Normal development; neurological perspectives

Peter Baxter

Childrens Hospital

Sheffield

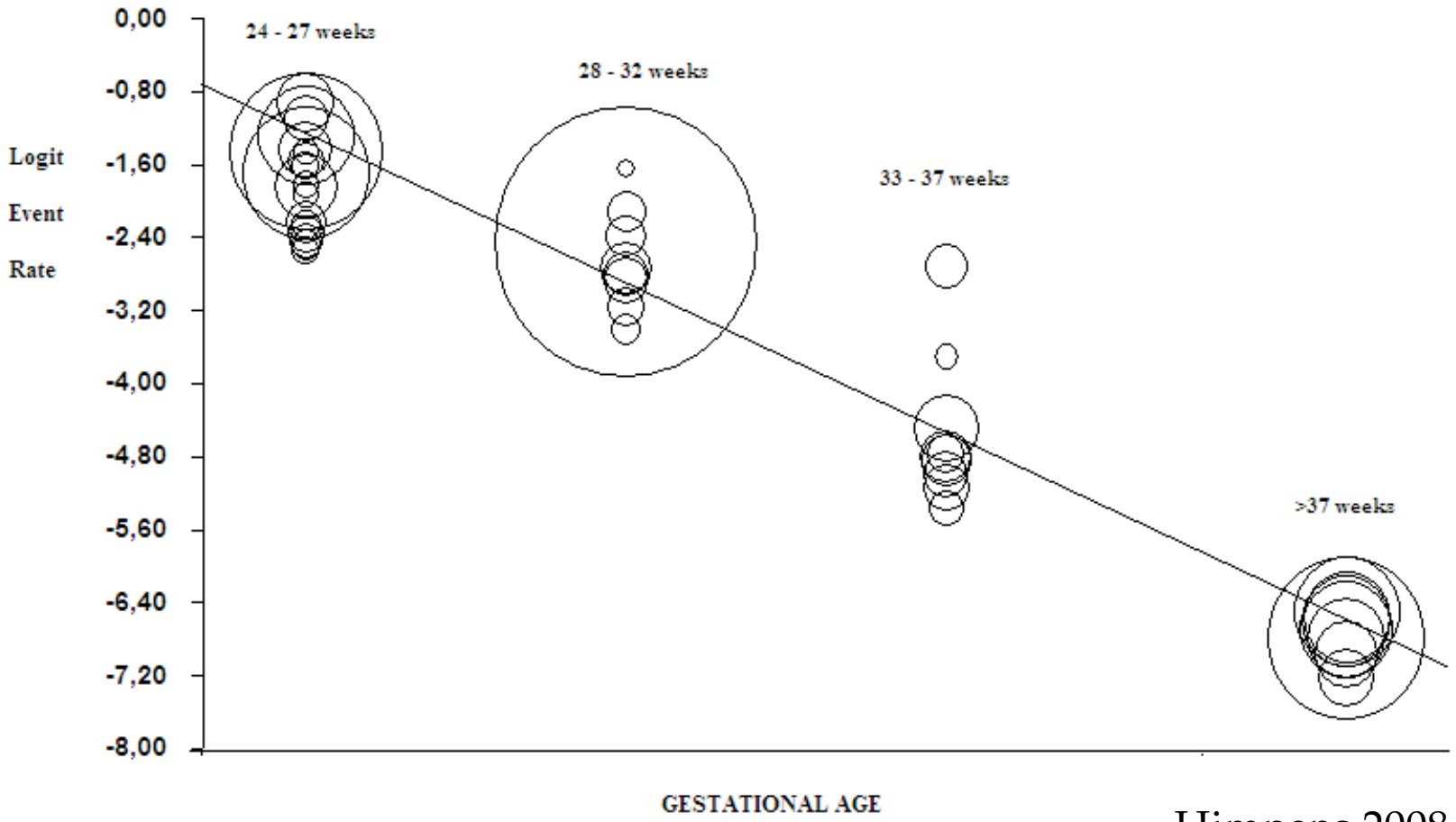
UK

Term vs preterm

20 weeks

