Normal Development: How (and what) Children Learn

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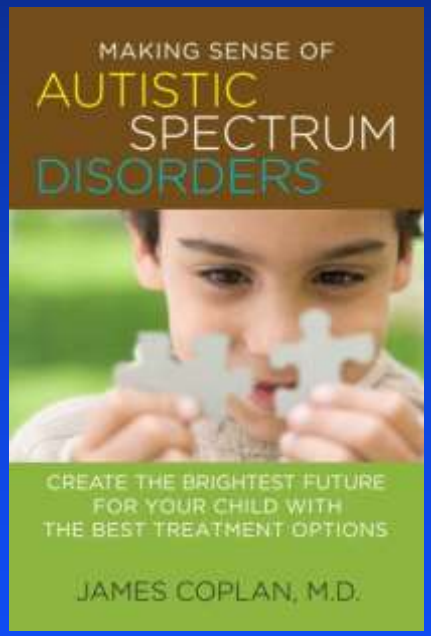
Disclosures

- **Dr. Coplan is author of *Making Sense of Autistic Spectrum Disorders: Create the brightest future for your child with the best treatment options* (Bantam-Dell, 2010), and receives royalties on its sale**



- **This presentation will include a discussion of off-label drug use**

Child Development

- The study of the change in brain function with time
- Areas of function
  - Motor
  - Cognitive
  - Sensory
  - Behavioral

Goals of Developmental Pediatrics:

- Optimize developmental outcome
  - Functional Diagnosis
  - Etiologic Diagnosis
  - Associated Medical Conditions
  - Formulation of Therapy Program
  - Prognosis / Iterative re-evaluation
- Optimize Family Function

Definitions

- "Developmental Period"
  - Conception to age 5 yrs
  - Period of maximal brain growth
    - Brain weight
      - Birth ~ 500 gm
      - 1 yr ~ 1000 gm
      - 5 yr ~ 1500 gm, 90% of adult
- But some aspects of development continue until mid-adulthood

Developmental Models

- Piaget: Stages of Development
- Gesell: Domains of Development
- Behaviorism (Watson, Thorndike, Skinner): Rejects the developmental model

Behaviorism

- **All behavior is the result of prior experience (conditioning)**
- **A useful technique to *shape behavior*, but ignores (or denies the existence of) developmental processes:**
- **"We build in at an early age everything that is later to appear…there is nothing from within to develop."***

*Watson, J., *Psychological care of infant and child*. 1928

Jean Piaget (1896-1980)

- Described 4 stages:
  - Sensorimotor
  - Pre-Operational
  - Concrete Operations
  - Formal Operations
- Within each stage, child interacts with the environment according to specific "*schemas*," and takes in the world via specific cognitive structures

Jean Piaget (1896-1980)

- Transition from one stage to the next:
  - Emphasizes child's interaction with the environment
    - Interacts with environment using current schemas
    - Accommodation & Assimilation lead to modification of schemas
  - (How do you get to Carnegie Hall?)

Jean Piaget (1896-1980)

- **Described 4 stages:**
  - Sensorimotor (0-24 mo)
    - "Children experience the world through movement and the senses"
      - Acquisition of certain basic cognitive skills:
        - Existence of self
        - Existence of others / Social reciprocity
        - Object permanence
        - Causality (simple)

http://en.wikipedia.org/wiki/Jean_Piaget

Sensorimotor Schemas

- **Banging & Mouthing objects (7-9 m)**
- **Cause & Effect:**
  - **Parent bounces child on knee, then stops: Child tries to "re-activate" parent by bouncing (9 mo)**
  - **"Busy box" toys: 14 mo +**
- **Social Interaction**
  - **Peek-a-boo, patty-cake, etc: 9 mo**

Jean Piaget (1896-1980)

- **Described 4 stages:**
  - **Pre-operational (24-48 mo)**
    - **Child begins to grasp more complex relationships, but sensory perceptions or temporal sequence still dominate, distorting child's perceptions:**
      - ***Why is the moon following the car?***
      - ***How do the deer know to cross where the "Deer Crossing" sign is?***
      - ***Umbrellas cause rain!***

Jean Piaget (1896-1980)

- **Described 4 stages:**
  - Concrete Operations (4-10 yr)
    - Physical logic:
      - Rule-based behavior, ex:
        - Rule-based games (Uno, Candyland, etc)
        - Arithmetic
        - Irreversibility of death
      - However: Child engages in "unicausality":
        - Ex: All disease is caused by "germs"
    - Social logic: Able to "de-center" and take the other person's point of view

Jean Piaget (1896-1980)

- **Described 4 stages:**
  - Formal Operations (10+)
    - Abstract Logic
      - Existential questions
        - What are good and evil?
        - What is the meaning of life?
      - Multicausality:
        - Some diseases are due to germs, but other diseases are from other causes, and not all germs cause disease

Jean Piaget (1896-1980)

Piaget's Stages:

- **Very powerful as a descriptive tool**
- **Limited data on age criteria**
- **Adults with DD (Inhelder):**
  - **Mild MR [ID]: Concrete Operations**
  - **Moderate MR [ID]: Pre-Operational**
  - **Severe-Profound MR [ID]: Sensorimotor**

