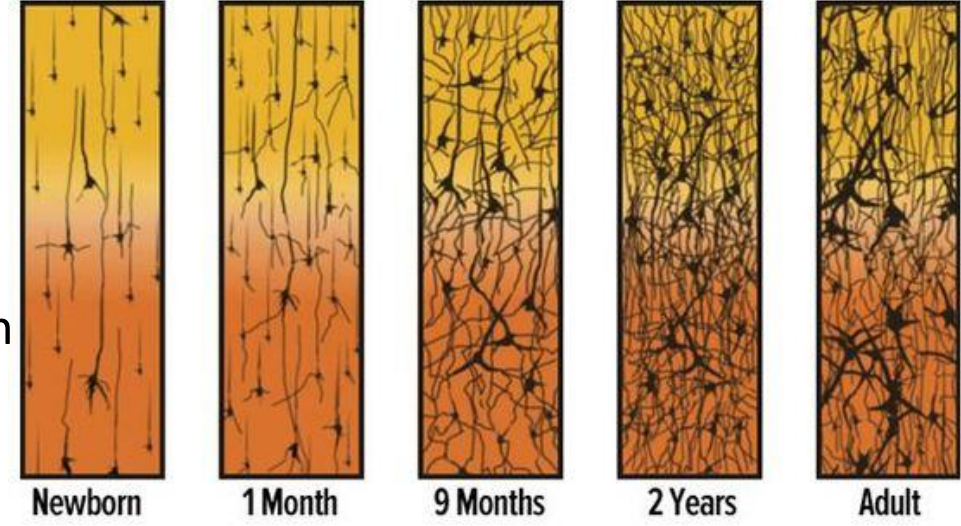


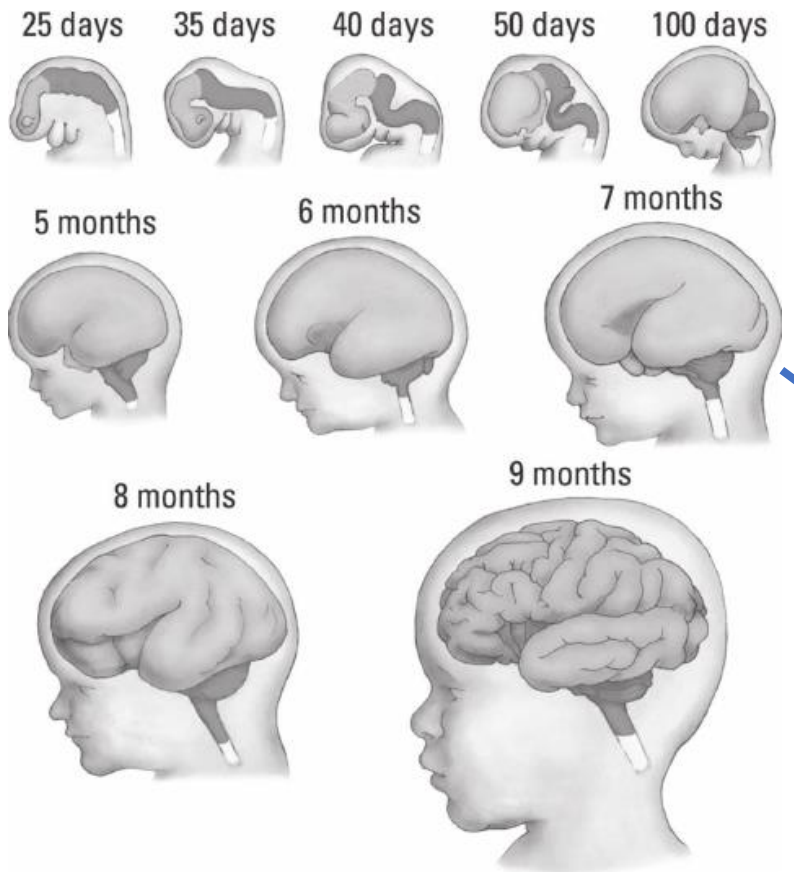
L&M across development

# Human brain development

~100 billion neurons at birth

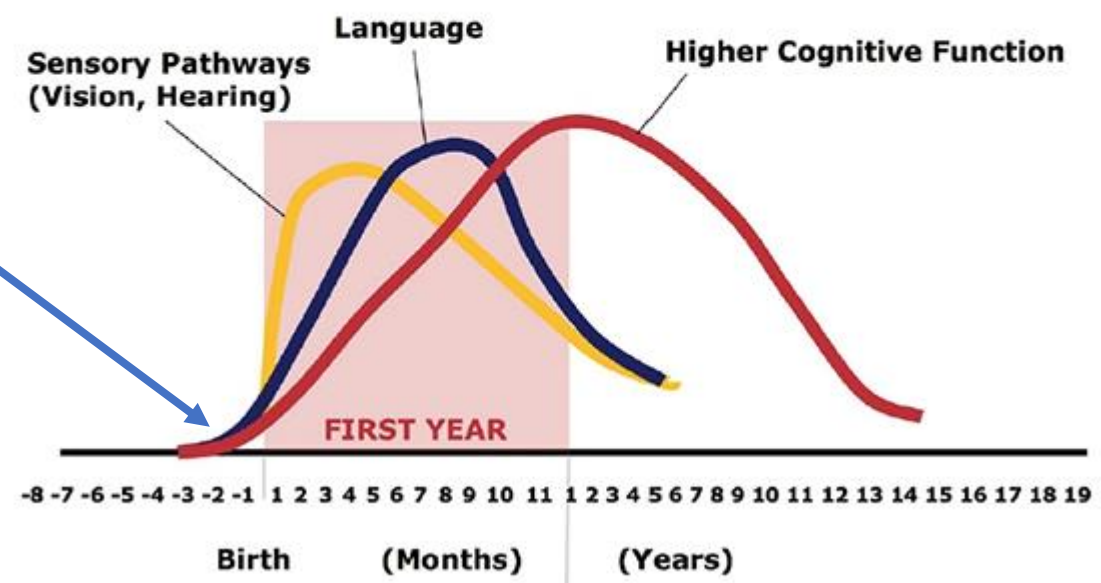


Synapse Density Over Time **FIGURE 3**  
Source: Adapted from Corel, J.L. The postnatal development of the human cerebral cortex. Cambridge, MA:

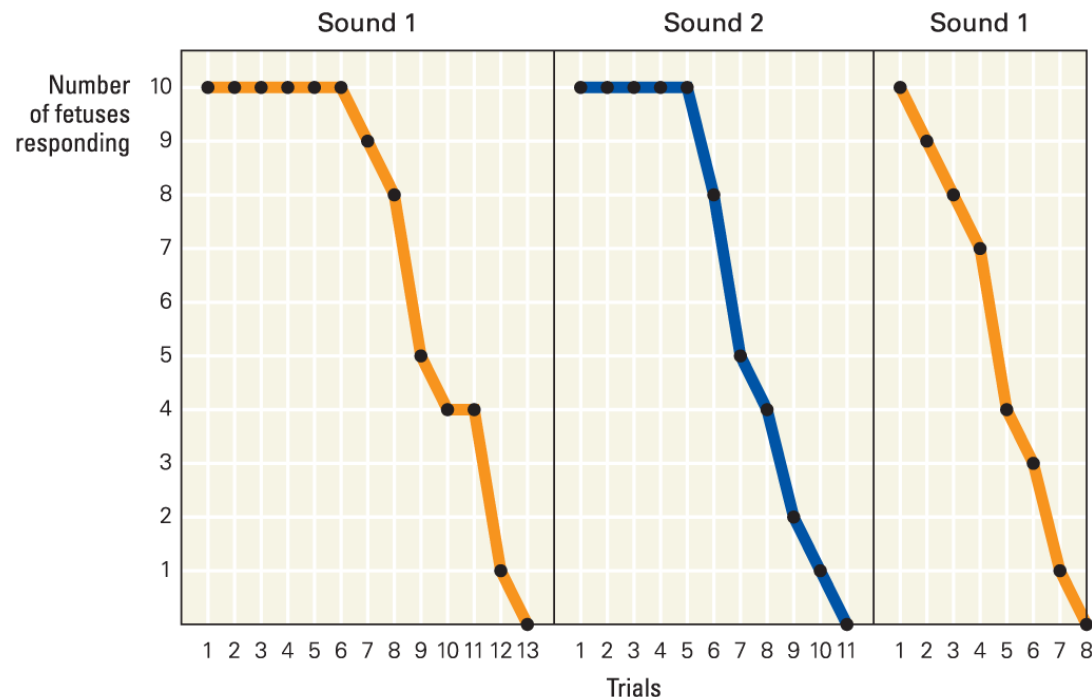


## Human Brain Development

Neural Connections for Different Functions Develop Sequentially



# Habituation to Sound in Human Fetuses (prenatal)



When sound 1 is presented, all 10 human fetuses initially respond with movement; as the sound is repeated, the number of fetuses responding decreases. By trial 13, all have habituated. When a new stimulus (sound 2) is presented, all the fetuses again respond; this response also habituates over about a dozen trials. Finally, the original stimulus (sound 1) is presented again. The fetuses show spontaneous recovery of responding followed by fast habituation (only 8 trials).

# Prenatal Maternal Speech Influences Newborns' Perception of Speech Sounds\*

ANTHONY J. DECASPER AND MELANIE J. SPENCE

*University of North Carolina at Greensboro*

Pregnant women recited a particular speech passage aloud each day during their last 6 weeks of pregnancy. Their newborns were tested with an operant-choice procedure to determine whether the sounds of the recited passage were more reinforcing than the sounds of a novel passage. The previously recited passage was more reinforcing. The reinforcing value of the two passages did not differ for a matched group of control subjects. Thus, third-trimester fetuses experience their mothers' speech sounds and that prenatal auditory experience can influence postnatal auditory preferences.



- Mother recites a story for 6 weeks during pregnancy (prenatal)
  - Total 3.5 hrs story time over 6 weeks
- 
1. Story in mother's voice
  2. Story in another lady's voice
  3. Control – diff story in mother's voice
  4. Control – diff story in another lady's voice

- 
- (1) For experienced subjects (babies) the target story was more reinforcing than the novel story when both were concurrently available
  - (2) the greater reinforcing value of the target story was independent of who recited the story; and
  - (3) for matched control infants the target story was no more reinforcing than the novel story.

↓

S (artificial nipple/pacifier) → R (long pause before sucking burst) → O (familiar story)

S (artificial nipple/pacifier) → R (short pause before sucking burst) → O (novel story)

