PSYC2500
Friday Sept 27/13

Growth in the Nervous System

- prenatally, at 5 months of gestation, 100B neurons have been created already
- **the production of neurons is at the bottom layer**
- after birth, the greatest growth will occur in the dendrites (receiver cells that grow immensely during first year of life) – become more web-like, become longer
- **the axon transports the electrical impulses**
- **dendrites receive the electrical impulses** which are carried through to axon to the axon ending. Here, there's a gap called a synapse.
- The **myelin sheath helps the transportation of electrical energy –** speeds it up
- **myelinization does not occur until after birth**
- some argue that myelinization occurs until 30 years of age
- communication between neurons is sped up until age 15
- **when we are born, we're overwired:** we start to prune some synapses (called **synaptic pruning)**
  - we're eliminating the synapses we don't need
  - what develops: brain growth, number of neurons we have, myelinization
    - what you don't need/use will be pruned
    - there can be synaptic pruning of essential perceptional systems
    - brain is hardwired and overly so to react to experiences

Three developmental processes in neurons – end of chapter 4:

1) **growth –** evidence that neuron growth can occur after birth, but at a very reduced level; maybe only to replace neurons that are dying off.
2) **Myelinization**
3) **synaptic pruning**

Placticity – the ability of the brain to reorganize itself; infants have enormous placticity and some of this placticity is lost over time.

- baby born with connections – what does s/he do with these connections? Brain reorganizes itself with synaptic pruning with the baby's experiences

There are **two types of experiences:**

- **1) experience-expectant growth –** ex: vision – the brain expects some visual stimulation for development occur. The brain is expecting stimulation in the visual cortex from the get-go; if it does not get stimulation, the brain will reorganize in a way that will not be able to recover.
- **2) experience dependant growth –** makes everyone unique; it's those experiences in that environment that will differentiate you.

We are the most plastic when we are young and we lose some of that plasticity with age.

- there are periods of development where the growing period is most vulnerable
- hightened sensitivity to drugs the mother ingests during certain periods
- for anti-depressants, there is no evidence as of yet that it will produce physical abnormalities in

the baby. But, after the birth, there is some evidence that during the prenatal period, the baby might experience withdrawal from the drug (sometimes seizures, etc.) Mothers have to weigh the cost-benefits with their MD re: stopping medication.

Chapter 5: Perceptual and Motor Development

1) **basic processes –** all 5 senses of babies are functional at birth; can experience pain such that our medical procedures today are quite different than they were before. Ex: snse of touch is fine, vision is fine (not great, but still there)
2) **complex processes**
3) **motor development**

Observations – looking at their behaviour
- can look at EEG scans (electrical stimulation in the brain)
- cognitive development: humans prefer novelty over things we've seen before...

Habituation – when exposed to the same information over and over, spend less and less time processing that information
- present info over and over to babies; once baby has become bored with that information, they have become habituated

- replace that information with new source of information (ex: picture) and look for dishabituation – will the baby start looking again, given that humans love novel stimuli?
- The baby can discriminate between the old stimuli that they've seen for a long time and the novel stimuli
- **in order to discriminate, presumably have a memory of the initial information –** requires some mnemonic representation of what they saw before.
  Visual preferences – what you want to see is whether the children prefer to look at one type of stimuli versus the other. Ex: babies like to look at high-contrast areas versus low-contrast areas. Also prefer patterns vs plain images.

Dishabituation means that once a novel stimuli has been presented, there is a regained interest.

Basic Processes:

1) **Seeing –** visual acuity
   - how sharp you see information; in literate adults, we use the eye chart – presented at 6 metres from the adult to measure their vision, go down the list to see whether they can read the letters. The vision of newborns is 20/200 to 20/400 – highly blurred, but grows rapidly. **By 3 months of age, have practically the vision of adults.** Vision grows rapidly during the first 3 months and continues to age 9. For babies, **we use a habituation paradigm to measure visual acuity in newborns.** Ex: present baby with 2 images, one of a plain square vs one with horizontal lines. If the baby dishabituates, would be 20/200 vision. Continue testing by decreasing the width of those lines, but the space occupied by the line remaining the same.
2) **Hearing**

- when the lines are closer together, the baby does not distinguish -- does not dishabituate
- with visual acuity, we know a newborn is between 200 or 400
- their optimal visual capacity is between 6-12 inches
- the shape of the eyeball is still forming up until age 9
- baby continues until age 9 in terms of visual acuity (at age 1, greatest growth in

visual acuity)
- babies prefer patterned stimuli
- cones in babies' retinas are not fully dispersed

Colours:
- 2 characteristics of waves: length and frequency; the shorter the wave, the more energy it radiates. Ultraviolet rays can be dangerous, all the way to gamma rays.
- wavelength: blue has shorter waves; dark red has longer waves
- on retina, have 3 types of colours. They specialize according to wavelength.
- 3 types of cones: 1 is sensitive to shorter wavelengt (blues); other in medium-sized wavelength (yellow, green); others in long wavelengths (oranges, reds)
- the retina becomes active very quickly between 3-4 months of age