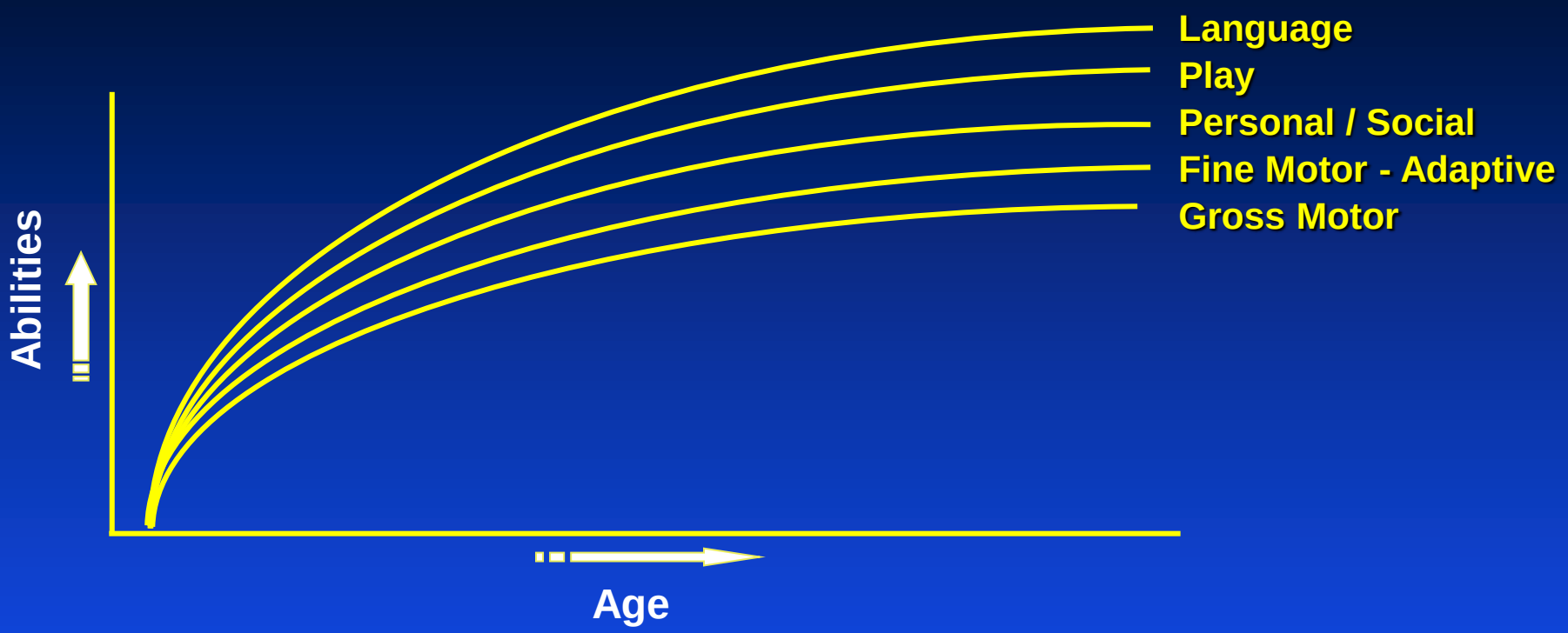

CROSSROADS
464
484
Rio Grande

Arnold Gesell (1880-1961)

- Career path: Psychology, Child Development, Medicine, Children with Disabilities
- Child Study Center (Yale)
- Stressed interactional basis for child development
- Identified distinct streams of development

http://en.wikipedia.org/wiki/Arnold_Gesell

Streams of Development

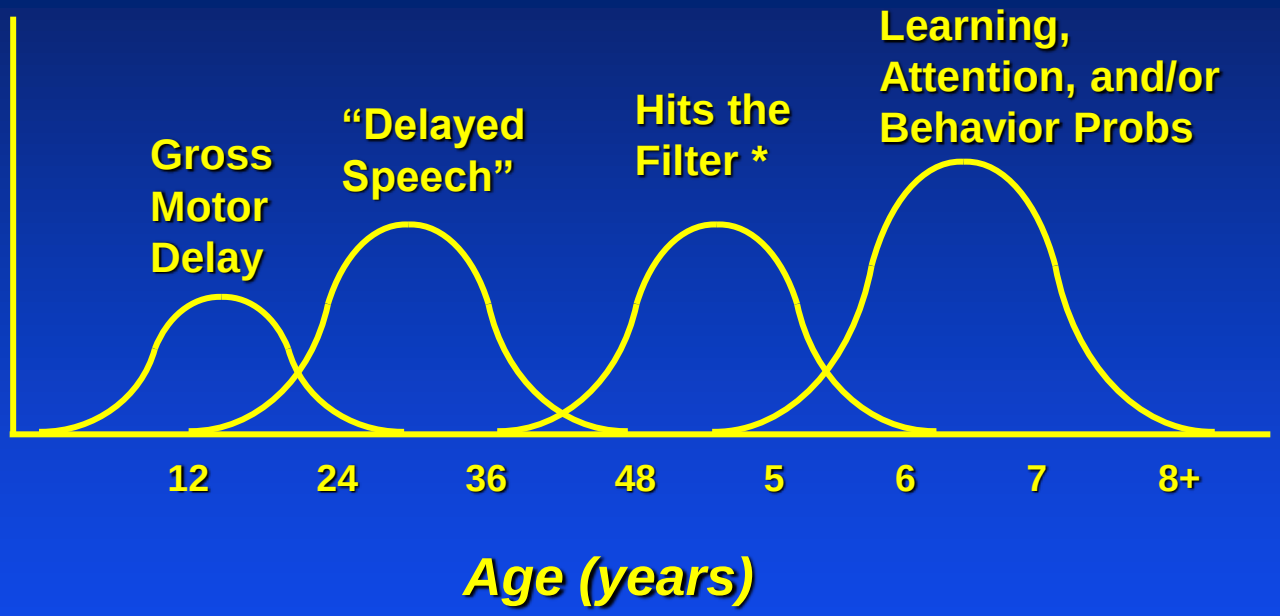


Each stream of development must be assessed separately. A child's development may be normal, delayed, or atypical in one area, independently of his/her performance in the other areas.

Parental Concerns: *4 Waves*

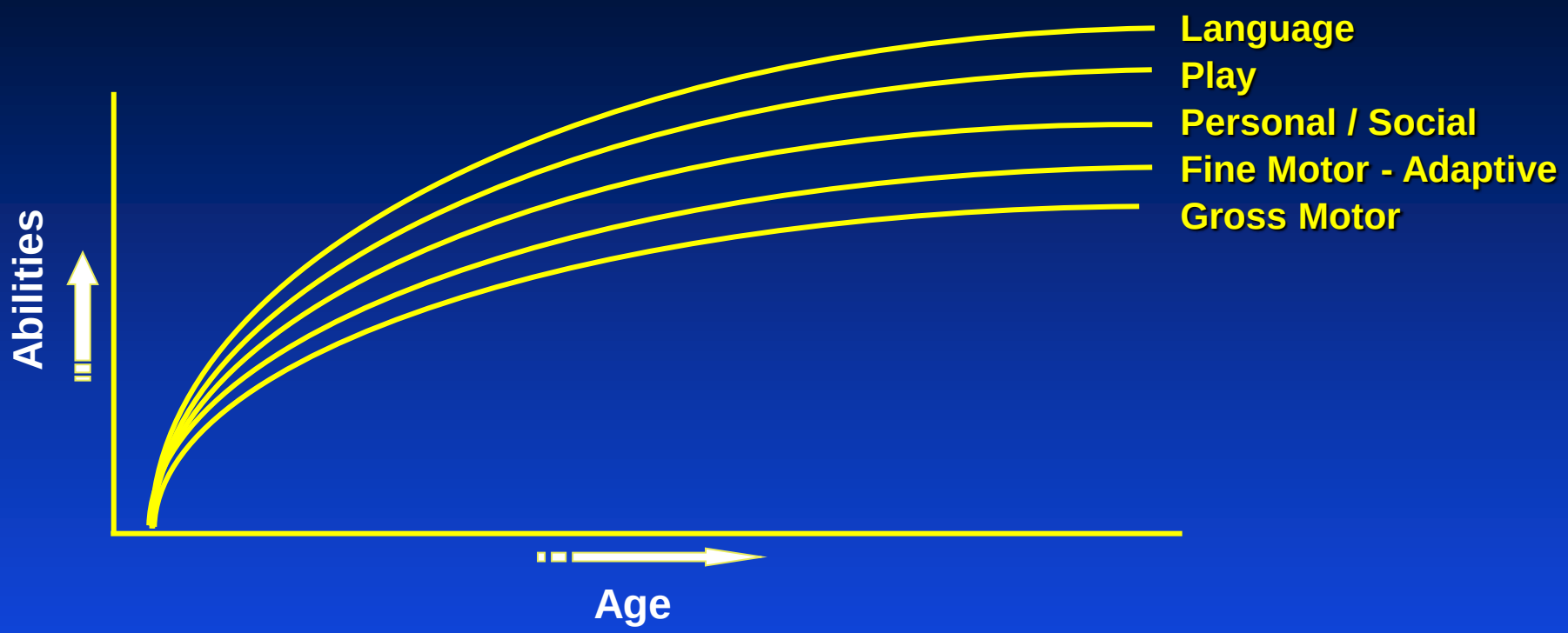
- **Wave 1: 9-18 mo: Gross Motor Delay**
- **Wave 2: 24-36 mo: "Delayed Speech"**
- **Wave 3: 4 to 6 yrs: Hits the filter (Pre-K, K, 1st Grade)**
- **Wave 4: > 6 yrs: Poor School Performance, with or without "Behavior Problems"**

