Part 2, Nervous System Development and Diseases

2.3. Modification of neural circuits as a result of experience

- The rich diversity of personalities, abilities, and behaviors generated by individual human brains derives from both **genetic** and **environmental** influences on developing neural circuits.

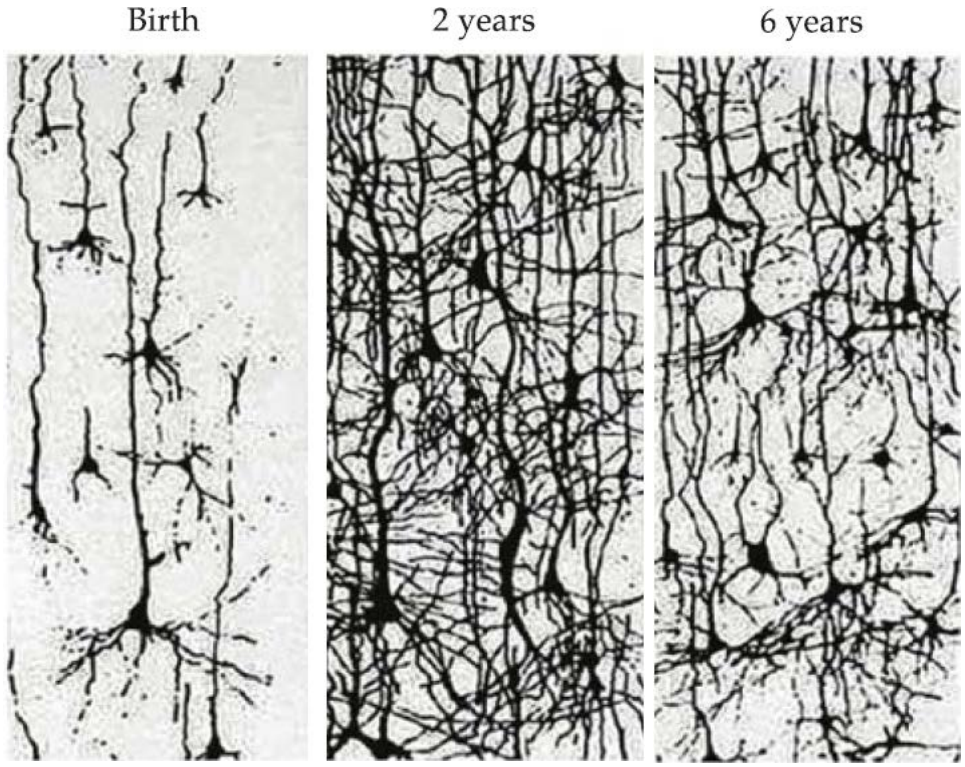
- This activity-mediated influence is greatest during temporal windows called **critical periods**.

