The Development of Self Regulation in High-Risk Infants

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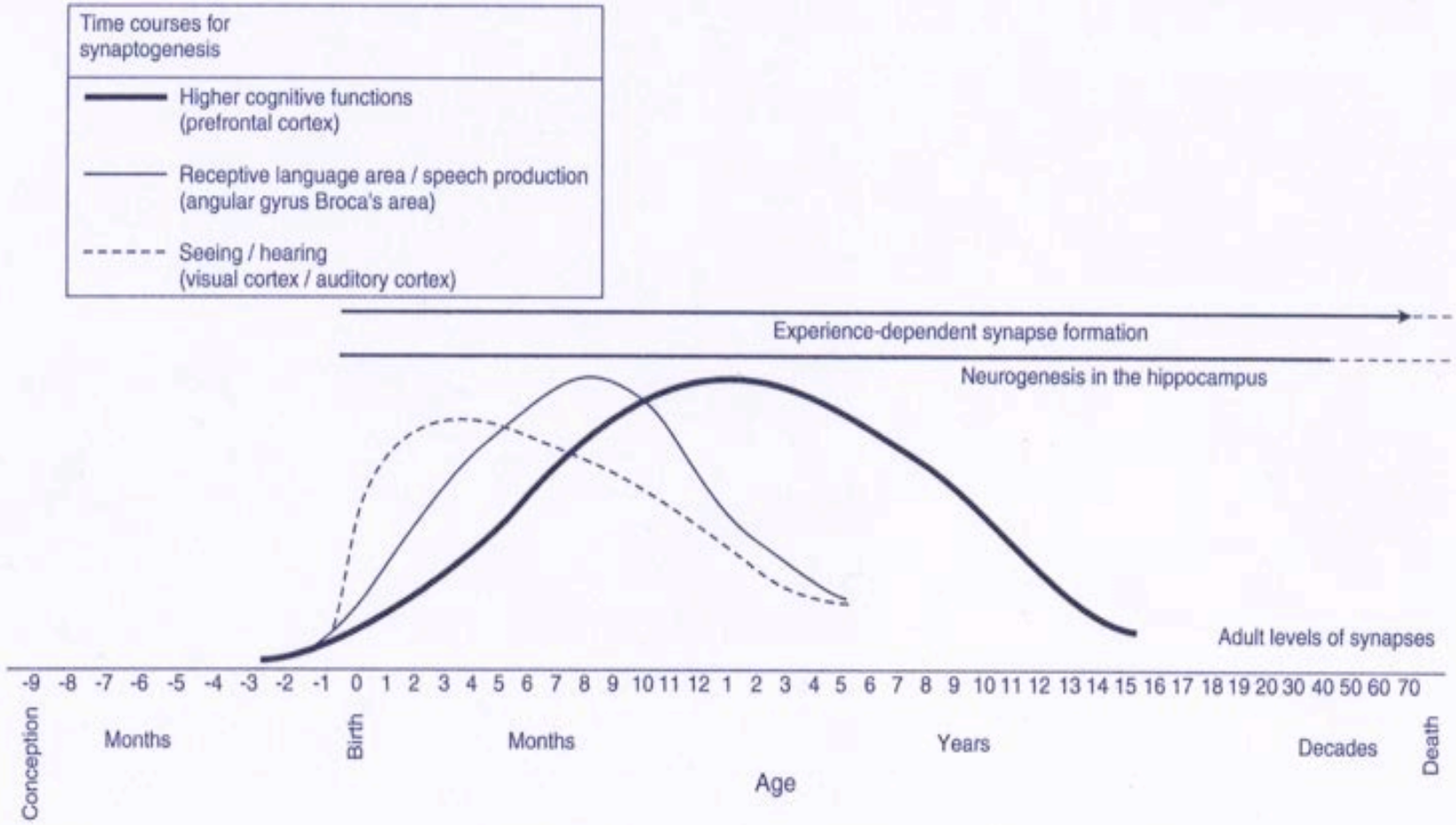


FIGURE 8-1 Human brain development. SOURCE: Charles A. Nelson, University of Minnesota. Reprinted with permission.

In Shonkoff, J. & Phillips, D. 2000. From Neurons to Neighborhoods.

What is Self Regulation?