Four Waves



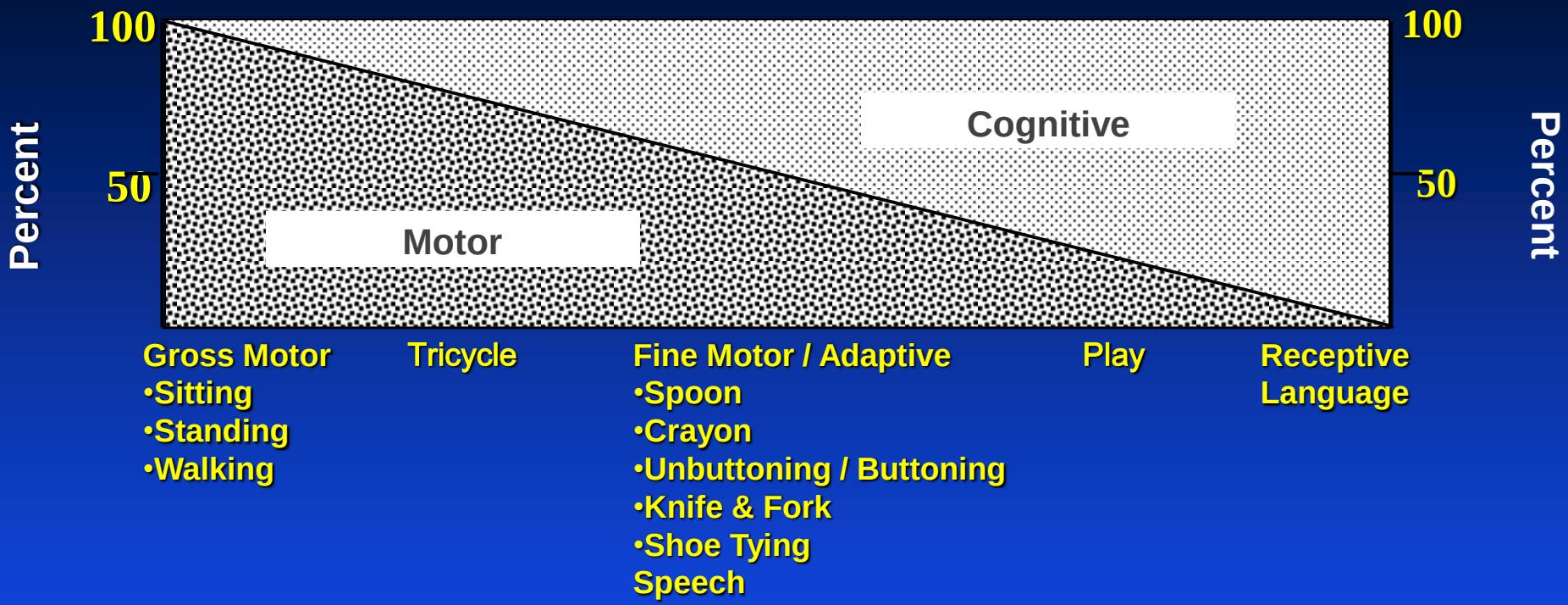
* Not doing well in Nursery School or Pre-K
  Failed school readiness testing
  Not progressing in KG

Streams of Development



Each stream of development must be assessed separately. A child's development may be normal, delayed, or atypical in one area, independently of his/her performance in the other areas….*Not entirely true!!*

Relative contribution of Motor and Cognitive ability to different streams of development



Motor Development

Motor Development

- Cephalocaudad (“head to tail”) progression
  - Oromotor
  - Oculomotor
  - Fine Motor
  - Gross Motor
  - Sphincter control

Oromotor

- Suck & swallow (in utero)
- Independent swallow (6 mo)
- “Smacking” (9 mo)
- Chewing (12 mo)
- Abnormalities
  - Excess drooling
  - Prolonged feedings
  - Choking or Coughing on feeds
  - Nasal escape of liquids

Oculomotor

- Conjugate gaze in all fields by 6 mo
- Intermittent esotropia normal <6 mo
- Blind eyes → Turn
- Turned eyes → Blind
  - Strabismus → Loss of stereopsis
  - " → Amblyopia

Fine Motor / Adaptive

- Midline hand play (3 mo)
- Reach / Grasp / Transfer (5-7 mo)
- Pincer (9-10)
- Index finger exploration (9-10)
- Tool Use (12-14)
  - Spoon
  - Crayon
- Hand preference (>12-18)

Gross Motor

- Righting
  - Head control (2-4 m)
  - Sitting (6-9 m)
  - Hands & Knees (9 m)
  - Standing (10-12 m)
- Walking (12 +)
- Stairs (18-24 m)
- Riding toys (“Flintstone”) 24 mo
- Tricycle (36 m)

Cerebral Palsy

Cerebral Palsy

- Abnormality of movement, tone, and/or posture
- Due to static CNS abnormality
- Arising during the developmental period (conception to age 5 yrs)

“Cerebral Palsy”

- Not limited to the cerebrum. May include any upper motor neuronal pathways:
  - Basal Ganglia
  - Cerebellum
- Not a palsy (not weak)