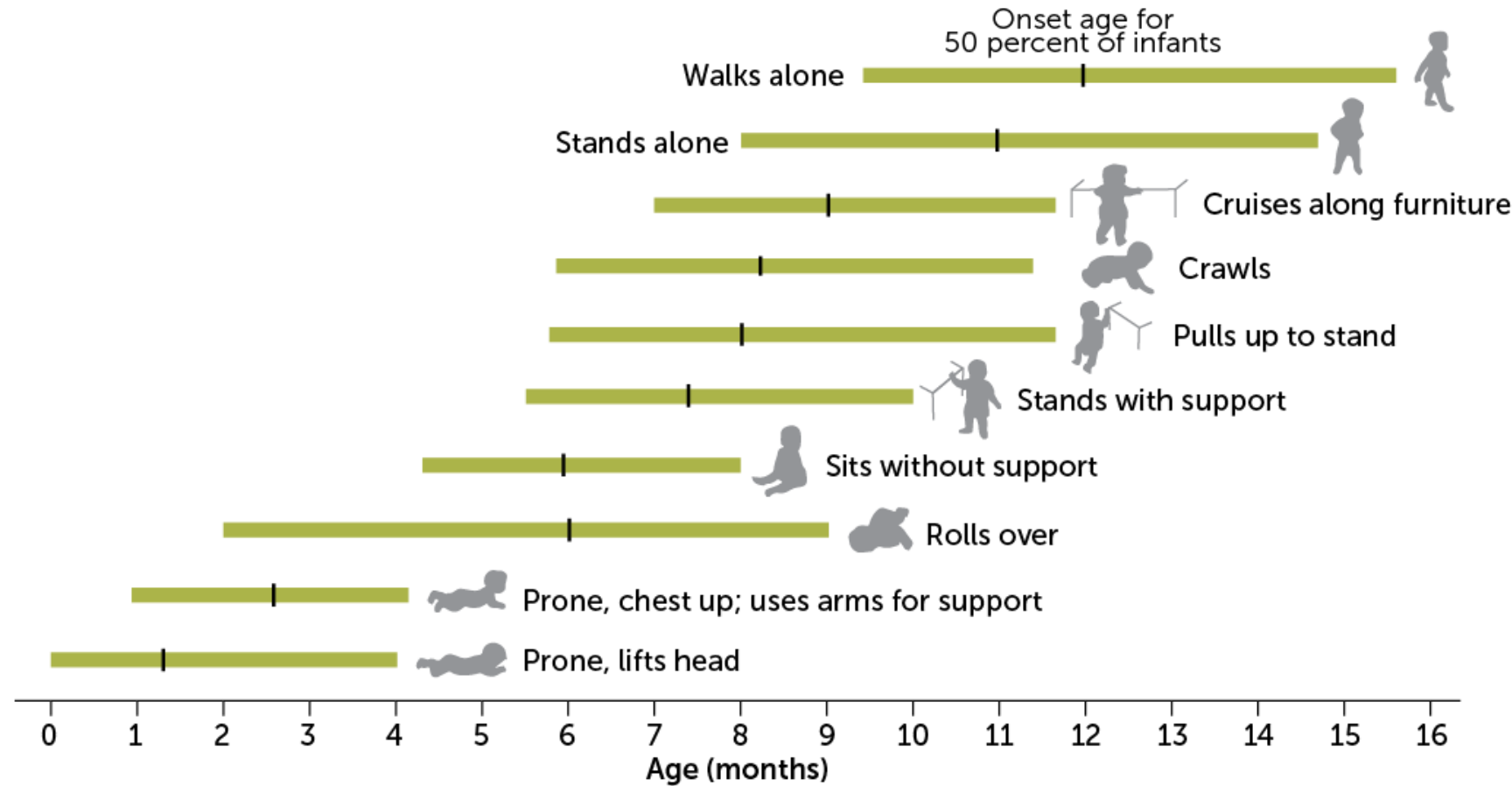
**Learning to distinguish sounds**



# Motor developmental milestones

S (crib with mobile) → R (kick) → O (mobile moves/curiosity/entertainment)

Operant conditioning (2-4 months of age)



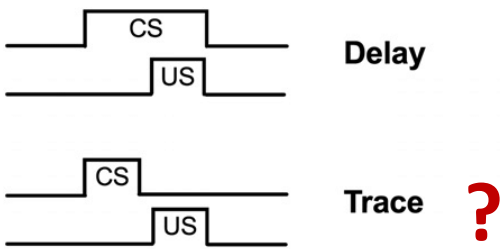


# Classical Conditioning in Newborn Humans 2-48 Hours of Age\*

ELLIOTT M. BLASS  
*Johns Hopkins University*

JUDITH R. GANCHROW AND JACOB E. STEINER  
*Hebrew University—Hadassah Faculty of Dental Medicine*

Classical conditioning was studied in newborn humans 2-48 hours of age. Infants in the Experimental group received 18, 2-min conditioning trials, each consisting of 10 s of gentle forehead stroking followed immediately by midline intraoral delivery of 0.2 ml 12.5% (0.037 M) sucrose solution via pipette. Sucrose delivery for infants in one control group was delayed following stroking by intervals of 10, 20, or 30 s presented randomly. Infants in the second control group were not stroked but only received sucrose on each trial. Immediately following the 18 sucrose trials, all infants received 9, 1-min extinction trials which consisted exclusively of 10 s of forehead stroking with no other manipulations during the remaining 50 s. All sessions were video-recorded and analyzed at a later date, with special attention paid to head-orienting, sucking, and crying behaviors. Only infants in the Experimental group presented evidence for classical conditioning. Relative to infants in the first control group, they emitted many more head-orient and sucking responses during the 10-s stroking intervals. Moreover, they exhibited a classic extinction function to stroking in sucrose absence. Finally, 7 of 8 Experimental infants cried during extinction, whereas only 1 of 16 Control infants cried. These findings demonstrate the ability of human newborn infants to extract predictability between two related events and that this form of conditioning is strongly affective. Implications for early mother-infant bond development are discussed.



Head-Stroke → sucrose water  
Head-Stroke → (variable intervals) → sucrose water  
(No Head-Stroke) → sucrose water

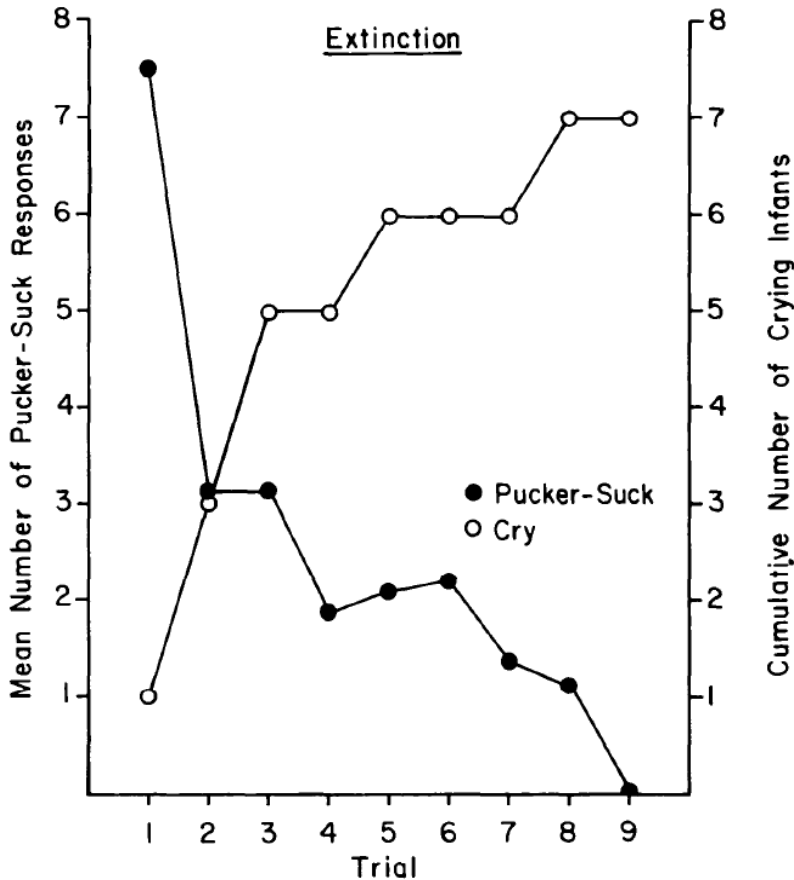


Figure 3. Mean number of Pucker-Suck responses emitted by each Experimental subject during each 60-s Extinction trial (filled circles). Open circles represent the cumulative number of Experimental subjects that cried or whimpered at least once during Extinction.