…initially it refers to the mastery of tasks accomplished by the mother's body in the womb… but now must be accomplished by the child's body and through signaling needs to responsive adults…

Shonkoff & Phillips (2001)

What is Self Regulation?

…early events permanently affect the development of the self…infant interactions with early human social environment directly and indelibly influence the postnatal maturation of brain structures that will regulate all future socioemotional functioning…

Shore, A. 2003

What is Self Regulation?

Requires that parents/caregivers:

-read infant cues/signals

-understand infant signals

-have knowledge, energy and resources to respond to infant in ways that promote growth and development

Self Regulation...

"...refers to the ability to regulate emotional state and to organize a behavioral response to experience."

Barton & Robins, 2000

"...reflects the growing maturation and integration of several brain areas, particularly the frontal lobe."

Als, H., l999

"…is the ability to coordinate and organize motor activity, levels of arousal, attention….important for human learning, planning, decision making, performing complex sequential actions.

Watson, 2010

The Frontal Lobe

- most completely organized brain area
- crucial for complex planning and communication
- inhibits stimuli reactions
- supports delay of gratification
- allows for suspended action while reviewing uncertainty
- it diffuses pressure while planning

Als, l997

The Role of the Parent/Caregiver

To establish connections with their child-- becomes the basic task of the early months of life for parents.

Provide experiences that allow children to take over and self regulate each aspect of their lives one after another.

Shift the responsibility of regulation over to the child in day to day domains of sleeping, waking, and soothing.

The Full Term Healthy Newborn

Synchronization occurs in

Physiology function (breathing, skin color and visceral)

Motor Function (posture, tone, movement)

State Function (sleep and waking cycles)