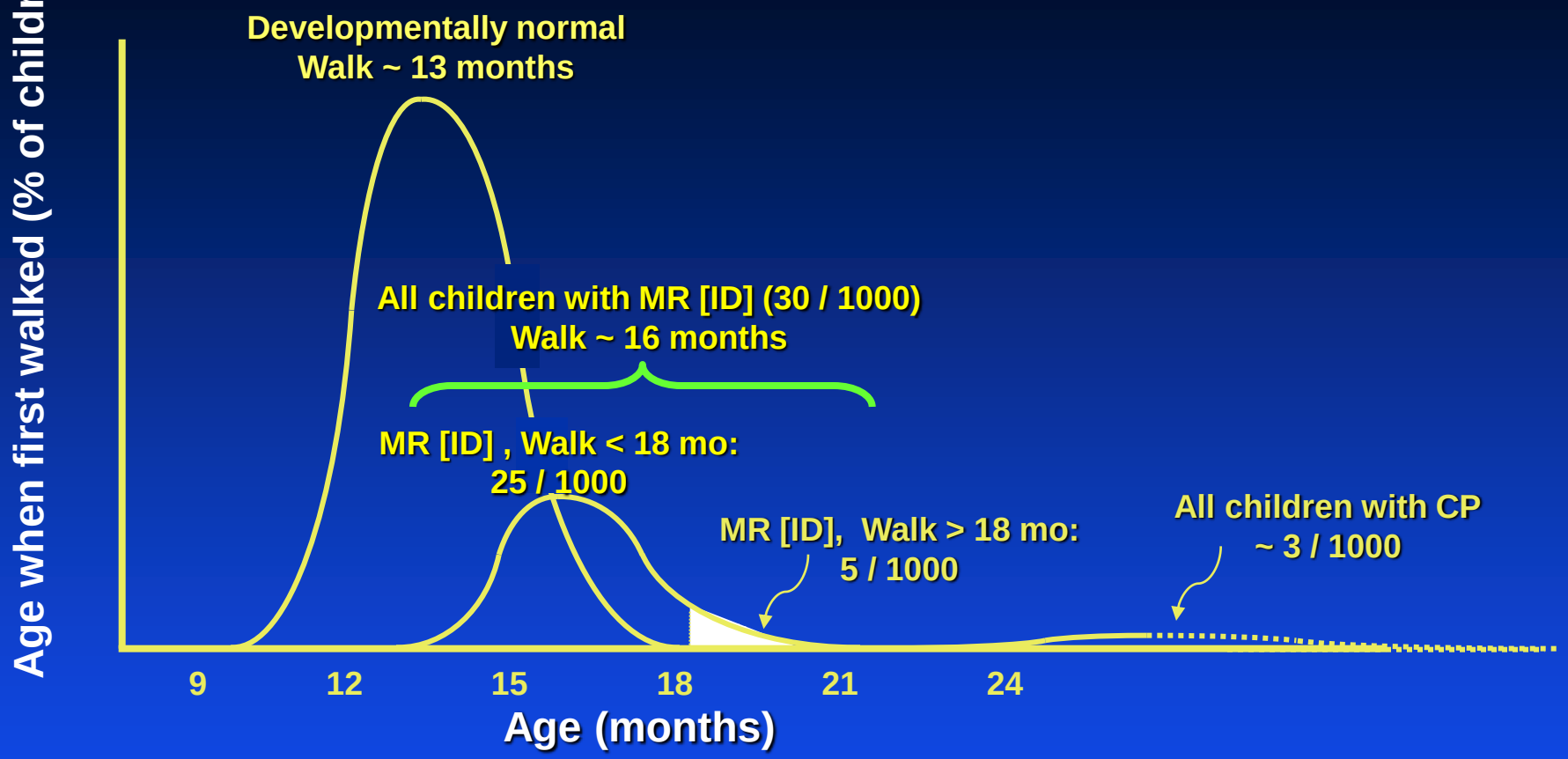
Cerebral Palsy - PE

- Hyper- or hypotonicity
- Hyperreflexia
- Persistent primitive reflexes
  - Asymmetric Tonic Neck Reflex (ATNR)
  - Tonic Labyrinthine (TL)
- Athetiod movements

Cerebral Palsy - 3 Pearls

- **Usually *not* due to birth injury**
- **Most children with CP do *not* have MR [ID]**
- **The most common cause of gross motor delay is *not* CP, but MR [ID] (even though most children with MR [ID] have normal gross motor milestones).**

MR, CP, and Gross Motor Delay



The most common cause of GMD is MR [ID], even though most children with MR [ID] walk within normal limits for age.