# Generalization abilities in infants

Perceptual properties –

experimenter picks blue ball → squeeze,  
child given a yellow ball → will it squeeze? YES

Language – acquired equivalence

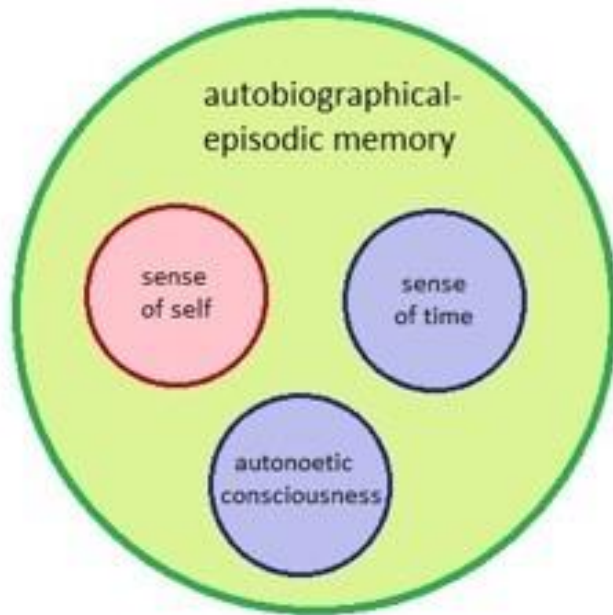
Do you remember your first day at school? Try to visualize what your classroom looked like. What colour was your uniform? Who accompanied you to school? Were you crying? What did your teacher look like?

Think of the best birthday you've ever had. How old did you turn that year? Did you cut a cake? What flavour was it? Do you remember the people who were part of your birthday celebrations? What were you wearing?



# Autobiographical memories

Do not appear until 3-4 years of age



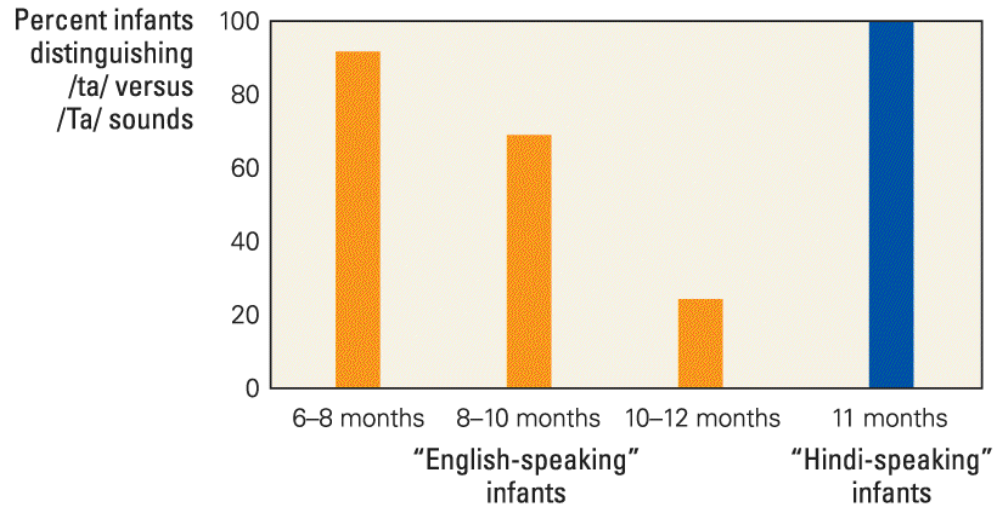
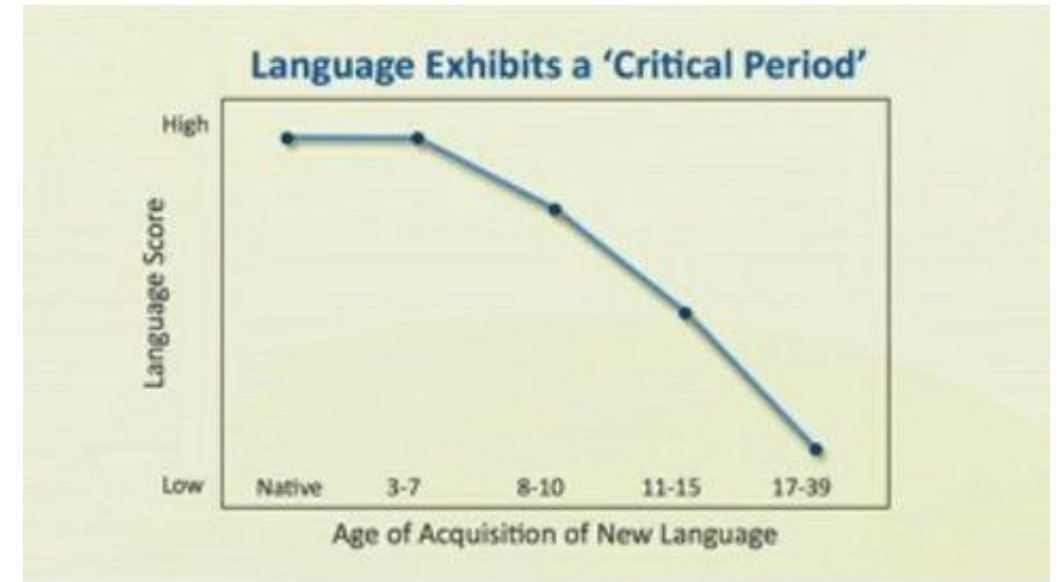
Tulving's (2005) view of autobiographical-episodic memory.