Hearing:
- auditory threshold: fetuses can hear voices thru the womb, evidence shows that it can hear the mom's voice
- when born, is a baby's hearing as good as that of an adult's? Have to measure their auditory threshold (quietest sounds that one can hear)
- audiologists give the child a toy car and tell them to make it run when they hear something (used between age 2 to 5)
- with new borns, do screening. Put mic in ear as the baby is speaking. Increase tonal energy; if looking at auditory system of outer and inner ear, can do an EEG to look @ brain, whether the auditory cortex is lighting up. If it's the middle ear, can look @ the vibrations of the ear drum.
- in Ontario, 4/1000 babies will have a hearing problem -- hearing diffulties all the way to deafness
- idea: critical period -- if there is a hearing difficulty, want to intervene early.
- we know babies' hearing isn't as sensitive as that of an adult
- the frequencies of sounds perceived best by newborns are those that correspond w/our voices
- by 7 months, babies can locate objects in the dark by their sound: have started integrating senses. The baby can distinguish whether an object is close or far and orient towards it.

The baby is particularly attuned to human voices.
- by 10 months, baby no longer a universal listener -- an example of synaptic pruning

Sensory Integration:
- in order to function, we need all our senses to be integrated w/each other
- we used to think that senses develop independently of each other. New theory: maybe it's not an issue of independent senses from the get-go; maybe all our senses have characteristics that makes learning better when information comes from multiple senses. Ie: maybe newborns learn best when the same information comes from

multiple senses (ex: intensity as a characteristic in auditory output, light can vary in intensity, can vary in frequency, can vary in duration.) Given that this comes from multiple senses, could it be the case that children and newborns learn best when information is presented from multiple senses at once?

- Study (in book by Barret, etc.)
- had children habituate to mom's speaking; were shown videos of mom saying different phrases w/different expressions (ex: "it's beautiful outside" with a smile, a frown, anger)
- results: when the mom speaks and the baby sees emotions, babies at 4 months can discriminate the information
- reshow video w/voice absent: baby stops discriminating the info at 4 months -- until 7 months, can't discriminate
- babies can show discrimination much earlier if shown multiple senses than when it comes only from one sense

Complex perceptual faces:
- babies can focus on areas of high contrast of face
- at one month old, the eyes are an area of high contrast
- by 3 months, baby will focus on the mouth and eyes
- they go from beyond just high contrast area to information there
- issue: are we wired to have a preference for looking at faces?
- synaptic pruning goes on and baby loses connections -- could the same be true about the human face?
- even those who work w/lemurs can't distinguish their facial characteristics between one lemur and another... same w/babies?
- what babies don't use, they lose, including recognizing priamte faces. By 10 months, recognizing human faces better.
- if the mom looks worried, then baby is less likely to do something to further worry the mom

What information is the baby/infant processing that it judges important for survival?
- one is perceiving depth -- ex: determining distance between stair and the floor. In order to process depth, visual system has to recognize differences between far away and close objects.
- **Study: Eleanor Gibson** -- developed a tool that allowed babies to be safe while measuring their ability to perceive depth. If baby decides to crawl over plexiglass, they'll be safe. In order for experiment to work, want kid to crawl over to deep side. Mom stands at deep end w/toy so baby wants to cross to deep end.
- nearly all babies from 6-9 months will refuse to cross: can appreciate depth even though they have not fallen down stairs, etc.
- their perception of depth still stops them from crossing.

Depth perception:
- if there is a change of perspective (ie if baby is crawling), will you have to relearn what you know about the world? Crawling vs walking vs sitting
- Carol Adolf - has a motor development lab and is trying to study whether chidlren's understanding of the gap varies according to the phase of motor development they're at
- if you can perceive gap while sitting, can you make the same judgments while crawling? Or do you have to relearn it?
- Follows the children longitudinally and varies the gap to see whether children are exhibiting same behaviour
- it seems as though we have to relearn depending on whether we are sitting or crawling

Motor Development:
- in the past, have viewed motor development as developing when the system is ready to do so; when brain system ready and mature, then the baby would be able to sit, crawl, etc. **Maturation was the explanatory construct.**
- modern thinking in motor development argues that the system is much more complex; not one thing that develops at once, but we try to integrate all of our senses. If this is true, we should look at the development of locomotion in terms of all the systems that are involved.

Question: are all reflexes involved in motor development?
- why would we have this reflex at birth that would disappear? Is there no continuation in the development of the system?
- in the 70s, thought was that it might be a question of experience: stepping would be a reflex after parents encouraged baby to step. Compared to parents who didn't exercise the stepping reflexes, babies who did stepping exercises learned to walk quicker and lost that reflex later.

Dynamic Systems Theory:
Esther Thelen's Work
- Based on two mechanisms of development: Differentiation, Integration
- Differentiation: component system needs to become differentiated before integration occurs; how components become differentiated
- **Integration:** how the components combine w/each other to form a coherent whole
- this theory exists in physics, but was adopted to explain whether the conundrum of the stepping reflex -- is there a continuity between the stepping reflex and the walk?
- stepping reflex begins to stop when leg mass gets heavier (when baby gains weight)
- also, when baby lies on its back, it kicks. The movement of the kicking looks like the stepping reflex.

- same muscles involved in kicking as stepping
- appears as if the disappearance of stepping, but might manifest in a different way (when baby is on the back)
- the use of the Dynamic Systems Theory is starting to be used in cognitive and emotional development