Cognitive Development

General Intelligence

- Language
- Problem Solving
- Adaptive Skills
- Play

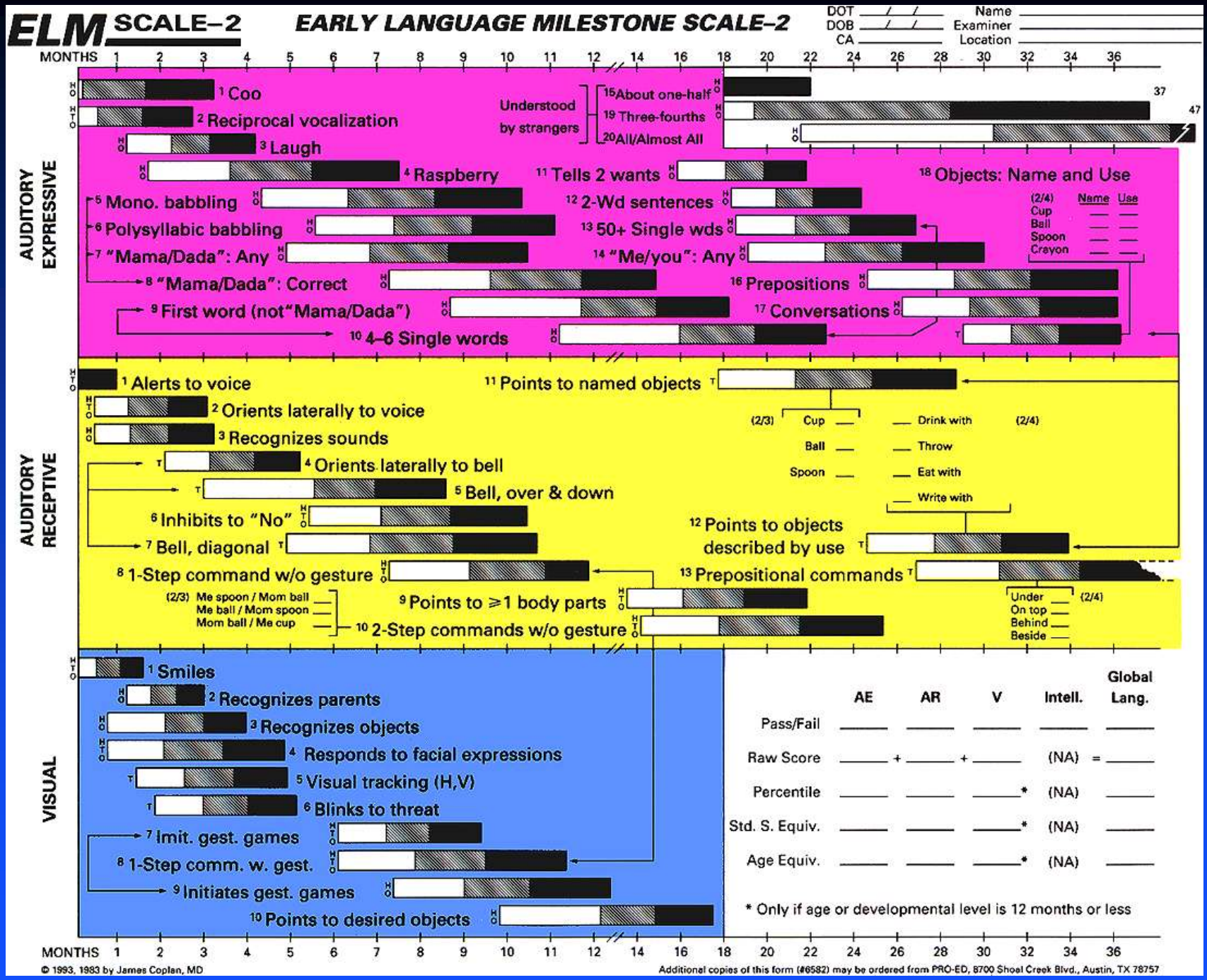
Definitions - Language

- **A symbol system for the storage or exchange of information**
  - **Spoken / Written languages**
  - **American Sign Language**
  - **Braille**
  - **Morse Code**
  - **Binary (computer) code**
- **Speech is only one element of language**
  - **A child may have normal *language* with impaired or absent speech**
    - **Deafness, Dysarthria**

Definitions

- **Components of auditory expressive language**
  - **Semantics (word meaning)**
  - **Pragmatics (social function of language)**
  - **Syntax (structure: word order, e.g.)**
  - **Prosody (inflection)**
  - **Fluency (rate, rhythm)**
  - **Intelligibility (clarity)**
  - **Voice (hoarse? “breathy”?)**

Language Acquisition


ELM SCALE–2
EARLY LANGUAGE MILESTONE SCALE–2
DOT / / Name
DOB / / Examiner
CA Location
MONTHS 1 2 3 4 5 6 7 8 9 10 11 12 14 16 18 20 22 24 26 28 30 32 34 36
AUDITORY EXPRESSIVE
1 Coo
2 Reciprocal vocalization
3 Laugh
4 Raspberry
5 Mono. babbling
6 Polysyllabic babbling
7 "Mama/Dada": Any
8 "Mama/Dada": Correct
9 First word (not "Mama/Dada")
10 4–6 Single words
Understood by strangers
15 About one-half
19 Three-fourths
20 All/Almost All
37
47
11 Tells 2 wants
12 2-Wd sentences
13 50+ Single wds
14 "Me/you": Any
16 Prepositions
17 Conversations
18 Objects: Name and Use
(2/4) Name Use
Cup
Ball
Spoon
Crayon
AUDITORY RECEPTIVE
1 Alerts to voice
2 Orients laterally to voice
3 Recognizes sounds
4 Orients laterally to bell
5 Bell, over & down
6 Inhibits to "No"
7 Bell, diagonal
8 1-Step command w/o gesture
(2/3) Me spoon / Mom ball
Me ball / Mom spoon
Mom ball / Me cup
9 Points to ≥1 body parts
10 2-Step commands w/o gesture
11 Points to named objects
(2/3) Cup
Ball
Spoon
Drink with
Throw
Eat with
Write with
(2/4)
12 Points to objects described by use
13 Prepositional commands
Under
On top
Behind
Beside
(2/4)
VISUAL
1 Smiles
2 Recognizes parents
3 Recognizes objects
4 Responds to facial expressions
5 Visual tracking (H,V)
6 Blinks to threat
7 Imit. gest. games
8 1-Step comm. w. gest.
9 Initiates gest. games
10 Points to desired objects
AE AR V Intell. Global Lang.
Pass/Fail
Raw Score + + (NA) =
Percentile * (NA)
Std. S. Equiv. * (NA)
Age Equiv. * (NA)
* Only if age or developmental level is 12 months or less
MONTHS 1 2 3 4 5 6 7 8 9 10 11 12 14 16 18 20 22 24 26 28 30 32 34 36
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Auditory Expressive

- **Content**
- **Intelligibility**

Aud. Expressive: Content

- **Prelinguistic utterances**
  - **Lack symbolic meaning**
- Single words
- 2-word phrases
- Telegraphic speech
- Sentences

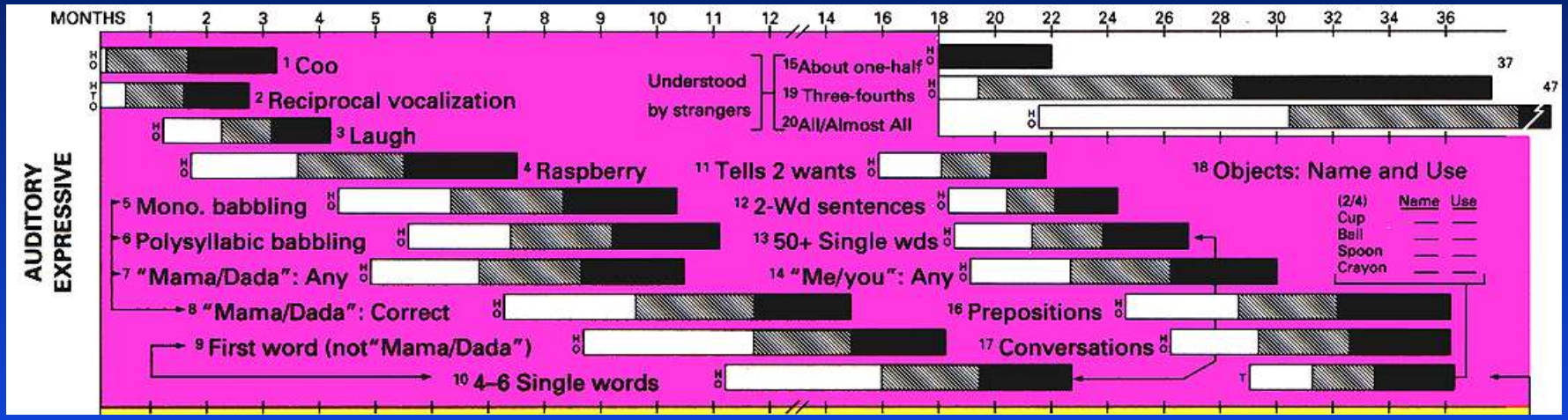
Pre-linguistic utterances

- **Cooing**
  - **open vowels**
- **Monosyllabic babbling**
  - **ma, ba, da, ga**
- **Polysyllabic babbling**
  - **lalala, nanana, mamama, dadada, etc**