Sense of self

# Sensitive Periods of Development

- Vision – blind children
- Sounds – deaf children
- Language – (sensory deprived children)



dominant process for children → social imitation; they learn to mimic the speech around them.

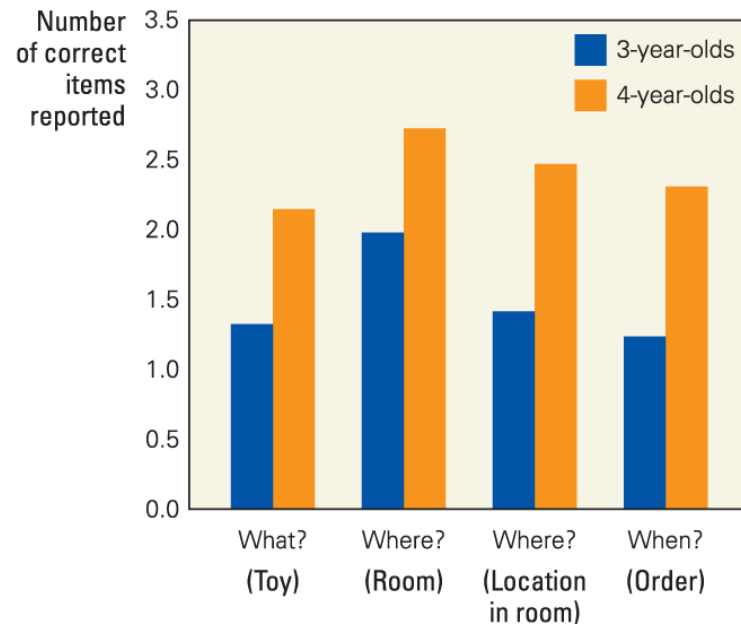
dominant process for adults → involves semantic memory, including explicit strategies such as memorization of new vocabulary

Learning a second language is easier in childhood

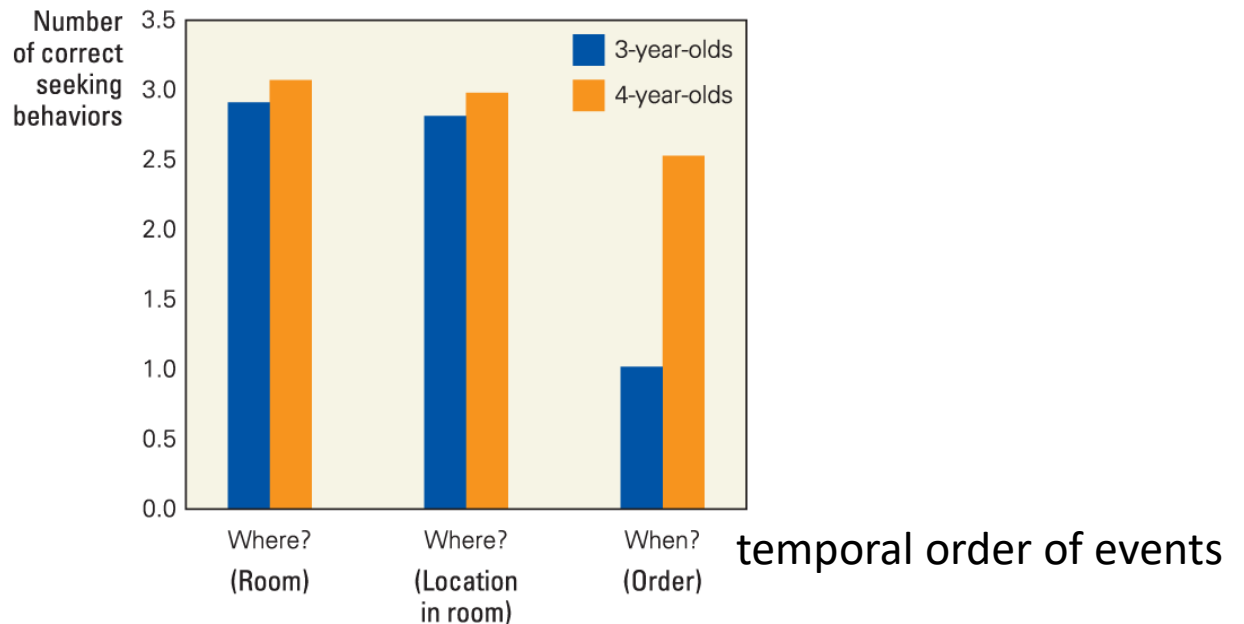
# Episodic-Like Memory in Children

children hid three different stuffed toys in three separate locations around their own homes.