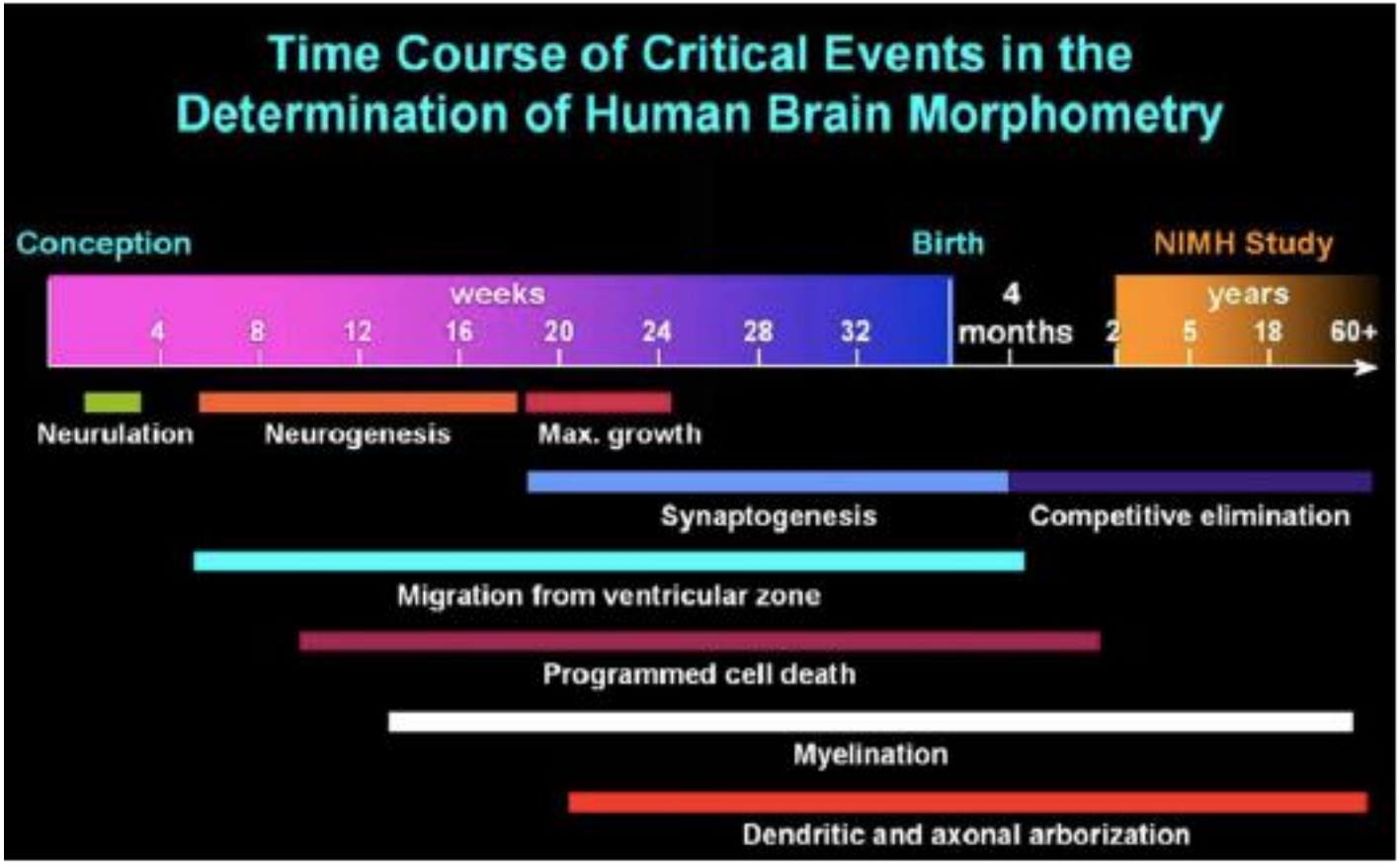
40 weeks

CP vs gestational age



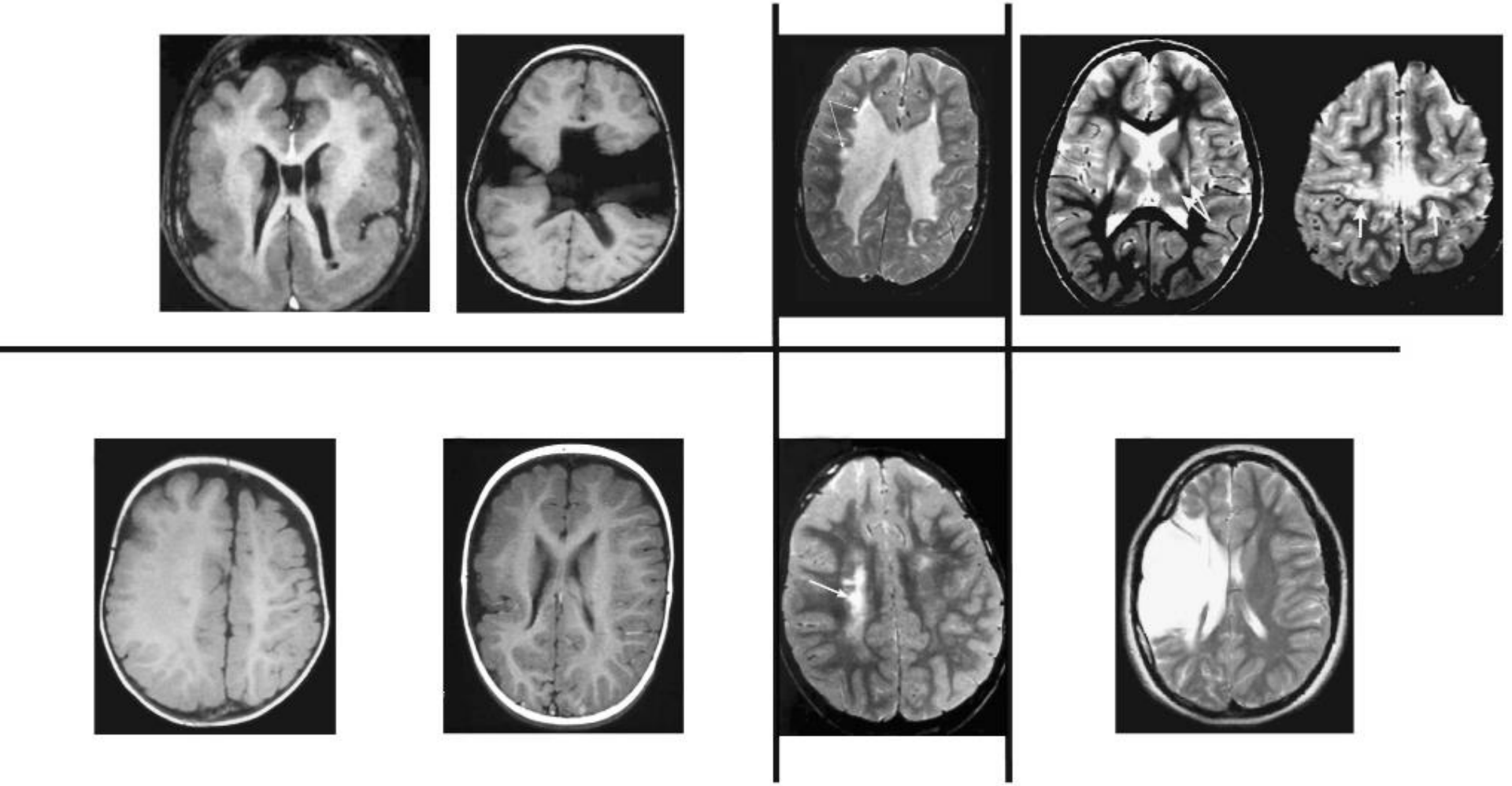
Himpens 2008

Brain development

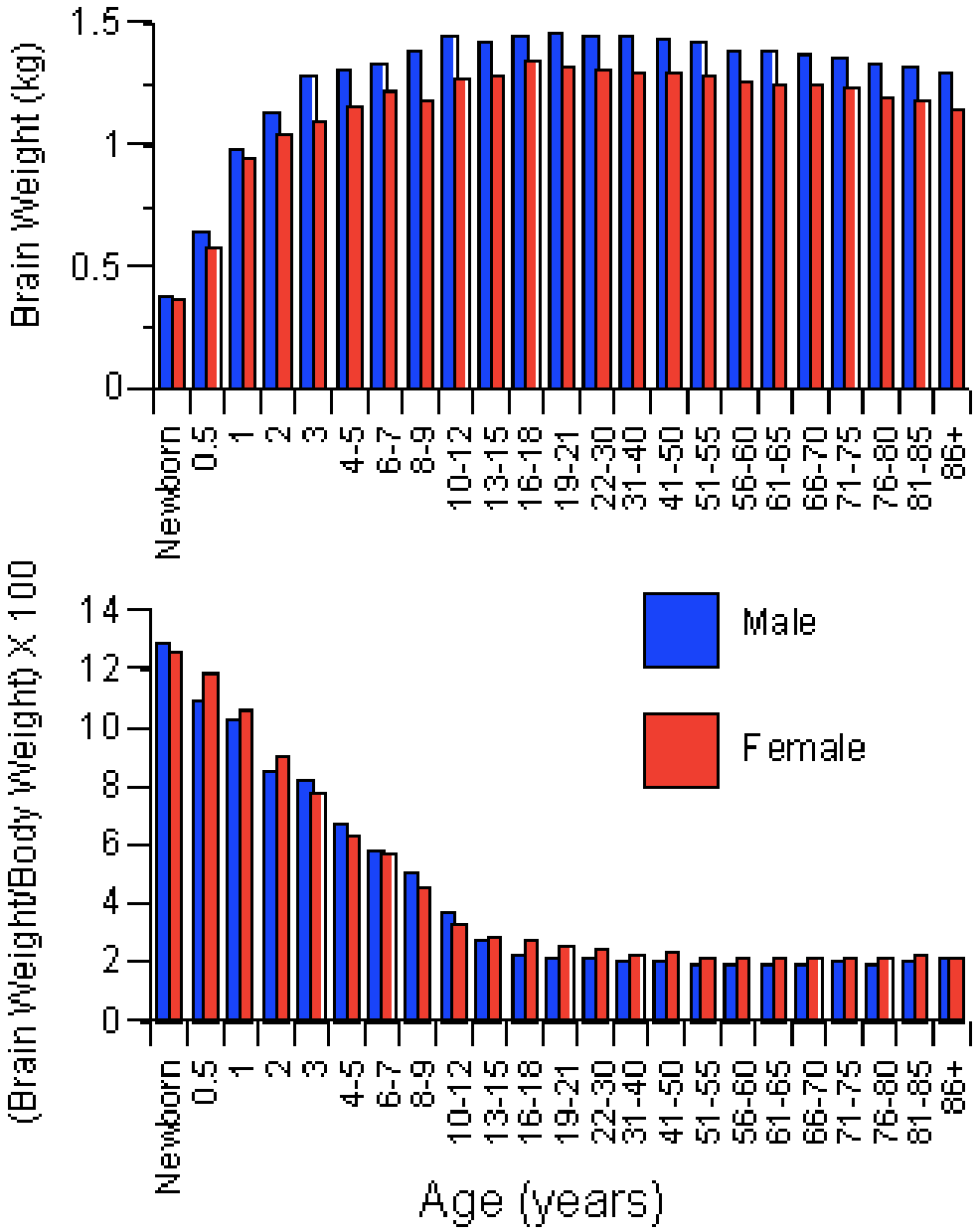