Pre-linguistic utterances

- **Birth to ~ 9 mo: Universal**
  - **Regardless of language of rearing**
  - **Regardless of ability to hear**
- **After 9 mo:**
  - **Hearing infants: emulate language of rearing**
  - **Deaf infants: Loss of babbling**

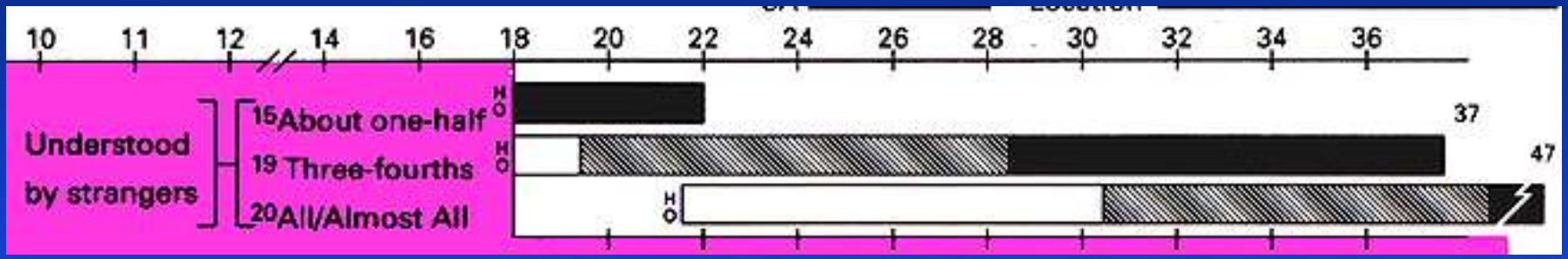
Auditory Expressive



Intelligibility (Clarity)

- % of child's speech understandable by strangers (even if mispronounced)
- Rule of 4's:
  - Age in Yrs / 4 = % intelligible
    - 1 yr: 1/4
    - 2 yr: 2/4
    - 3 yr: 3/4
    - 4 yr: 4/4

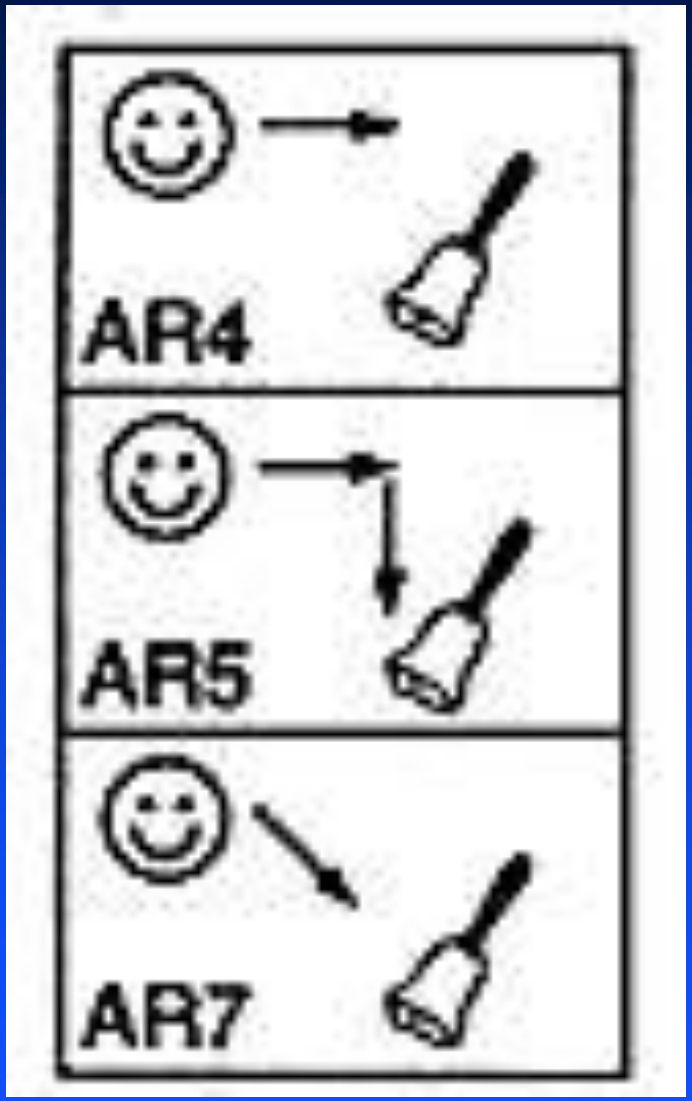
Auditory Expressive - Intelligibility



Auditory Receptive: Pre-Linguistic

- **Alerting to sound (0-1 mo)**
- **Recognition of voice / sound (~ 3 mo)**
- **Orienting to sound (5-9 mo)**
- **Recognizes own name (9 mo)**
- **Follows commands**
  - **Understands "No" (9 mo)**
  - **1-step commands with gesture: (9 mo)**
  - **1-step commands w/o gesture (12 mo)**
  - **2-step commands (24 mo)**
  - **etc.**

Orienting to sound



Auditory Receptive: Linguistic

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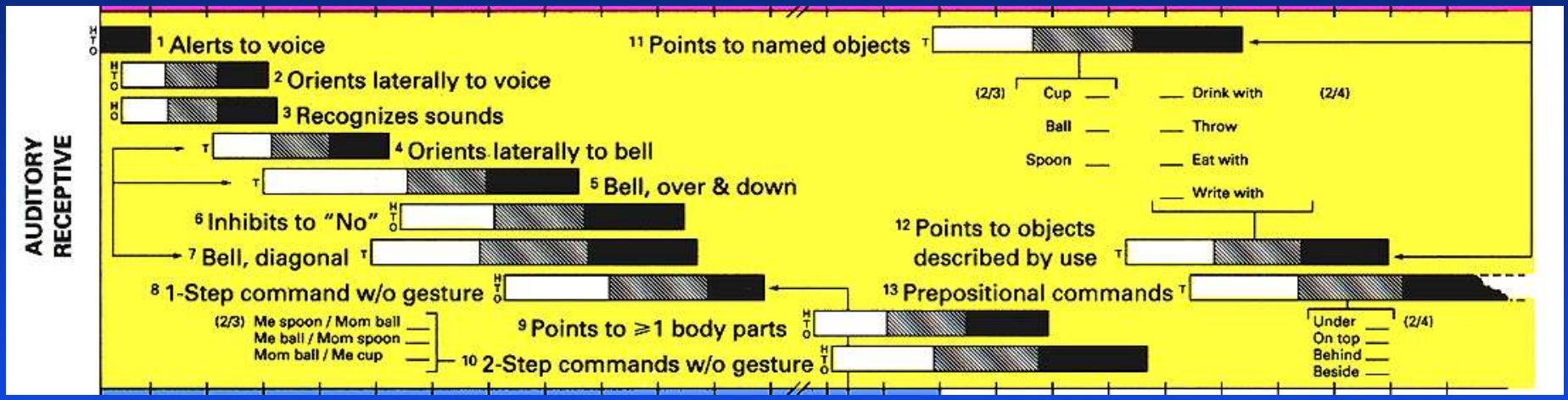
Auditory Receptive