Als, 1982; 1999; 2007

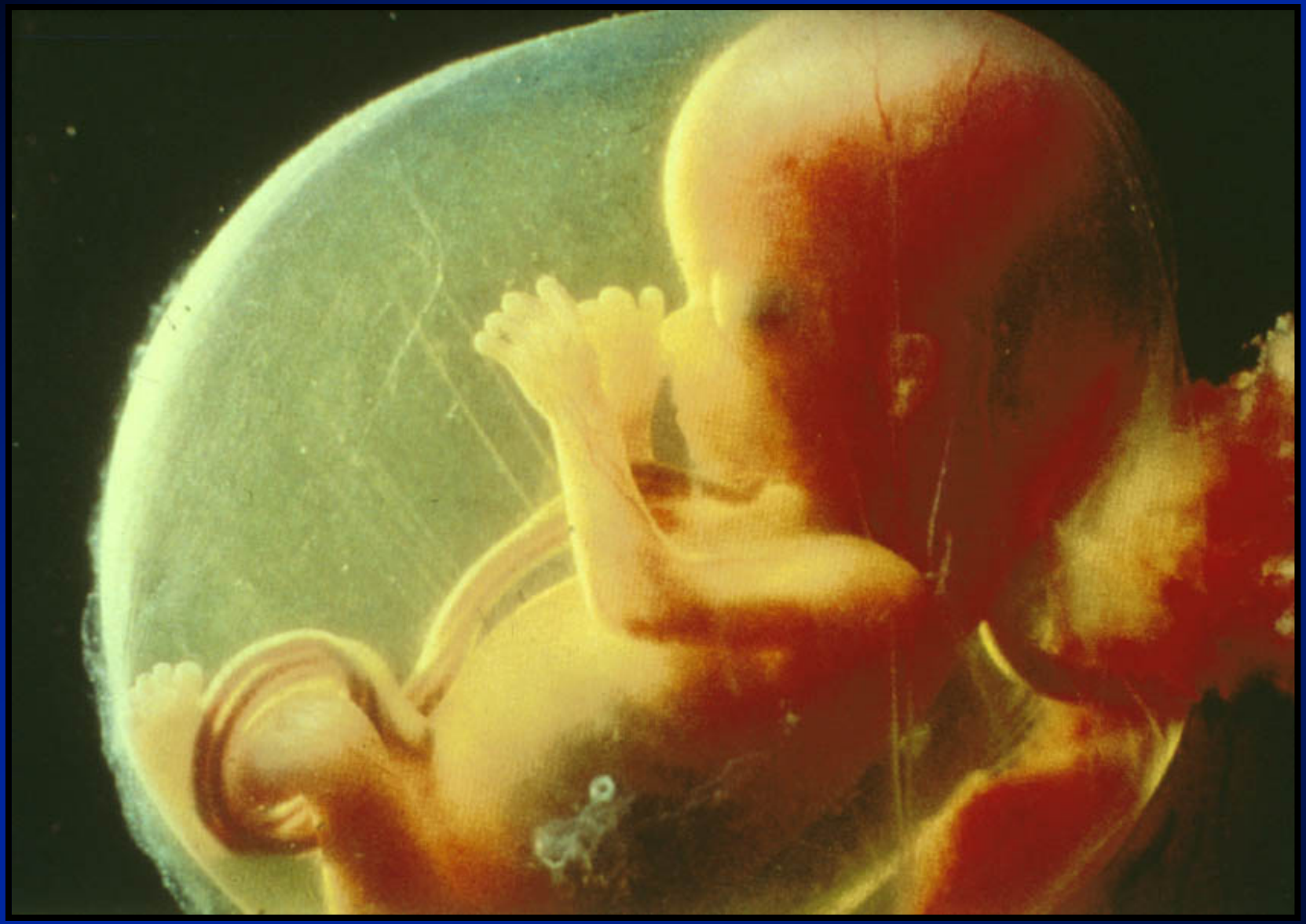
Fetus' Situation

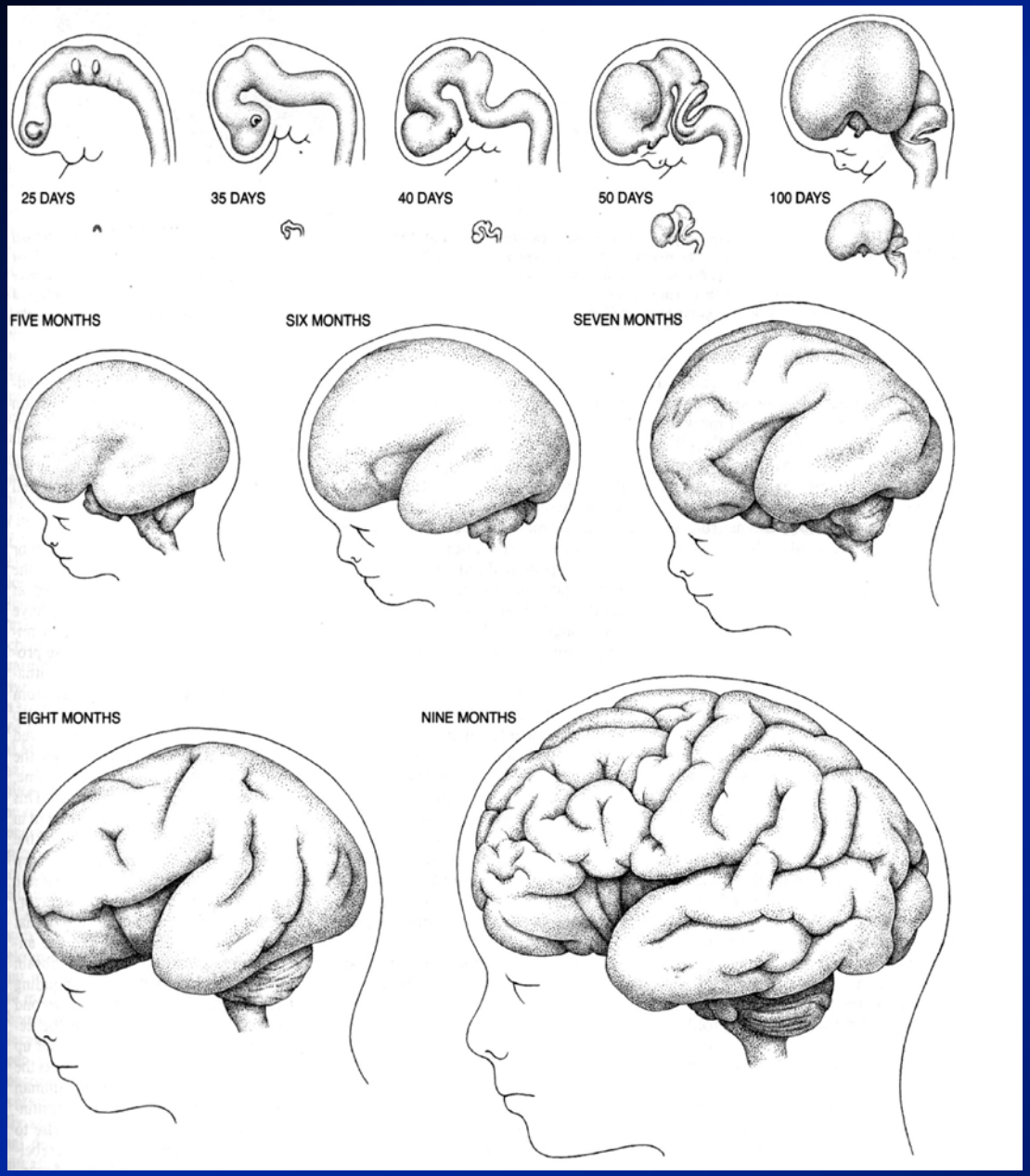
In womb:

Fluid-filled oscillating sack

Warm, constant mother-mediated temperature

No gravity





Drawing by Tom Prentiss.

In: Cowan MW 1979. The development of the brain. Scientific American 113; 113-133

H. Als, 1982

Neural Network

The First Three Months of Life

Foundation for organizing regulatory capacity.

Physiology, arousal, emotion, and attention come under control.

Sensory function and integration matures.

Interconnections in the brain create intricate pathways between emotions and cognition.

Watson, 2010

Fetus' Situation

In womb:

-fluid-filled oscillating sack

-warm, constant mother-mediated temperature

-no gravity

Gestation

Photo: Nilsson L. (1973). *Behold Man.* Boston, Toronto: Little, Brown and Company.

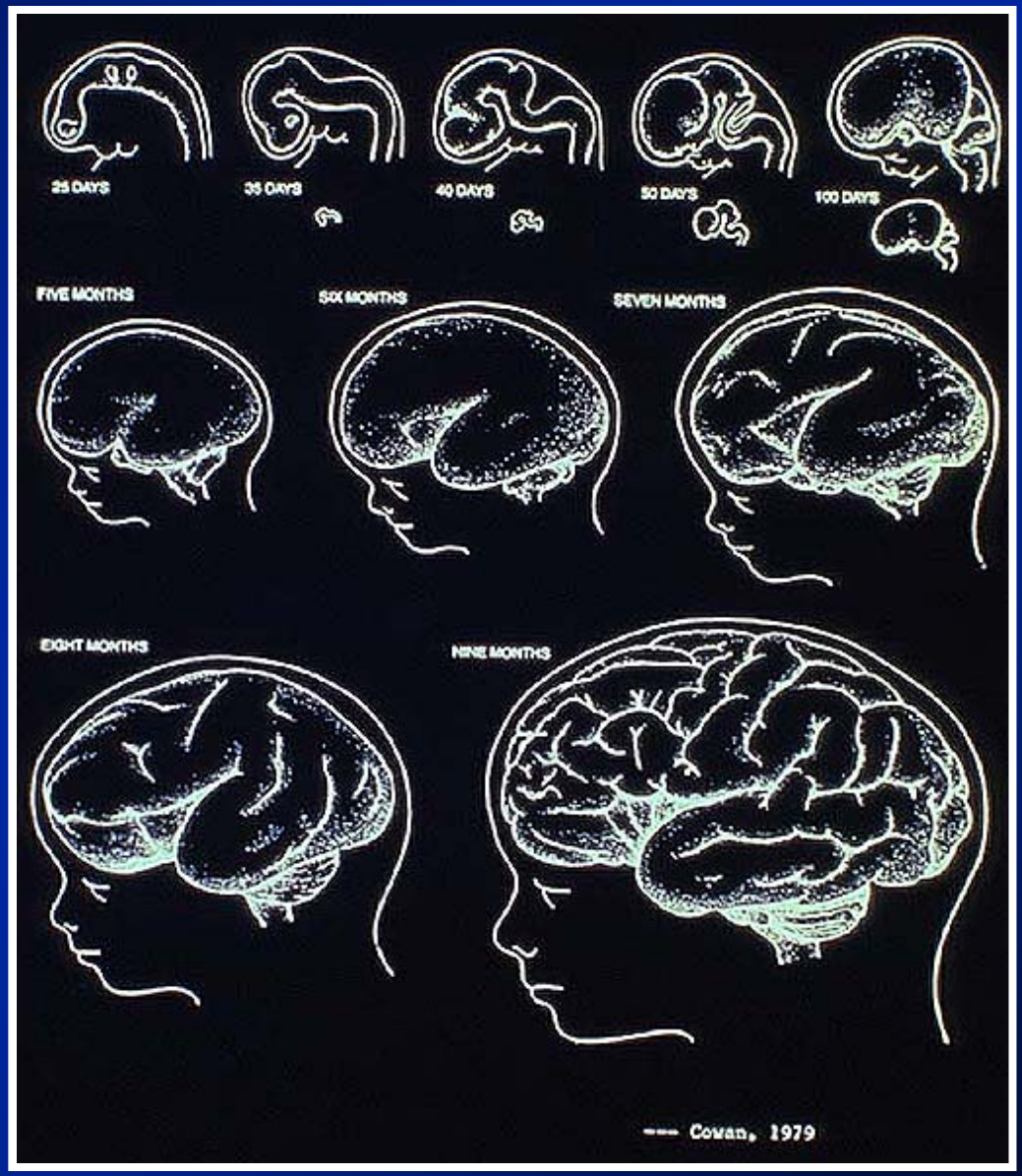
Right Photo: Tsiara, A. (2002). *From Conception to Birth*, New York: Doubleday.