Lenroot & Giedd 2006


10
10



Kraegeloh-Mann 2007



Dekaban & Sadowsky 1978

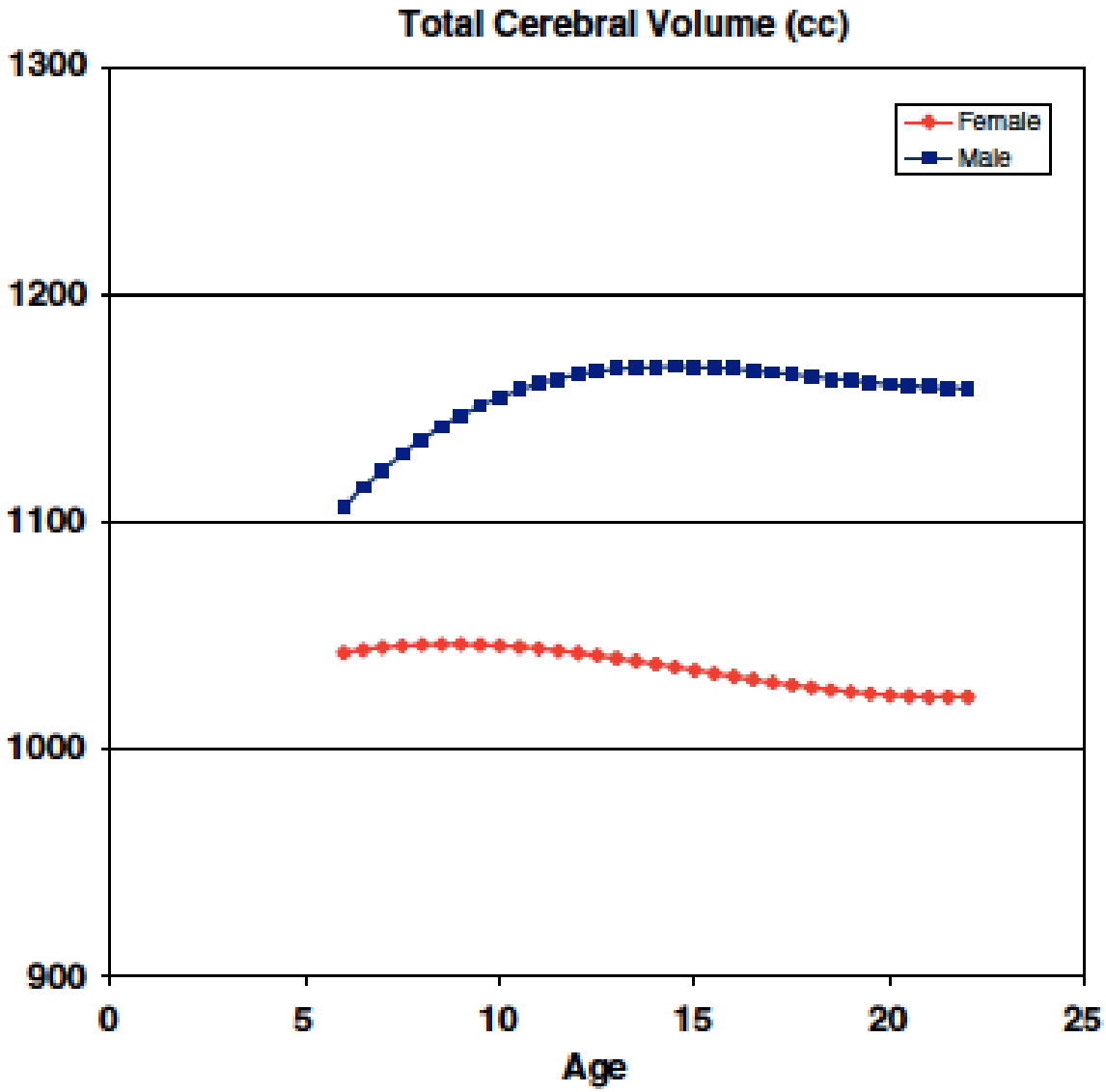
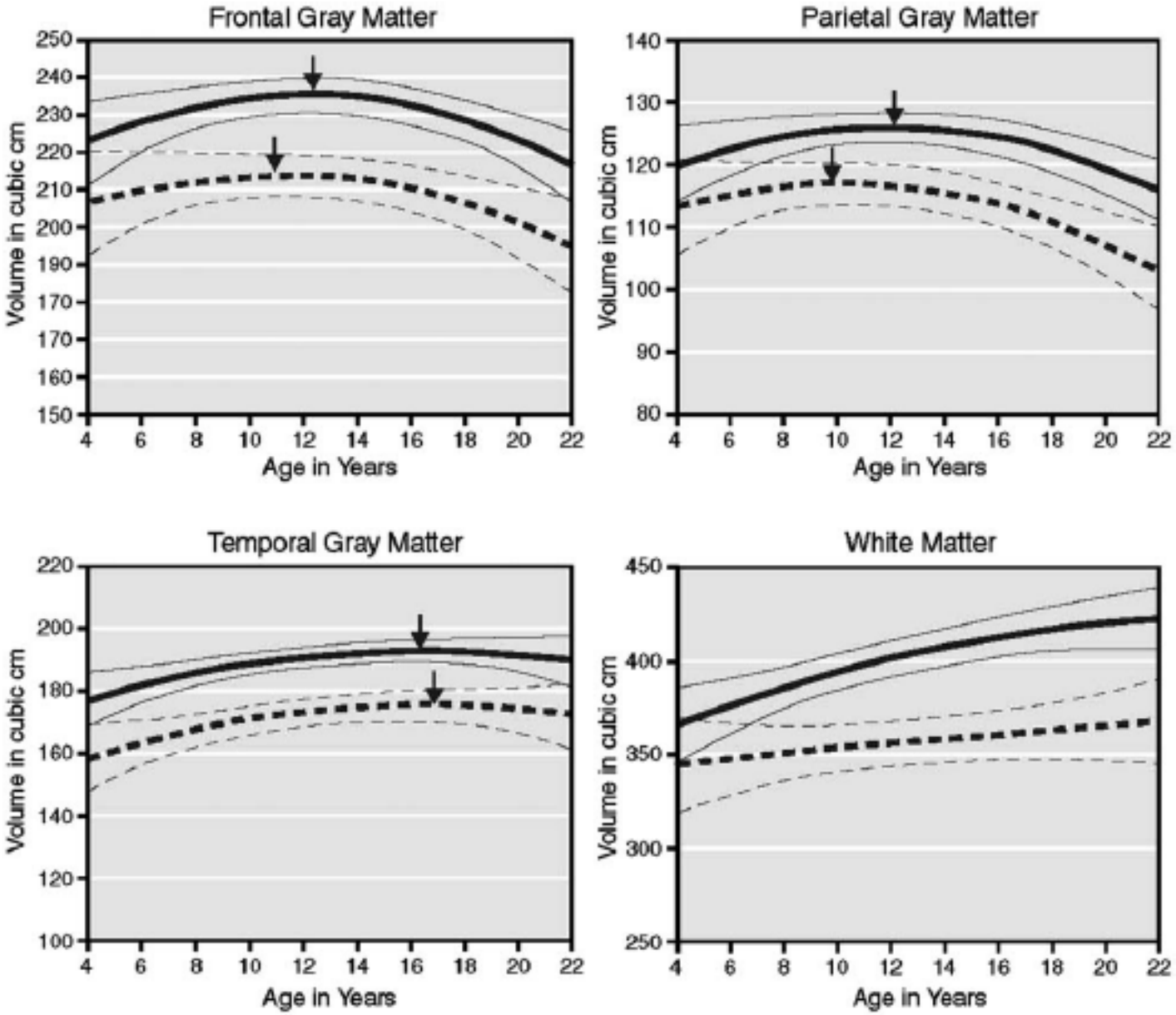