**A** Verbal recall



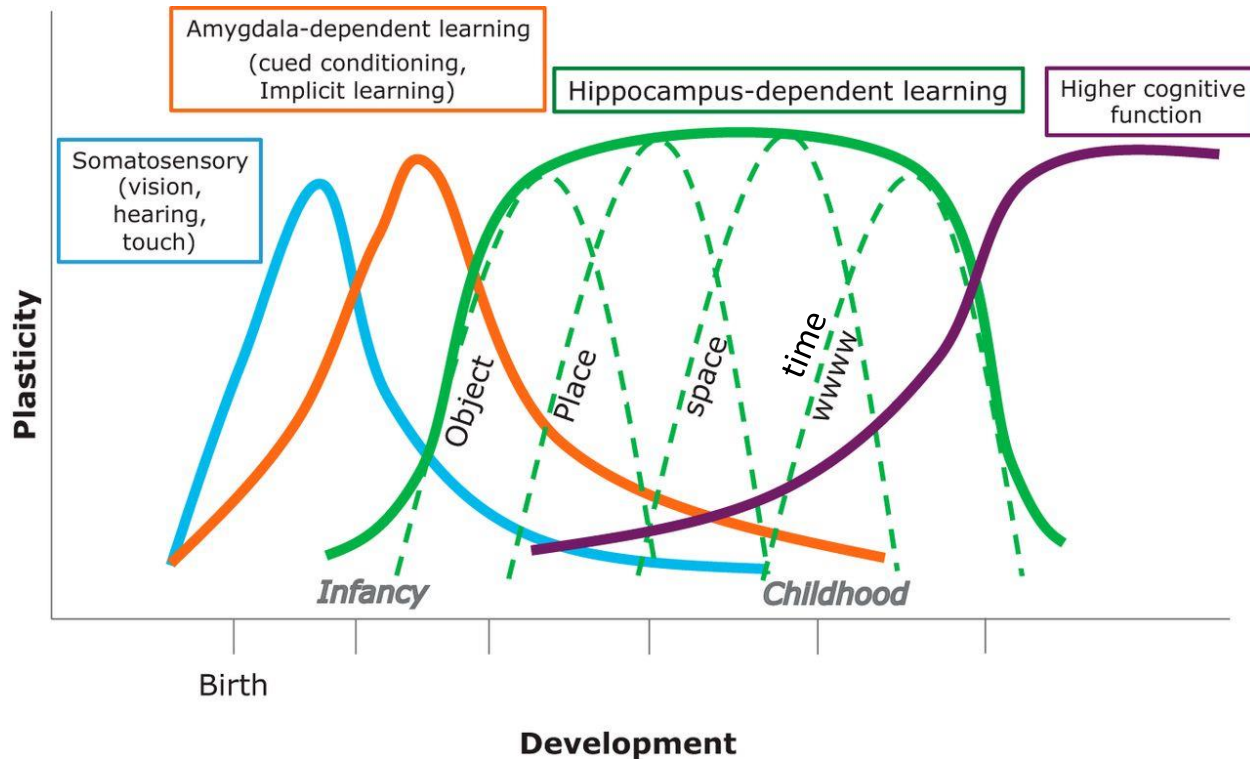
**B** Behavioral test



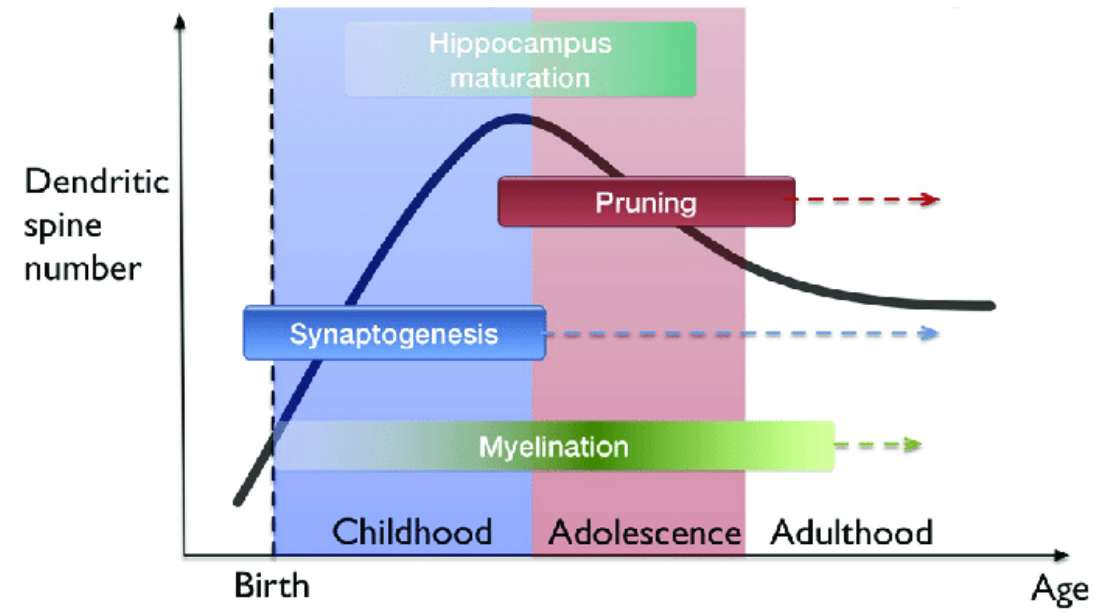
Gluck et al., *Learning and Memory*, 4e, © 2020 Worth Publishers

“Can you show me the room we went into first and find who (toy) is hiding there?”