K Abrupt Transition

- *Fetal brain development*
- *Mismatch situation*
- *Change in central nervous system*

Als, l982

Fetal Brain Development



Early Brain Development

- Neurons are building blocks in brain
- Formation starts 8 weeks of fetal life and continues to 40 weeks, with few connections between neurons
- Neurons connect to each other to form synapses

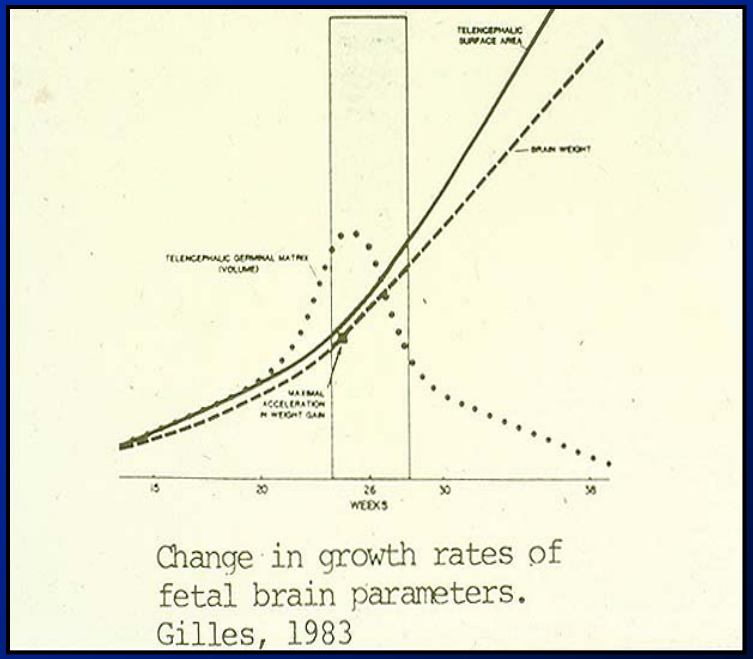
Bennett 1996;2005

Migration to Cerebral Cortex

Peak Time Period: 3-5 months of gestation

Major Events:

- Millions of nerve cells move from their sites of origin in ventricular and subventricular zones to the CNS where they remain for life - a highly ordered process of regulated timing and direction.
- Cells that migrate first take deepest position in cortex and those that migrate later take a more superficial position.
- By 24 weeks gestation the cerebral cortex has its full complement of neurons.



Change in growth rates of fetal brain parameters. Gilles, 1983

Volpe, 2005

(Volpe, 1984)