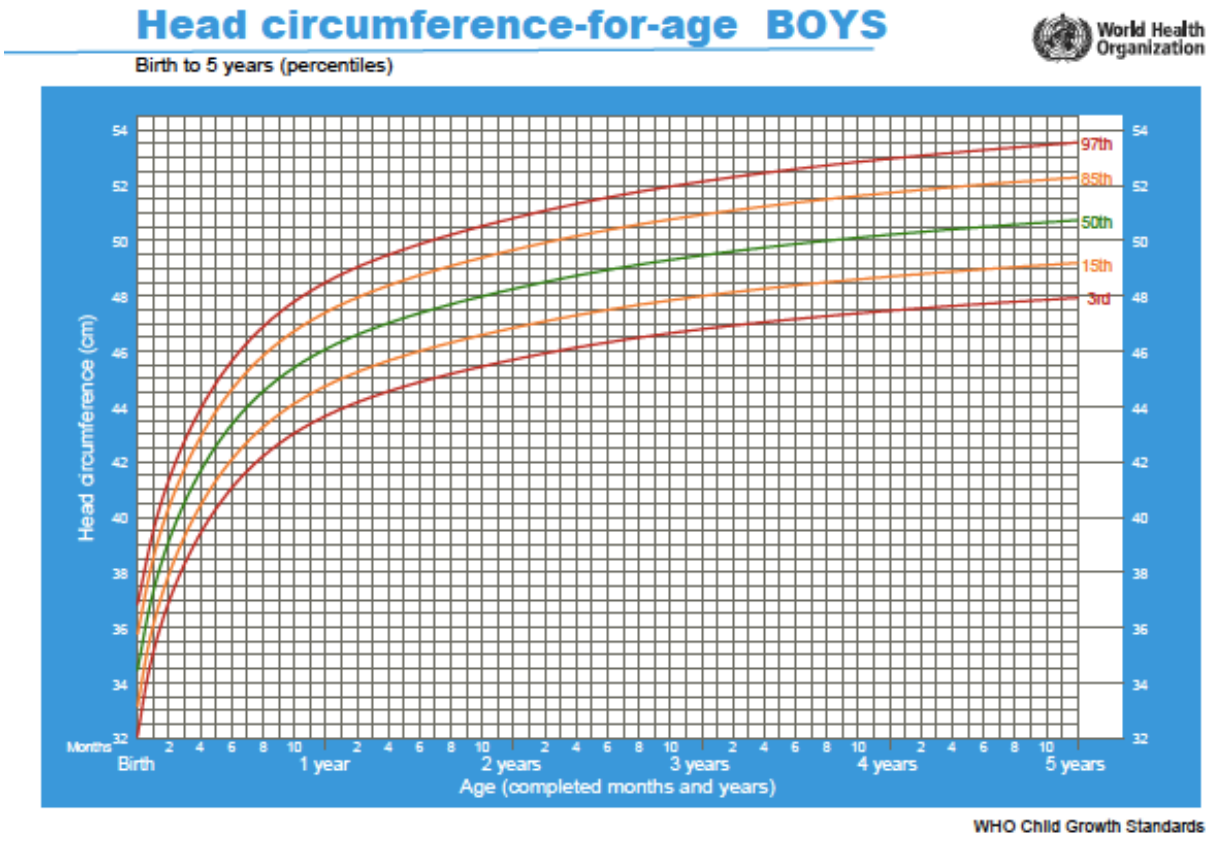
Fig. 3. Total cerebral volume (TCV) by age for 224 females (375 scans) in red and 287 males (532 scans) in blue.

Lenroot & Giedd 2006

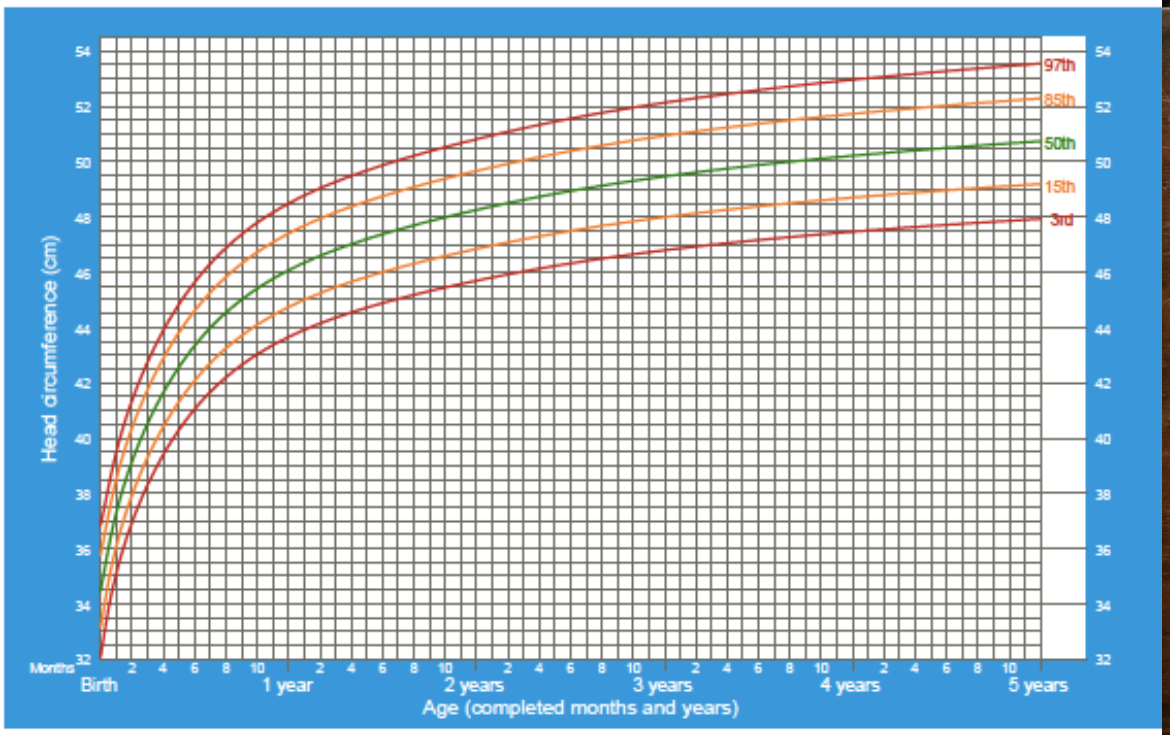


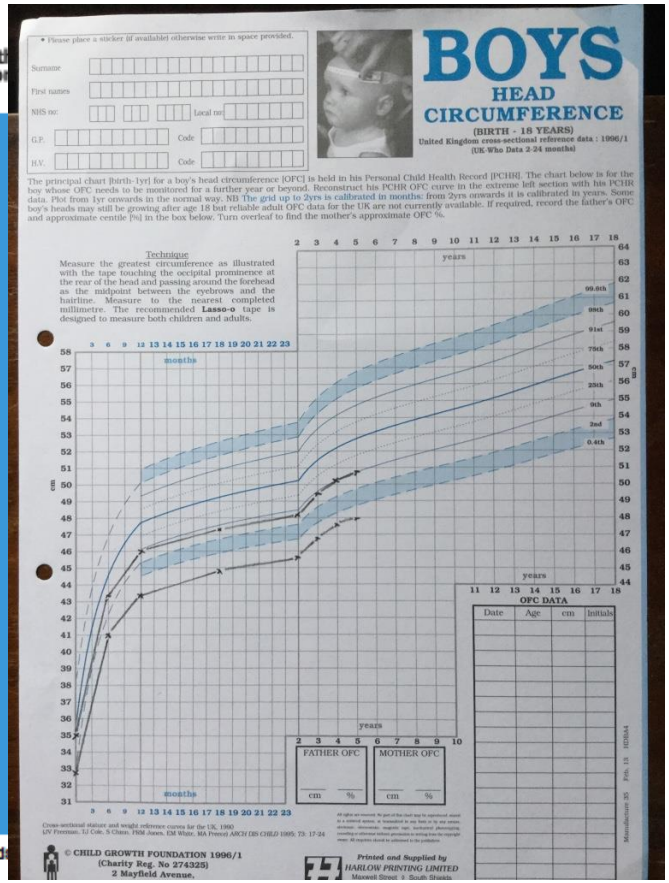
Lenroot & Giedd 2006

Brain growth: WHO chart



Brain growth: WHO vs previous





Development

- Gross motor
- Fine motor
- Vision
- Hearing
- Communication
- Behaviour / social

