An infant behaviour profile

Bayley Scales of Infant Development (cont’d)

- Includes assessment of:
  - Auditory & visual attention to stimuli
  - Manipulation, such as combining objects or shaking a rattle
  - Examiner interaction, such as babbling & imitation
  - Relation with toys, such as banging spoons together

- Memory is involved in object permanence, as when the infant finds a hidden toy
- Goal-directed behaviour that involves persistence, such as putting pegs in a board
- Ability to follow directions & knowledge of object’s names, such as understanding the concept of “one”

The Fagan Test of Infant Intelligence

- **The Fagan Test** is becoming increasingly popular.
- The test focuses on the infant’s ability to process information in such ways as:
  - Encoding the attributes of objects
  - Detecting similarities & differences between objects
  - Forming mental representations
  - Retrieving those representations
Effectiveness of Infant Intelligence Tests
- Valuable in assessing the effects of malnutrition, drugs, maternal deprivation, & environmental stimulation on infant development.
- Have mixed results in predicting later intelligence on a global scale.

Language Development
- What is Language?
- How Language Develops
- Biological Foundations of Language
- Behavioural and Environmental Influences

What is Language?
- Language is a form of communication, whether spoken, written, or signed, that is based on a system of symbols.
- All human languages have some common characteristics such as infinite generativity & organizational rules.
- Infinite generativity is the ability to produce an endless number of meaningful sentences using a finite set of words & rules.
How Language Develops

- First few months of life – infants startle to sharp noises
- 3–6 months – begin to show an interest in sounds, respond to voices
- 6–9 months – babbling begins (goo-goo) due to biological maturation; infants also begin to understand their first words

How Language Develops

- Early communication is in the form of pragmatics to get attention:
  - making or breaking eye contact
  - vocalizing sounds
  - performing manual actions such as pointing
- 10–15 months – the infant utters its first word

Recognizing Language Sounds

- Before infants actually learn words, they are able to sort through a number of spoken sounds in search of ones that have meaning.
First Words
- Between the ages of 10 to 15 months, infants spoken vocabulary consists of one word utterances that have meaning.
- Examples include: important people, familiar animals, toys, food, body parts, clothes, household items & greeting terms.

Two-Word Utterances
- At 18–24 months, children begin to utter two-word utterances.
- They quickly grasp the importance of expressing concepts & the role that language plays in communicating.
- To convey meaning, the child relies heavily on gesture, tone, & context.
- Two-word sentences or telegraphic speech (short precise words) are used to communicate.

Biological Foundations of Language
- The strongest evidence for the biological basis of language is that children all over the world reach language milestones at about the same time developmentally, & in about the same order.
- Language occurs despite vast variation in the language input they receive.
- There is no other convincing way to explain how quickly children learn language other than through biological foundations.
Behavioural and Environmental Influences

- Behaviourists view language as just another behaviour involving chains of responses or imitation.
- The behavioral mechanisms of reinforcement and imitations cannot completely explain how we produce novel sentences.
- Behaviourists fail to explain the extensive orderliness of language.
- We do not learn language in a social vacuum.
- Studies have shown differences in language development due to environmental circumstances such as socio-economic status.

©2008 McGraw-Hill Ryerson Ltd.

Behavioural and Environmental Influences (cont’d)

- **Infant-directed speech** is the type of speech often used by parents & other adults when they talk to babies. It has a higher than normal pitch & involves the use of simple words & sentences.
- **Recasting** is rephrasing something the child has said in a different way, perhaps as a question.
- **Echoing** is repeating what a child says, especially if it is an incomplete phrase or sentence.
- **Expanding** is restating, in a linguistically sophisticated way, what the child said.
- **Labelling** is identifying the names of objects.