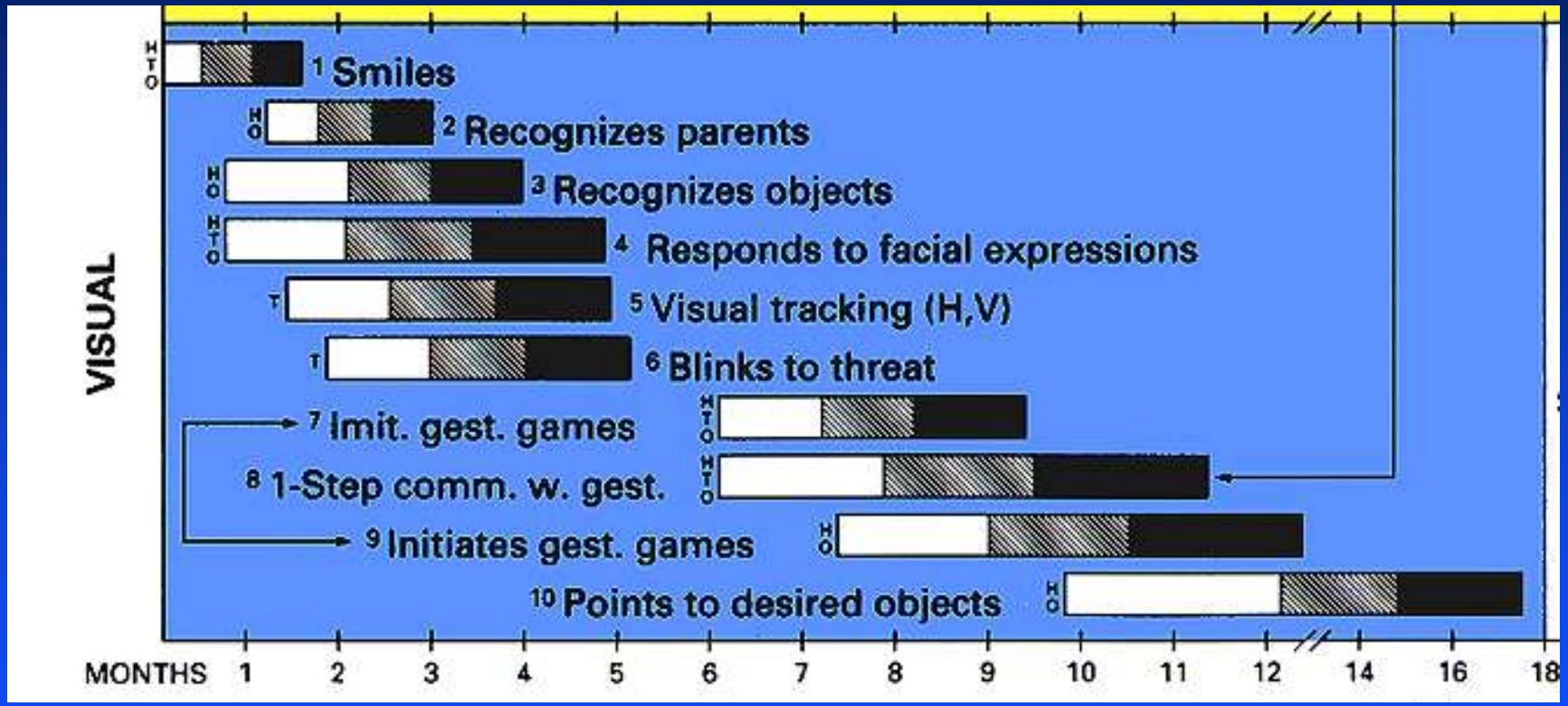
Visual Language

- **Pre-Linguistic**
  - **Eye contact**
  - **Social smile**
  - **Visual recognition**
  - **Gesture games**

- **Points to desired objects**

Babbling in the manual mode: Evidence for the ontogeny of language. Petitto LA and Marantette PF. Science 251; 1493-1496, 1991

Visual



A simple mnemonic

As easy as 1-2-3-4

Age	Auditory Expressive		Auditory Receptive	Visual
	Content	Intelligibility		
1 yr	1 single word	1/4	1-step commands	Index finger pointing
2 yr	2-wd phrases	2/4	2-step commands	---
30 mo	3-5 wd phrases	---	---	---
3 yr	Sentences	3/4	3-step commands	---
4 yr	---	4/4	---	---

“Now that we’ve got this wrapped up, I’d like to get into math.”

Problem Solving

- Object permanence
- Tool Use
- Cause and effect
- Progressively more complex visual-spatial tasks

Problem-Solving

1” Cubes

- Takes one: 6 m
- Transfers: 7 m
- Bangs two: 9 m
- Takes three: 10-12 m
- Copies

14 m

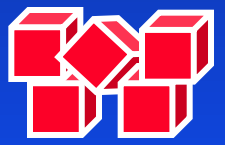
18 m

24-27 m

- Builds:

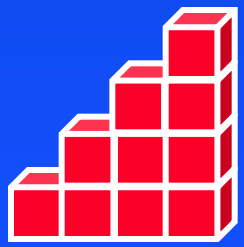
30-36 m

3 1/2 yr



4 yr

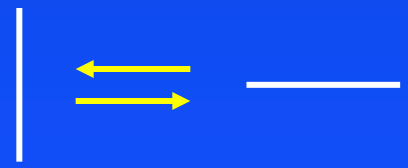
5 yr



6 yr

Problem-Solving

Crayon

- Mouths: < 9 m
- Makes marks 10-12 m
- Scribbles p demo: 14 m
- Scribbles spont: 16 m
- Alternates from stroke to scribble: 22 m
-  24-27 m

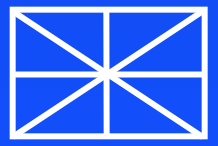
- Draws:

 30-36 m

 3 1/2 yr

 4 yr

 5 yr

 6 yr


BABY'S FIRST
A
B C

Adaptive Skills

- **Self-feeding**
  - Finger-feeding (7 m)
  - Cup (no lid; 9-10 m)
  - Spoon (tool use; 12 m)
- **Self-dressing**
  - Unbuttoning, buttoning (33-36 m)
  - Zippers, Snaps (48 m)
  - Tie shoes (5 y)
- **Self-grooming**

Play – The Missing Milestone

- **Sensorimotor**
  - Midline hand play (3 mo)
  - Banging & Mouthing (7 - 9 mo)
  - Casting (12 mo)
  - Tools (crayon) ~ 14 mo
  - Cause & Effect (14 to 16 mo & up)
- **Pre-Operational**
  - Imitative Play (24 mo)
  - Imaginative Play (36 mo)

Play (cont.)