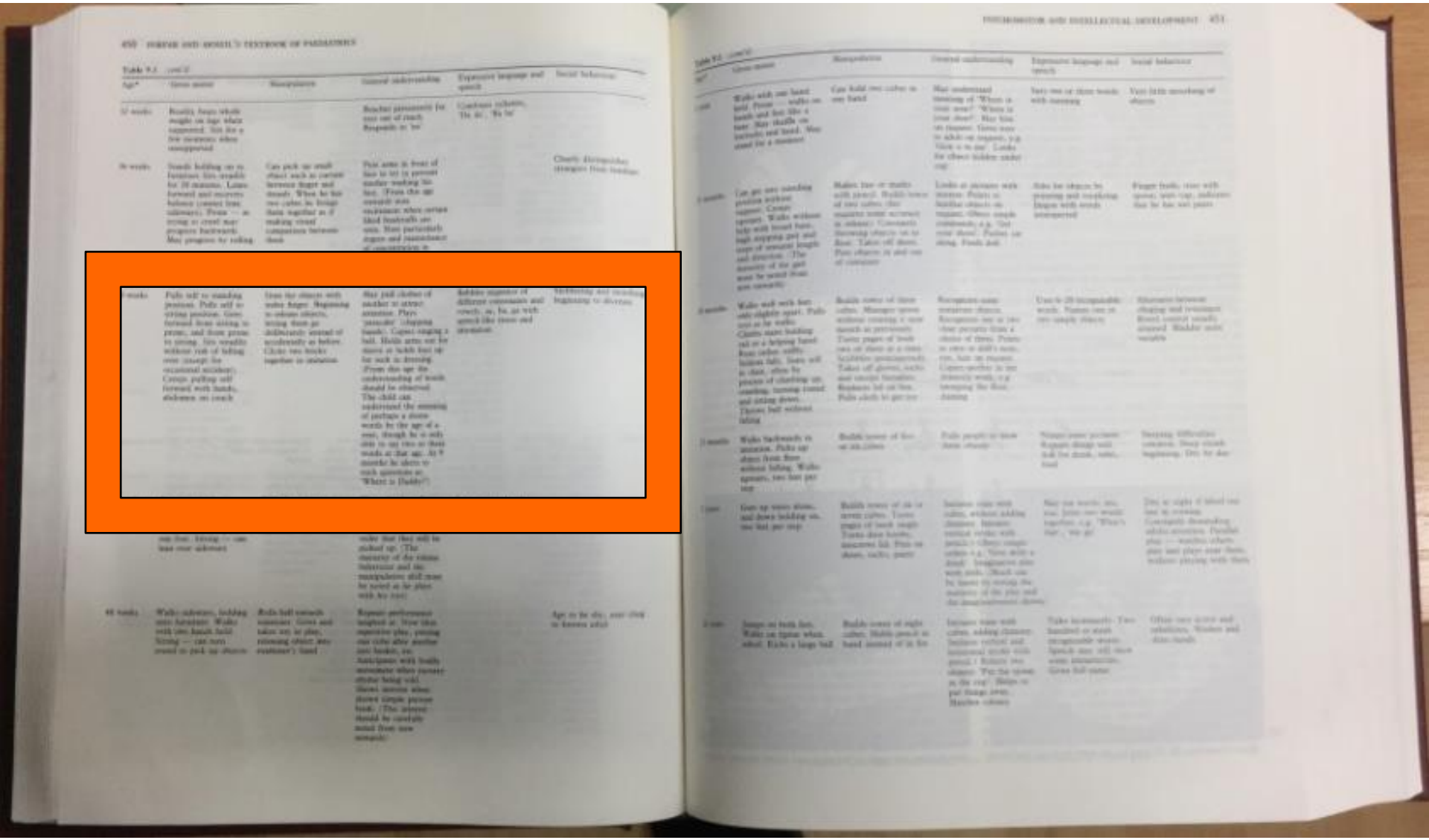
Table 9.1 cont'd

Age*	Gross motor	Manipulation	General understanding	Expressive language and speech	Social behaviour
12 weeks	Readily bears whole weight on legs when supported. Sits for a few moments when unsupported		Reaches persistently for toys out of reach. Responds to 'no'	Coos/babbles. Vocalises to 'No no', 'Bye bye'	
16 weeks	Stands holding on to furniture. Sits steadily for 30 minutes. Leans forward and recovers balance (cannot lean sideways). From — to prone or crawl may progress backwards. May progress to rolling	Can pick up small object such as currant between finger and thumb. When he has two cubes in front, bangs them together as if making crude comparison between them	Puts arms in front of face to try to prevent mother making his face. From this age onwards stops enjoyment when certain liked households are seen. Sees particularly fingers and reaches/tries to pick up objects and playing with toys. Plays peep-bo		Clearly distinguishes strangers from familiar
40 weeks	Pulls self to standing position. Pulls self to sitting position. Goes forward from sitting to prone, and from prone to sitting. Sits steadily without risk of falling over (except for occasional mishap). Creeps pulling self forward with hands, abdomen on couch	Uses the thumb with index finger. Beginning to release objects, letting them go deliberately instead of accidentally as before. Clicks two bricks together in imitation	Has full clothes of another to arouse attention. Plays 'pinocchio' clapping hands. Copies singing a ball. Holds arms out for dress or holds feet up for sock in dressing. From this age the understanding of words should be observed. The child can understand the meaning of perhaps a dozen words by the age of a year, though he or she may be able to say two or three words at that age. At 9 months he starts to ask questions as 'Where is Daddy?'	Imitates sequence of different consonants and vowels, as, ba, ga with speech like tones and inflection	Undressing and attempting beginning to dress
44 weeks	From — stands, abdomen off couch. When standing holding on to fifty and replaces one foot, forward — can lean over sideways	Will place object into container's hand on request, but will not release it	Waves bye-bye. Covers own face with towel in peep-bo game. Drops objects deliberately in order that they will be picked up. The discovery of the relationship between and the manipulative skill must be noted as he plays with his toys	Says one word with meaning. Shakes head for no	
48 weeks	Walks sideways, holding onto furniture. Walks with two hands held. Sitting — can turn round to pick up objects	Rolls ball towards examiner. Gives and takes toy in play, releasing object into examiner's hand	Repeats performance laughed at. Tries blue inspection play, putting one cube after another into basket, etc. Anticipates with bodily movements when nursery rhyme being told. Shows interest when shown simple picture book. (The interest should be candidly noted from new stimuli)		Age to be shy, wary shy to known adult