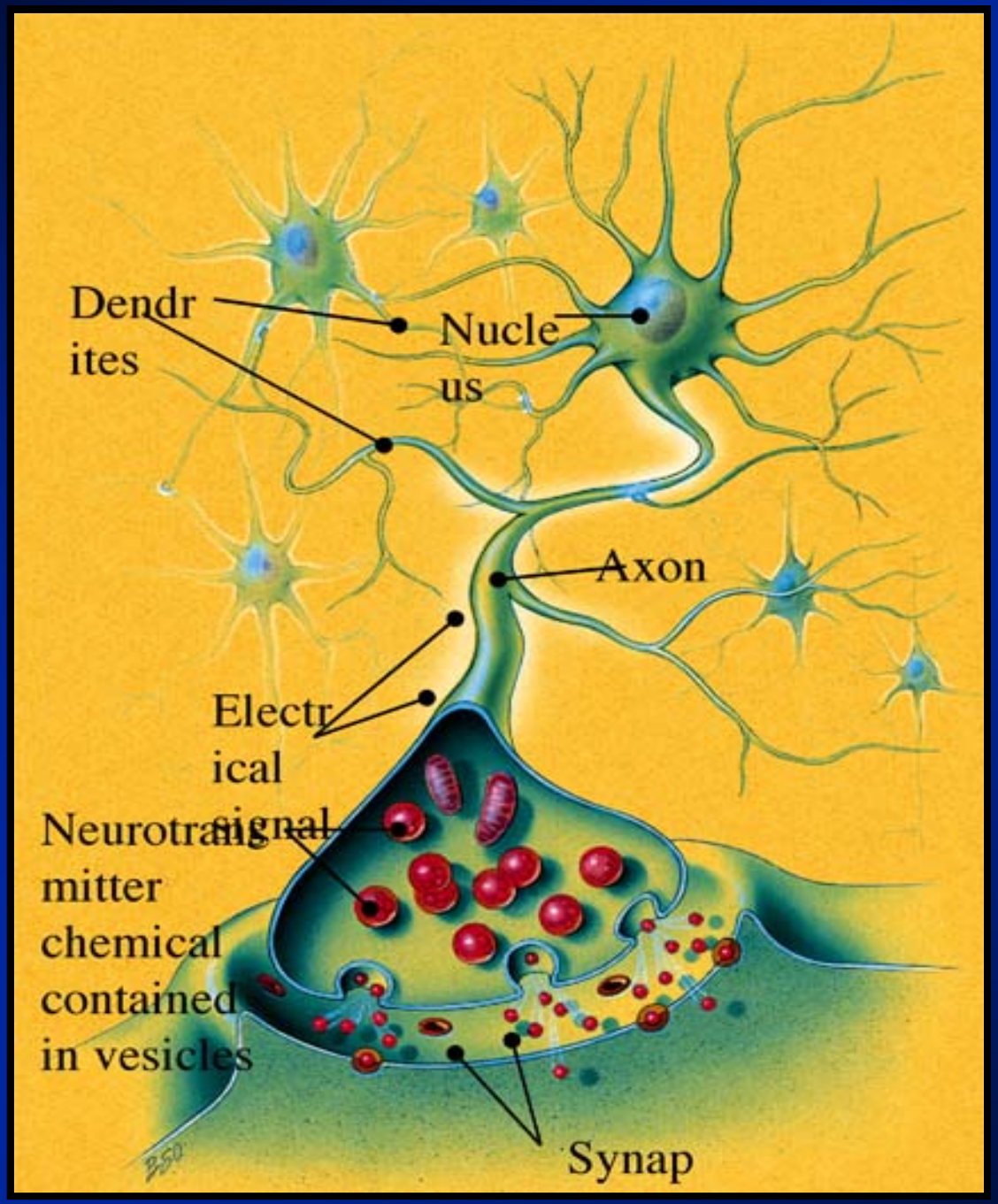
Synaptic Overproduction and Loss

- Neuron and synapse overproduction
- Synapse pruning

Brain prunes half of what is produced

Which neurons get eliminated and which are saved is a function of the kinds of experiences and interactions the infant has after birth

(Bennett, 1996)


Dendr
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Nucle
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Axon
Electr
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signal
Neurotrans
mitter
chemical
contained
in vesicles
Synap

“In full term infants, axonal and dendritic proliferation … and cell growth and differentiation … occurs in an environment of mother mediated protection from environmental perturbations, with a steady supply of nutrients, temperature control, and the presence of multiple hormonal regulating systems …”

Als (1997)

“It is likely that waiting and regressive events are modified when the brain finds itself … outside the womb too early … and cells are preserved that otherwise would be eliminated, and cells are eliminated that would otherwise be preserved.”