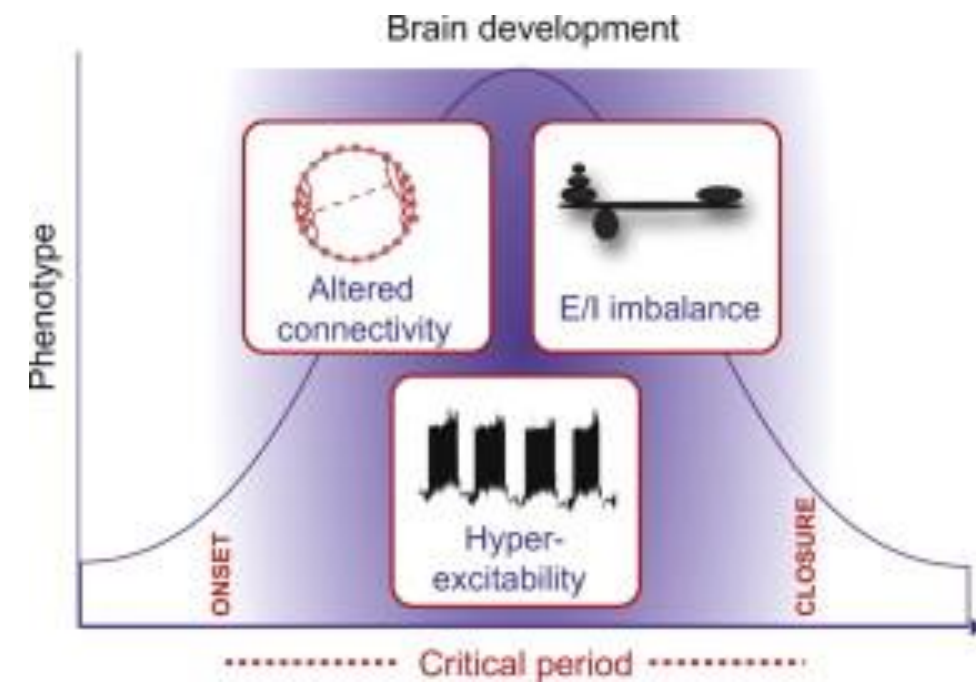
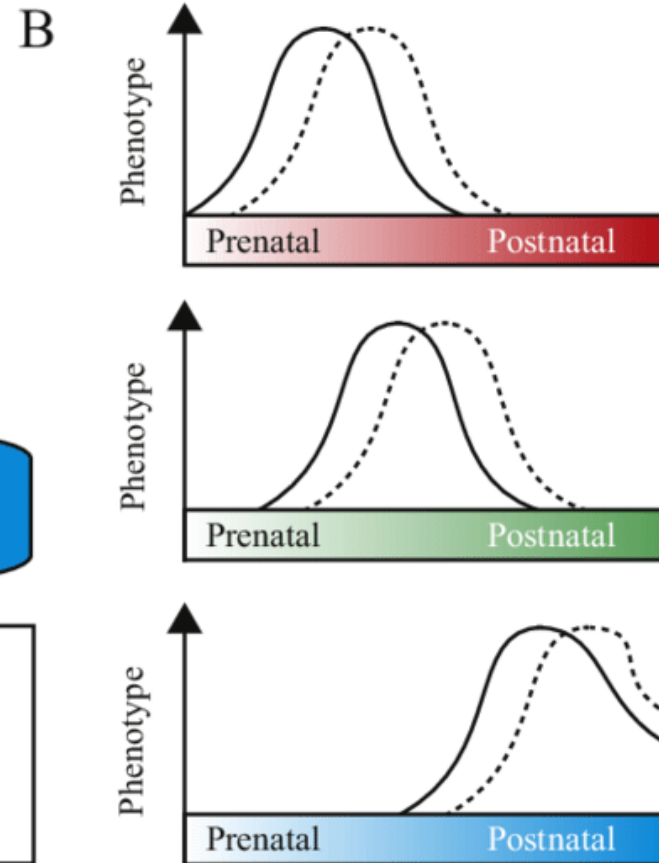
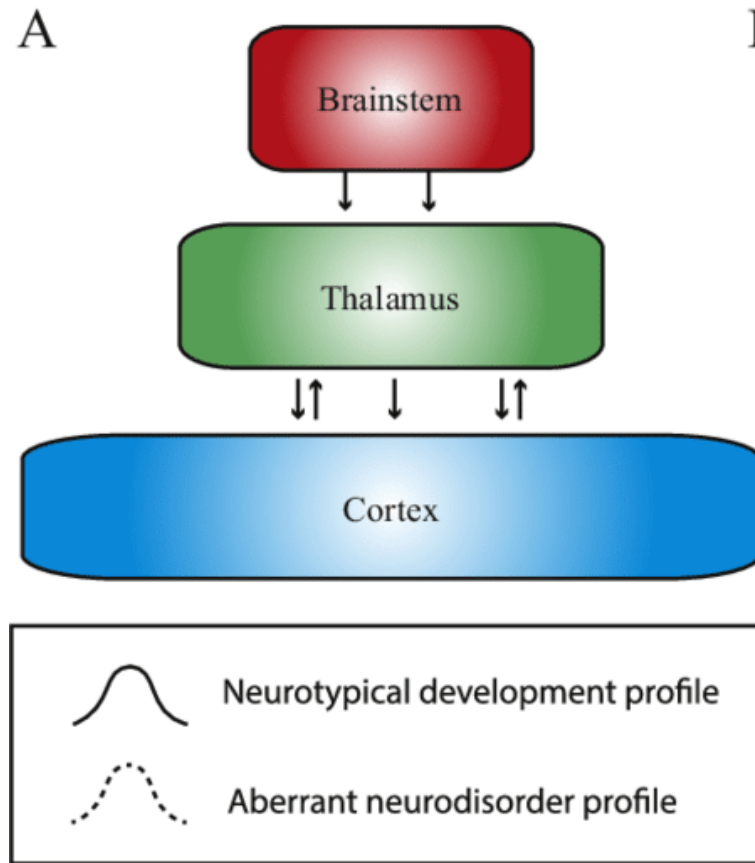
# Infantile Amnesia (pdf link)



Alberini and Travaglia (2017)



Typically, the hippocampi are not very well developed at birth. At around age 2, the hippocampi begin to mature and connect with other brain regions. That is why infants and toddlers are unable to remember many events or episodes from their lives. By the age of 4, children begin to slowly recollect events and verbalize what they remember, but not as well as adults. This is probably the reason why many of us cannot remember events from when we were kids, such as our first day at school. Our hippocampi were still developing at that age, and the memories that were formed then did not last very long.



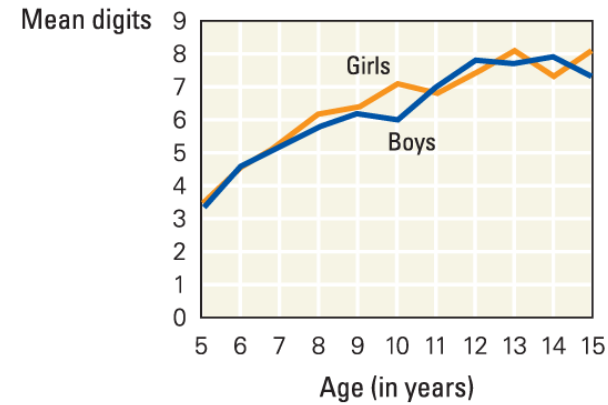


# Working memory

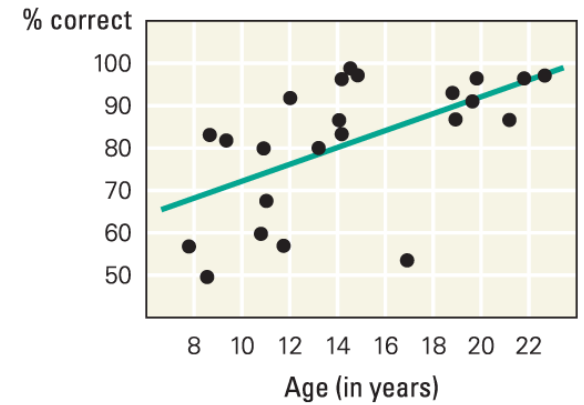


- Ten-year-old chess experts could remember more pieces than non-chess-playing adults,
- exposure to and familiarity with the material is important for working memory to develop