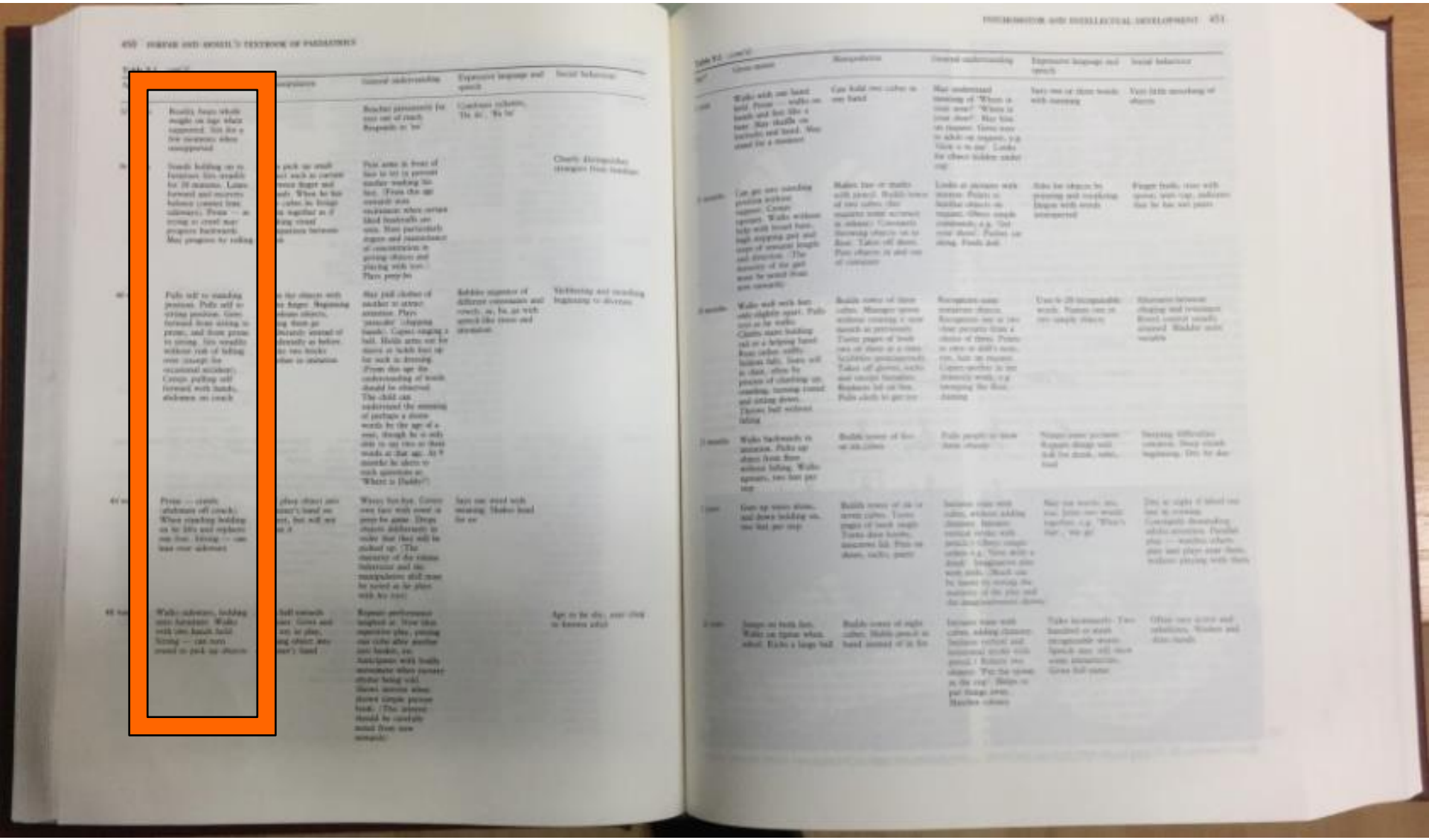
Table 9.1 cont'd

Age*	Gross motor	Manipulation	General understanding	Expressive language and speech	Social behaviour
1 year	Walks with one hand held. From — walks on heels and feet like a baby. May shuffle on buttocks and bend. May stand for a moment	Can hold two cubes in one hand	Has understand meaning of 'Where is your nose?' 'Where is your shoe?'. May bite on request. Tries now to adult on request, e.g. 'Give it to me'. Looks for object hidden under cup	Says two or three words with meaning	Very little knowledge of objects
15 months	Can get into standing position without support. Creeps upstairs. Walks without help with broad base, high stepping gait and steps of unequal length and direction. The necessity of the gait must be noted from now onwards)	Makes line or shuffle with pencil. Builds tower of two cubes (but imitation tower incorrect in relation). Continues throwing objects on to floor. Takes off shoes. Puts objects in and out of container	Looks at pictures with interest. Points to familiar objects on request. Obeys simple commands, e.g. 'Get your shoes'. Pushes car along. Feeds doll	Asks for objects by pointing and vocalising. Jargon with words interspersed	Finger feeds, rises with spoon, uses cup, indicates that he has wet pants
18 months	Walks well with but only slightly apart. Pulls over as he walks. Climbs stairs holding rail or a helping hand from carpet-width. Seats self in chair, often by process of climbing up, rotating, turning round and sitting down. Throws ball without falling	Builds tower of three cubes. Manages spoon without covering it with mouth in previously. Turns pages of book two or three at a time. Scribbles spontaneously. Takes off gloves, socks and simple garments. Replaces lid on box. Pulls clothes to get toy	Recognises name sometimes shown. Recognises two or three pictures from a choice of three. Points to two or three body parts, e.g. hair, nose, eyes, ears, hair on request. Copies another in one leisurely work, e.g. sweeping the floor, dusting	Uses 6–20 recognisable words. Names two or three simple objects	Alternates between clinging and resistance. Bowel control usually attained. Bladder under variable
21 months	Walks backwards to retrieve. Picks up object from floor without falling. Walks upstairs, two feet per step	Builds tower of five or six cubes	Pulls people to look from chosen	Names some pictures. Responds things said to/ for drink, toilet, food	Showing difficulties concerns. Dress/undress beginning. Dry by day
1 year	Goes up stairs alone, and down holding on, two feet per step	Builds tower of six or seven cubes. Turns pages of book singly. Turns door knobs, unscrews lid. Pats on drum, rocks, paints	Imitates some new rules, without adding elements. Imitates vertical stroke with pencil. Obeys simple orders e.g. 'Give doll a drink'. Imaginative play with dolls. (Much can be learnt by noting the sequence of the play and the developments shown)	May use words, not true, from own words together, e.g. 'What's that', 'me go'	Dry at night if lifted out late in evening. Constantly demanding adult attention. Parallel play — watches others, plays near player near them, without playing with them
2 years	Jumps on both feet. Walks on tiptoe when asked. Kicks a large ball	Builds tower of eight cubes. Holds pencil in hand instead of in fist	Imitates some with cubes, adding elements. Imitates vertical and horizontal strokes with pencil. Knows two objects. 'Put the spoon in the cup'. Sings or put things away. Matches colours	Talks incessantly. Two hundred or more recognisable words. Speech may still show some immaturities. Gives full name	Often very active and rebellious. Washes and dries hands