Als (1997;2007)

Results: Brain Tissue Volumes, 42wLMP

Tissue Class (ml)	Preterm Infants (n = 23)	Term Infants (n = 15)	P value ANCOVA)*
cG	176.2 ± 26.2†	162.4 ± 23.4	NS
scGM	21.2 ± 4.2	20.7 ± 5.2	NS
CER	29.0 ± 3.6	27.4 ± 3.9	NS
umWM	206.4 ± 29.2	216.5 ± 31.9	<0.10
Central umWM	36.1 ± 6.0	40.2 ± 5.6	*< 0.01*
R. Inf. Centr. umWM	6.8 ± 1.1	8.0 ± 1.1	*<0.0005*
mWM	7.3 ± 2.4	9.8 ± 3.8	*< 0.02*
Central mWM	3.7 ± 1.2	4.8 ± 1.9	*< 0.05*
Occipital mWM	3.1 ± 1.4	4.4 ± 1.9	*< 0.02*

*ANCOVA: CPAR as Covariate; † Means ± Standard Deviations;
‡ NS: Not Significant; R. Inf. Central: Right Inferior Central

Mewes AUJ, Hüppi PS, Als H, et al, Pediatrics, 2006;118: 23-33

H. Als, 2010

Fullterm-Born Infant at 2 weeks post EDC

Als H, Duffy FH, McAnulty GB. Behavioral differences between preterm and fullterm newborns as measured with the APIB system scores: I. Infant Behavior and Development, 1988;11:305-318.

H. Als, 2010

Preterm-Born Infant (28wGA) at 2 weeks post EDC

Als H, Duffy FH, McAnulty GB. Behavioral differences between preterm and fullterm newborns as measured with the APIB system scores: I. Infant Behavior and Development, 1988;11:305-318.

H. Als, 2010

The NICU and the Developing Brain

-A preterm infant is developing in an unusual environment and has had less time for the brain to develop.

-A preterm infant cared for in the NICU is vulnerable to ongoing exposure to severe sensory overload and inconsistent variations in input.

-This creates a dramatic mismatch situation between the developing central nervous system and the NICU.

Gilkerson, l997;Als, l982; l999;2004;2005)

Contrast the Infant and Mother's Experience for Evolution-Promised Closeness and Nurturing