- **Rule-based play**
  - **Concrete Operations**
  - **1 to 1 correspondence, Unicausality:**
    - **UNO, Old Maid, Memory, etc**
    - **Simple cause and effect (checkers)**
  - **Formal Operations**
    - **Multicausality, probability, teamwork**
      - **Bridge**
      - **Poker**
      - **Chess**


Chelsea Rhiannon
MISS RITA

Cognitive Delay (Mental Retardation / Intellectual Disability)

Definition

- Significantly sub-average general intellectual function
- Delayed adaptive skills
- Arising during the developmental period

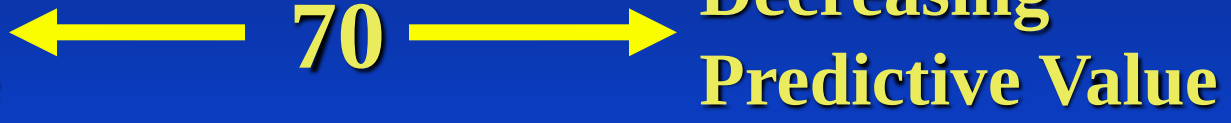
Definition (2)

- **Significantly sub-average general intellectual function:**
  - **2 or more SD below mean on a standardized test of intelligence**
    - **Language**
    - **Problem-Solving**
  - **Mean = 100; SD = 15 or 16**

Definition (3)

- **Mild MR: -2 to -3 SD (69 - 55)**
- **Moderate: -3 to -4 SD (54 - 40)**
- **Severe: -4 to -5 SD (39 - 25)**
- **Profound: > -5 SD**

Predictive Value of Infant Developmental Testing



Prognosis

- **"Contrary to the popular view, the younger the child, the more serious the prognostic significance of every degree of true retardation. Other things being equal, retardation, like a shadow, lengthens with the lapse of time."**

Gesell and Amatruda's Developmental Diagnosis 3rd edition, p 141

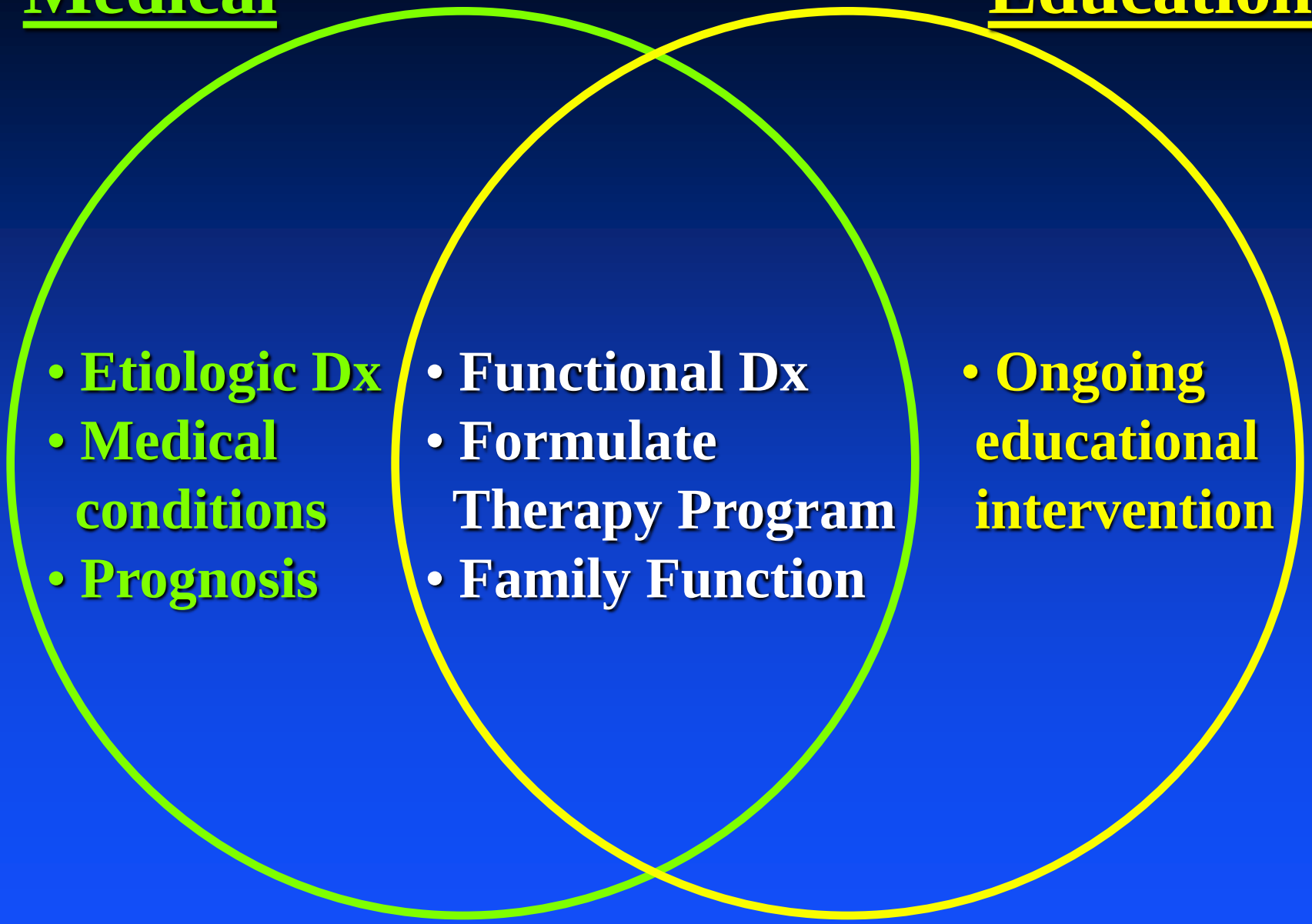
Medical Evaluation

Why a medical evaluation?

- **Specific etiology**
  - **Recurrence risk?**
  - **Associated medical needs?**
  - **Connect parents to other parents of children with same underlying medical condition**
  - **Peace of mind**

Family Function

- The unit of treatment is the family
  - Parents
  - Siblings
  - Other supports
- Family mental health
  - Stages of grieving
  - "Chronic sorrow"
  - Adaptation
- Stress points in family life cycle



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Thank you.