Forfar and Arneil



Forfar and Arneil



Forfar and Arneil

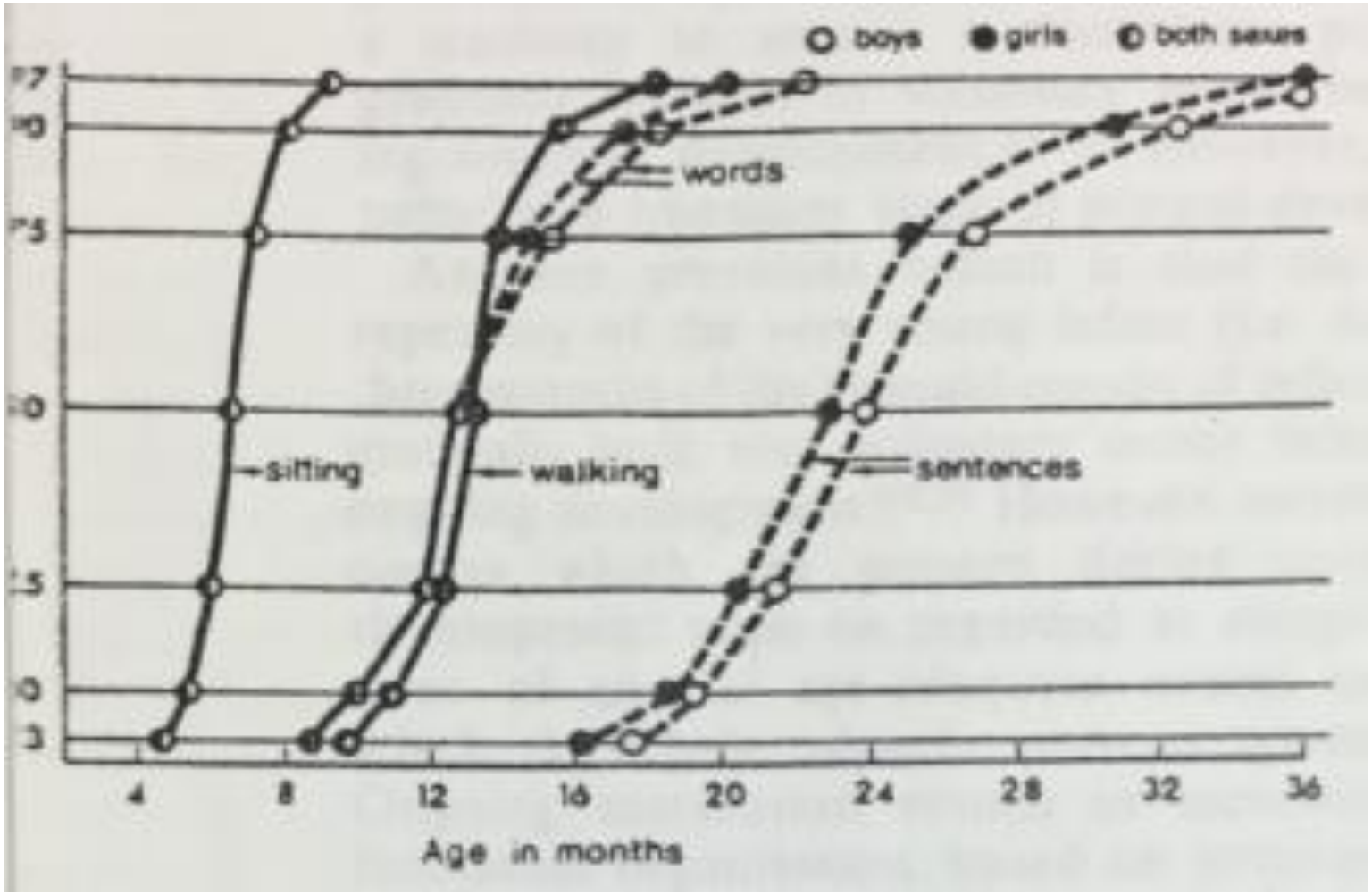
Normal medians

Ability	1	2	3	4	5	6	7	8	9
Head control	4-5	3-5	2.8	3	2-3	4	3.5-4	2.9	
Sit	8-9	8-9	6.9		9.5	8-9	8-9	5.5	6.4
Stand	13-14	13-14			13-15	13		11.5	
Walk	15-18	15	11.8		15-18	14	13	12.1	12.8
Pincer	11-12	11-12	9	11		9	11	10.7	
2-3 words	12	12	14.5	12		12	12	12.8	12.4

1. Gessell
2. Knobbloch
3. Bayley
4. Cattell
5. Buhler
6. Griffiths
7. Illingworth
8. Denver
9. Neligan

Touwen

Developmental ‘milestones’



Neligan & Prudham

Colour matching and naming

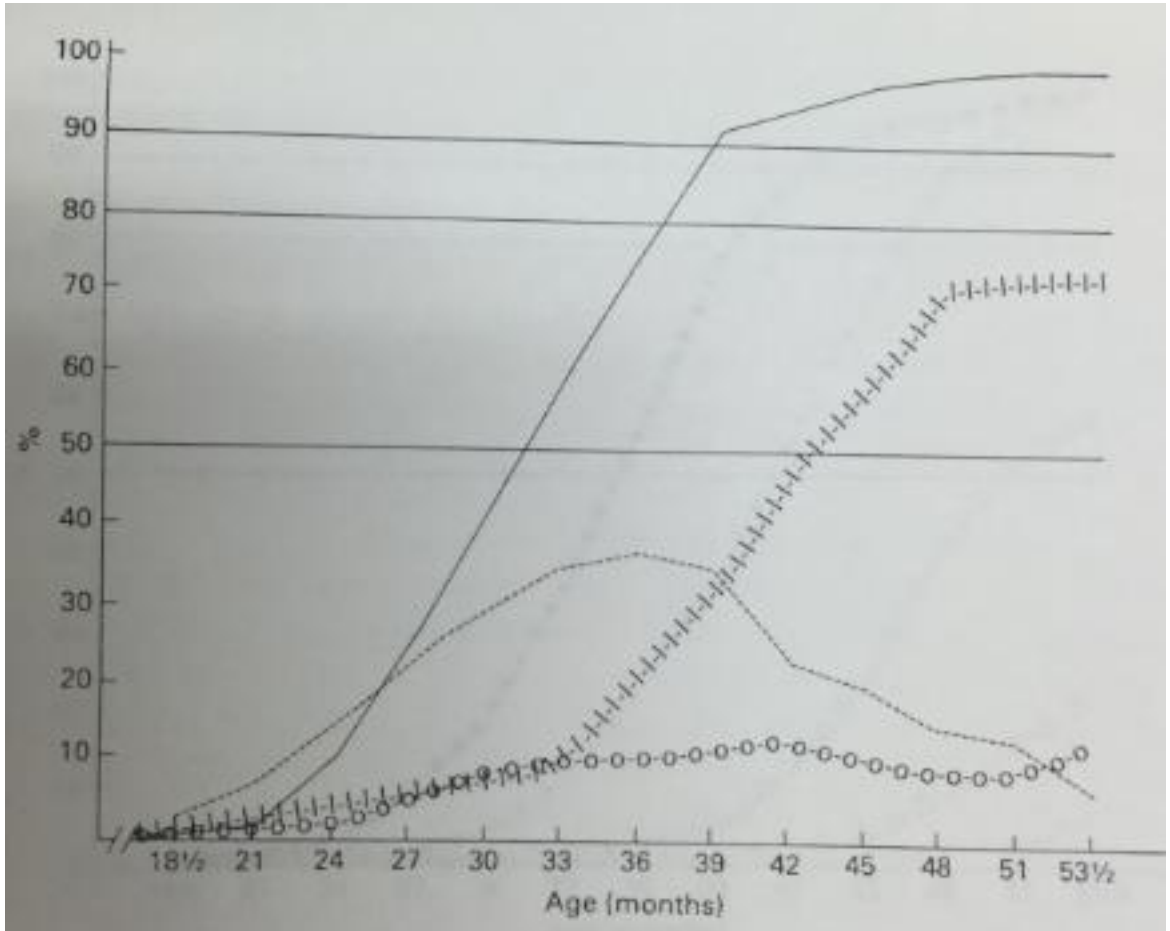
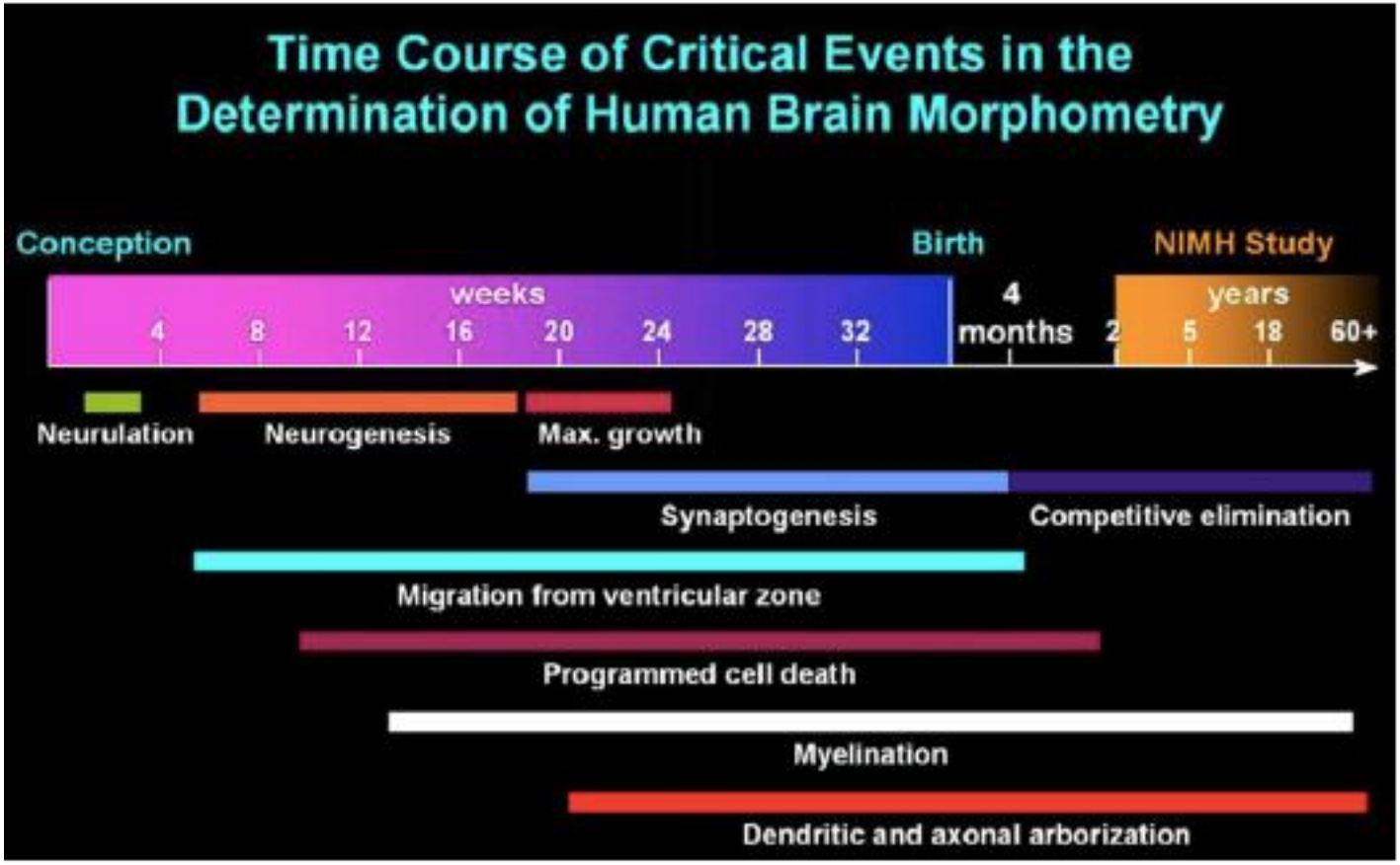