Fullterms

Preterms

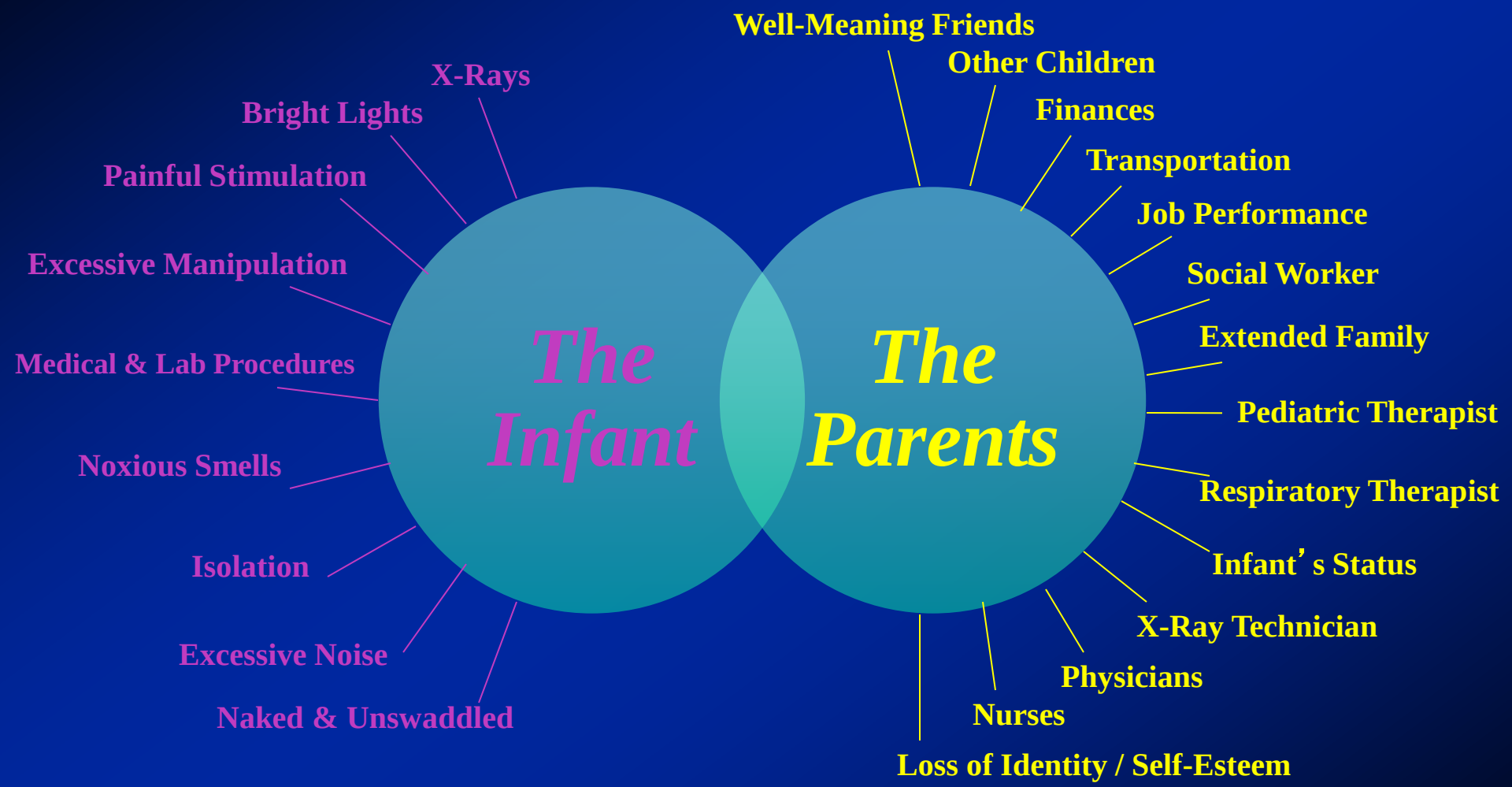
Als, 2005

The Traditional NICU /SCN Setting

Families within the NICU

H. Als, 1986

Stimuli Impact in the NICU



Leander & Pettett, 1986; Lightbody, 2011

The Regulated Balanced Infant

-regular breathing with stable color
-steady heart rate
-stable digestion
-modulated tone
-maintains flexion/tucked positions
-maintains flexor posture in grasp, tuck, bracing
sucking, holding on, etc.
-periods quiet restful sleep, smooth transitions,
-periods of quiet/relaxed awake
-generally relaxed, comfortable, steady, calm

The Disorganized Stressed Infant

-irregular breathing, fast, slow
-uneven, flushed, red, dusky, pale
-labored breathing, unsteady heart rate
-gagging, straining, emesis
-frantic, flailing, arching movement with tense extended arms/legs with rigid extensions
-overly flexed arms tightly into chest
-sleeps with random activity, abrupt changes,
-irritability, sudden arousal, appears fragile
-hyperalertness or may avoid interaction
-fussy, agitated, shut down, exhausted, unavailable

Als, l982;1999;2009

Facilitation of Self Regulation

-observe efforts to self calm
-build on available behaviors in infant
-support postures to help infant
suck on hand, hand to mouth or face, hands clasped, feet together or touching, foot/leg bracing, tucking, holding on, grasping, gazing, looking

VandenBerg, 2007; Smith et al, 2007; Als, 2011

The High Risk Newborn

Common Behavioral Issues

-unpredictable
-unconsolable
-poor social interaction
-cannot make eye contact
-less smiling and vocalizing
-less positive affect
-hard to read cues and needs
-“tuned out” stress

Self Regulation of Sleep

Sources of Problems with Sleep

-sleep skills are fragile

-overly tired

-fabric, odors, noise interferes

-illness

-medication

-overstimulation

-reactive to family tension

-immature baby -cannot organize self

Assessing Self Regulation

-Can this infant calm him/herself?

-Does he/she try?

-Is he/she unsuccessful?

-Is there some or no success?

Syndrome Excessive Crying

Classified as:

Disorders of behavioral and emotional regulation in early childhood

Persists beyond 3 months of life as *persistent excessive crying*

Papousek & von Hofacker, 1995

Clinical Syndrome

Diagnosis includes:

1. Infant's inconsolable crying with problems in sleep-wake organization.

2. Parent's overload and psychosocial stress.

3. Frequent interaction failure which exacerbates the behavioral patterns.

Papousek, 2000;2008

Self Regulation

Executive function

Regulating emotion

Infant Development occurs in context of *relationships*.