**A** Digit span



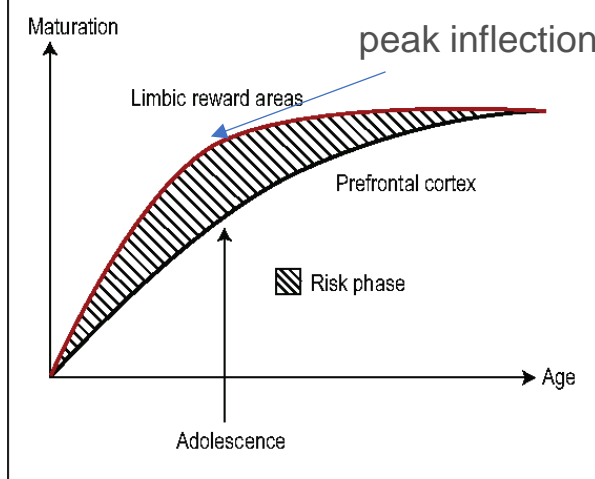
**B** 2-back task



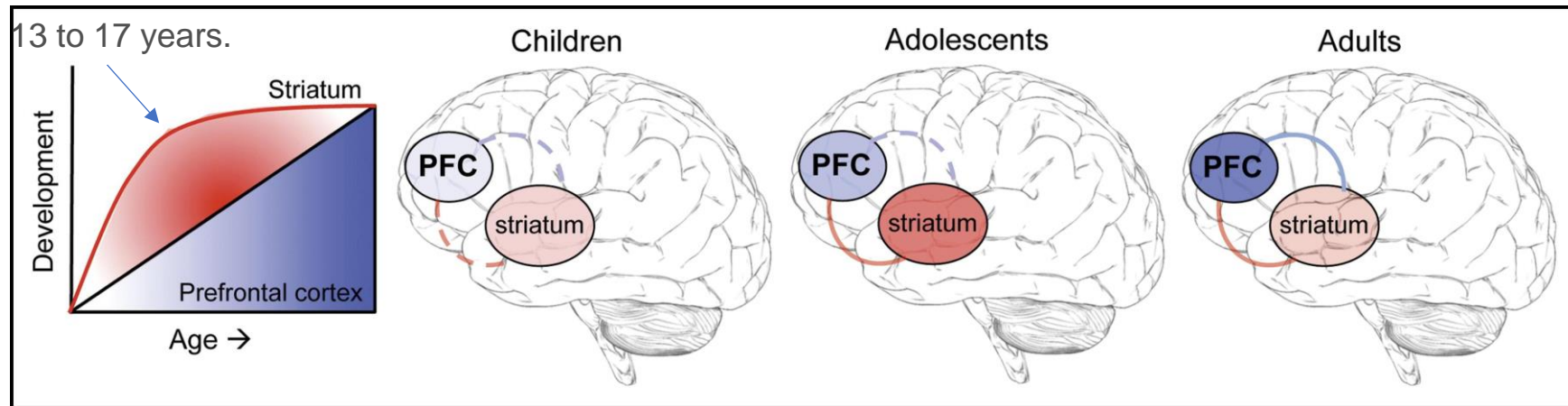
Gluck et al., *Learning and Memory*, 4e, © 2020 Worth Publishers

- n-back task
  - Requires spatial working memory (mental map of sequence of events)





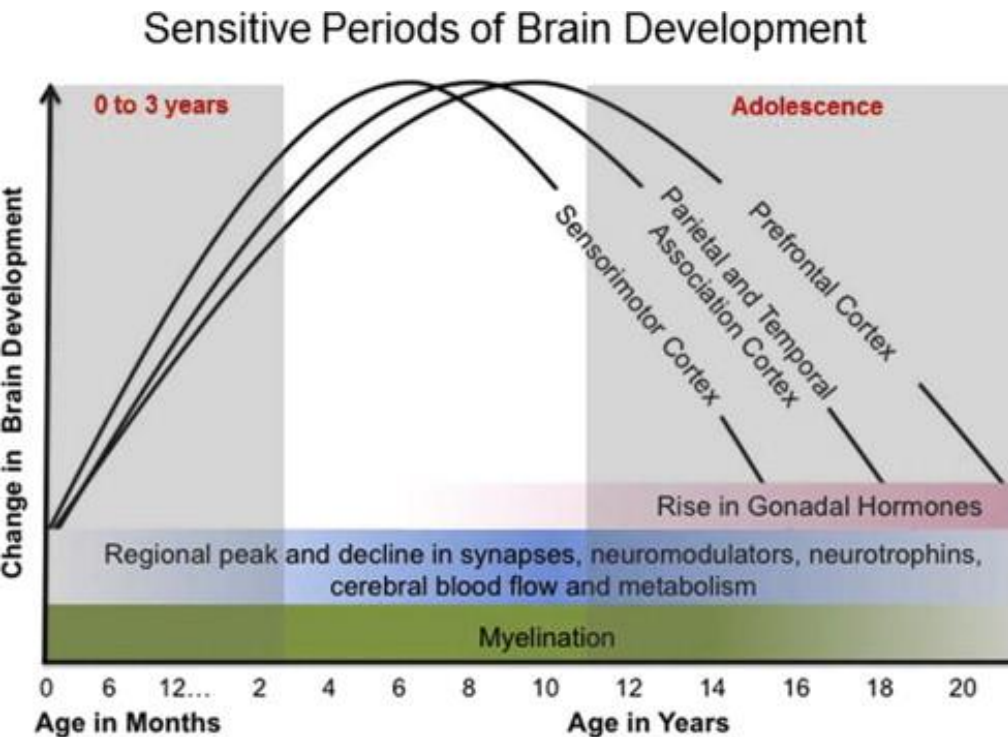
Nonlinear maturation processes of subcortical and prefrontal brain



[https://www.jaacap.org/article/S0890-8567\(10\)00670-2/fulltext](https://www.jaacap.org/article/S0890-8567(10)00670-2/fulltext)

Evolutionarily?

## PFC maturation



Post puberty  
Higher testosterone

- Juvenile crime?
- Addiction
- Drug abuse
- Rape
- Inability to assess consequences (thrill, risk)
- The PFC has inhibitory control over many brain regions.
- Inhibitory control during adolescence is not matured

Driving/drinking Laws