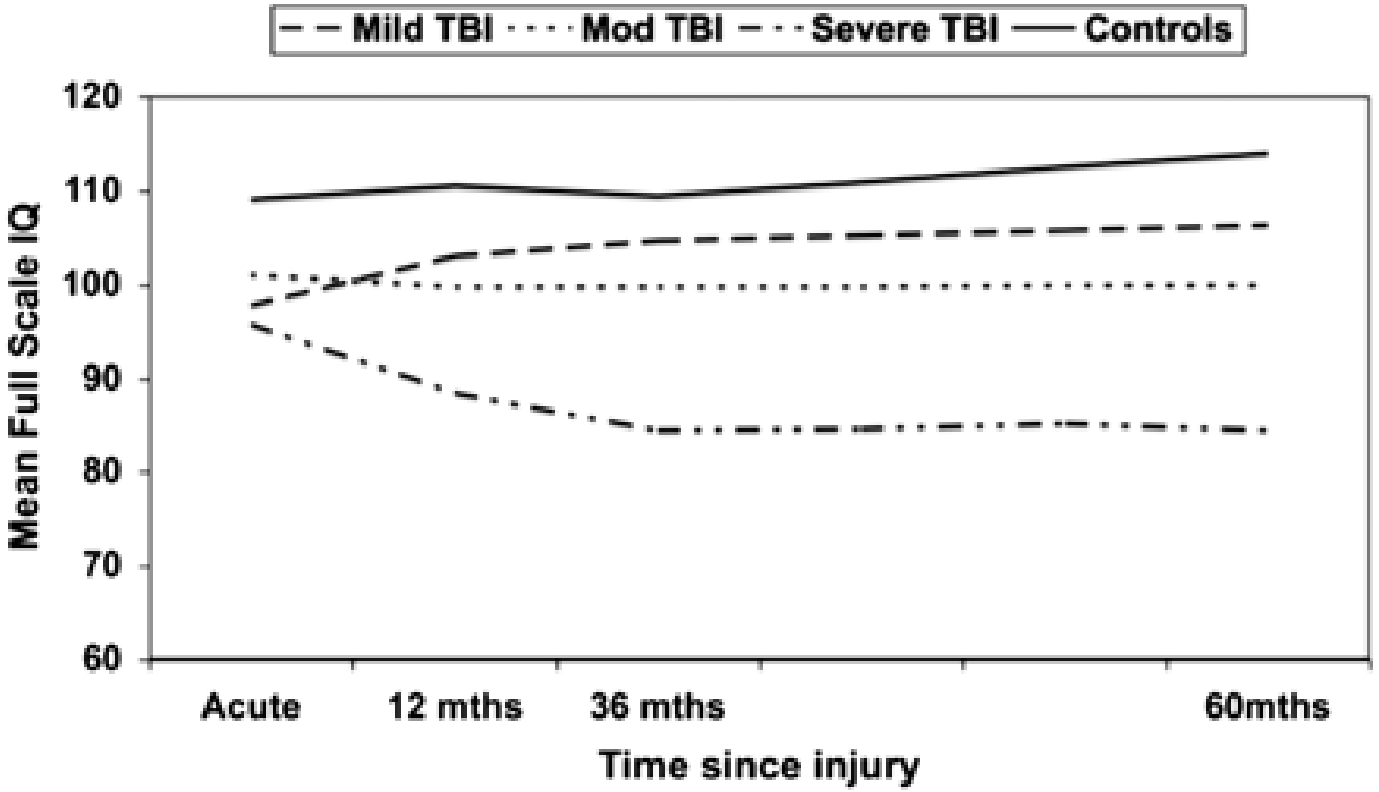
FIGURE 3. Colour matching and colour naming (language). ——— = colour match; ---- = one for all; —o— = primary; —I— = all.

Egan & Brown 1986

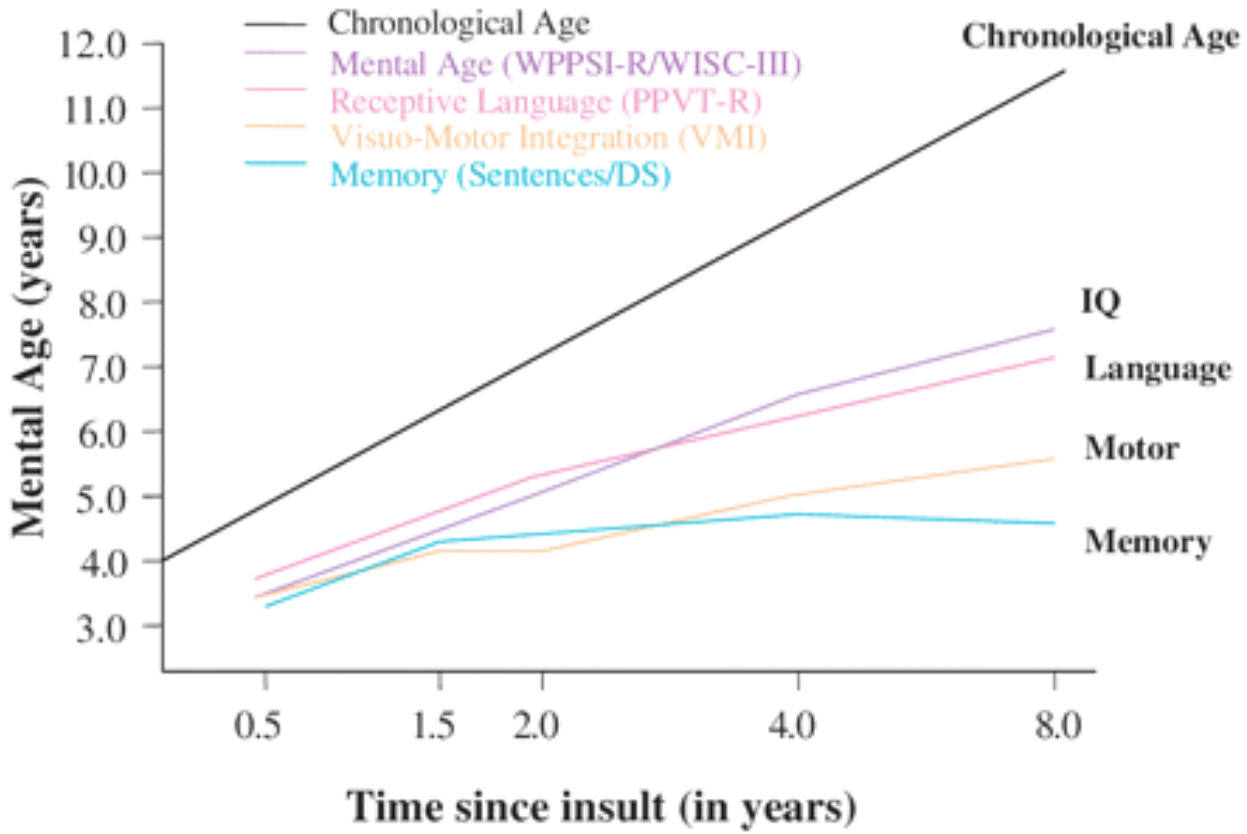
Brain development



Lenroot & Giedd 2006



Anderson et al 2011



Anderson et al 2011

Adult development