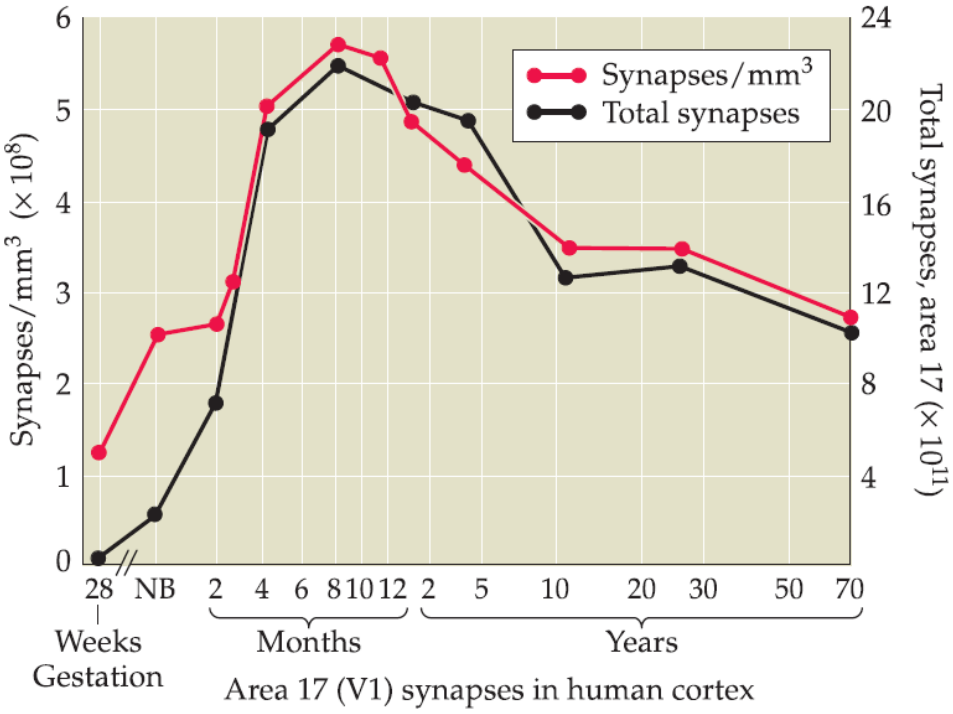
- As humans (and other mammals) mature, the cellular mechanisms that modify neural connectivity become less effective, and the brain becomes increasingly refractory to the lessons of experience.

Neural activity and brain development

- Role of activity in influencing the ongoing organization of neural circuits:

1. Behaviors not initially present in newborns emerge and are shaped by experience throughout early life.
2. The brain continues to grow after birth.
3. There is a subsequent decline in synapse number during adolescence.





Innate/"instinctual"/"built-in"/"preprogrammed" behaviors

- For most animals, basic survival behaviors relies on patterns of connectivity established by intrinsic developmental mechanisms:
  - foraging, fighting, and mating strategies.
  - parental identification, feeding, and responding to predators.
    - **Harry Harlow** did experiments on isolated baby monkeys within a few hours of birth and raised them in the absence of either a natural mother or a human substitute, instead, with one of two maternal surrogates:
      - a "mother" constructed of a wooden frame covered with wire mesh that supported a nursing bottle.
      - a similarly shaped object covered with soft terrycloth but without any source of nourishment for the young monkey.
    - Newborn monkeys have a built-in need for maternal care and have at least some innate idea of what a mother should feel like.
    - A naive monkey's fear reaction to the presentation of certain objects (e.g., a snake)
    - The "looming" response (fear elicited by the rapid approach of any formidable object)

Critical period

- The nervous systems of animals with increasingly complex repertoires of behaviors, including humans, clearly adapt to and are influenced by the particular circumstances of an individual's environment beyond innate behavioral capacities.

- These environmental factors are especially influential in early life, during temporal windows called **critical period**.

- Experience and neural activity that reflects that experience have maximal effect on the acquisition or skilled execution of a particular behavior.

  - **Parental imprinting** in hatchling birds (the event by which the hatchling recognizes its "parent"): expressed only if animals have certain specific experiences during a sharply restricted time (hours or days) in early postnatal (or posthatching) development.

    - **Konrad Lorenz**'s work with geese.

Konrad Lorenz's work with geese

- Goslings follow the first large, moving object they see and hear during their first day of life.
  - Goslings will imprint on a wide range of animate and inanimate objects presented during this period, including Lorenz himself.
  - The window for imprinting in goslings is less than a day.
  - if animals are not exposed to an appropriate stimulus during this time, they will never form the appropriate parental relationship.
  - Once imprinting occurs, however, it is irreversible, and geese will continue to follow inappropriate objects (male conspecifics, people, or even inanimate objects).

    - **Konrad Lorenz**: Austrian zoologist, ethologist, and ornithologist; Nazi party member; Nobel Prize in 1973.

- Parental imprinting is an innate behavior. However, the right imprinting requires specific experience during the critical period.