

# Developmental examination: birth to 5 years

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## ABSTRACT

Developmental examination is part of the process of identifying children at risk of poor developmental outcomes. Development is a rapidly changing process with large variations within the population and for the same child, which limits the sensitivity and specificity of any examination method. There is now a good body of scientific knowledge and an evidence base for improving the examination method and clinical decision-making. The four main components of this examination are eliciting concerns, gathering information on social and biological risk factors, making structured observations of spontaneous and elicited behaviour, and interpreting findings with knowledge both of the features which raise significant concerns and of common behavioural phenotypes of developmental disorders. The focus of developmental examination needs to shift from simply 'measuring' development to informing the developmental profile of a child's needs and identifying children at risk of adverse outcomes. The objective of helping the child is best achieved when the interpretation of findings, management guidance and management plan are shared through good communication with parents, carers and other agencies.

## INTRODUCTION

This article describes a developmental examination method which combines the scientific knowledge of developmental progression and social and biological risks with the tools of systematic enquiry and observation. It provides a practical stepwise approach for eliciting information on normative and qualitative aspects of developmental abilities to differentiate children with typical development from children who may have significant developmental impairments. It outlines key areas of associated psychological processes,

knowledge of which is essential for making sense of children's developmental difficulties.

Developmental impairments are a heterogeneous group of conditions which start early in life and present with delay and/or an abnormal pattern of progression in one or more domains, for example, sensation, perception, cognition, language, communication, movement and behaviour. The complexity and severity of the impairment and its impact on the child's activity and social and educational participation is influenced by multiple biological, social and environmental factors which interact with each other.<sup>1</sup> Collectively, developmental impairments are common, with prevalence ranging from 5% to 15%.<sup>2-4</sup> They are often associated with health and behavioural problems, and are linked with long term problems of social adaptation, learning and adverse mental health outcomes.<sup>5</sup> There is now good evidence that early identification and early intervention improve the outcomes of children with developmental impairments.<sup>6,7</sup>

Developmental examination is part of a multi-step process of early identification and management of developmental impairments (table 1). There are, however, wide variations in practice and a lack of agreement on how best to conduct this examination in a clinical paediatric setting. Subjective clinical impressions based on informal observations are often used, but they miss a significant proportion of children with problems, which may lead to delay in identification.<sup>8,9</sup> Standardised tests of development primarily differentiate children at different levels of performance on that particular test. These tests are considered as the gold standard by some but may be impractical in terms of time, unsuitable for the child's comprehension or motor abilities, and often too narrowly focus on *measuring* development.<sup>10</sup>

**Table 1** Process for identification of developmental impairments

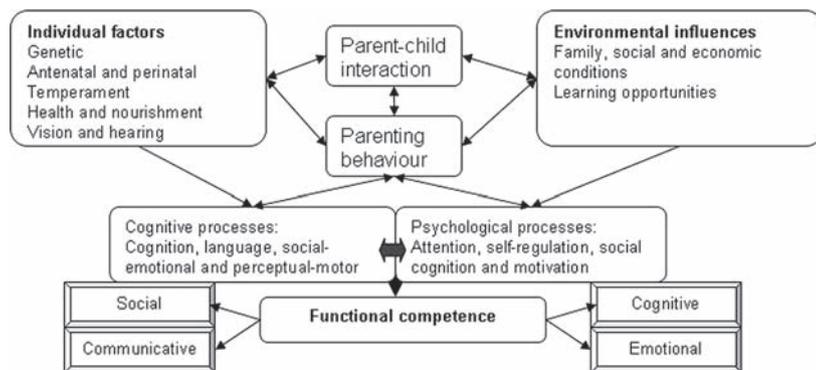
	Objectives	Methods
Surveillance: universal, for all children	Promoting health and development; promotion of good care and parenting; identification of risk factors; early presumptive identification of developmental difficulties <sup>29</sup>	Ongoing process involving parents (through the use of the Personal Child Health Record), health visitors and general practitioners <sup>59</sup>
Developmental examination	To verify concerns, and elicit and categorise developmental function and any likely risk or impairment and arrange further assessment and/or investigations as required	Clinical evaluation based on the knowledge and skills of general paediatrics, developmental progression and the tools and method of examination
Developmental assessment: for established concerns	To provide a detailed description of the child's developmental strengths and weaknesses for management planning and monitoring	Standardised assessment methods, for example, Griffith's or Bailey's scales; psychometric assessment, for example, the Wechsler Intelligence Scale for Children (WISC)
Diagnostic or functional assessment	Diagnostic or functional assessment for management planning	Diagnostic tools, for example, the Autism Diagnostic Observation Schedule (ADOS) and Autism Diagnostic Interview (ADI) for autism; functional assessment tools, for example, the Gross Motor Function Measure (GMFM) for motor assessment

**ESSENTIAL CONCEPTUAL KNOWLEDGE****What influences development?**

Development used to be viewed too narrowly as a maturational process. Child development is now seen as a bidirectional transactional process in which genetic and environmental influences continuously alter each other in a dynamic manner (figure 1).<sup>11 12</sup> Various levels of contexts such as parenting, poverty and social networks interact with each other and with genetic expression to create long-lasting consequences for development.<sup>13–15</sup> Environmental factors become even more important determinants of the child's future in the presence of any biological risk. While single or isolated negative environmental factors may have a small, incremental effect, accumulated risk factors make a major contribution to developmental problems.<sup>16</sup> Family and social environment most strongly but not exclusively, influences emotional regulation, cognitive and language outcomes,<sup>17 18</sup> with most negative influence occurring in infancy.<sup>19</sup>

**How does a child's development progress?**

Progress in developmental domains, for example, cognition, language, social-emotional and perceptual-motor, happens in concert with progress in the psychological processes of attention,



**Figure 1** Influences on development

**Box 1 Domain specific inquiry<sup>60</sup>**

- ▶ Do you have any concerns about how your child talks and makes speech sounds?
- ▶ Do you have any concerns about how your child understands what you say?
- ▶ Do you have any concerns about how your child uses his or her hands to do things?
- ▶ Do you have any concerns about how your child walks or runs?
- ▶ Do you have any concerns about how your child behaves?
- ▶ Do you have any concerns about how your child gets along with others?
- ▶ Do you have any concerns about how your child does things for him or herself?
- ▶ Do you have any concerns about your child's learning?
- ▶ Do you have any concerns about your child's hearing or vision?
- ▶ Do you have any other concerns?

emotional regulation, social cognition and motivation in a mutually dependent manner. Children's functional social and cognitive competence is a product of this interaction.<sup>20</sup> The process of development and learning is plastic – there are alternative pathways and sensitive periods. The magnitude of the plasticity varies at different ages and with biological and social contexts.<sup>20</sup> Most children attain the substages of development in the same order; however, each child develops specific skills at an individual rate.

**A PRACTICAL FRAMEWORK FOR DEVELOPMENTAL EXAMINATION**

Two main components of this framework are:

- A. Use of evidence based methods for a systematic enquiry from parents
- B. Structured observations of developmental abilities.

**Systematic enquiry**

Gathering information from parents and carers is undoubtedly the most important aspect of a clinical evaluation of development.<sup>21</sup> There are three main aspects to a systematic enquiry:

**Eliciting concerns**

Well elicited and carefully interpreted parental concerns are helpful in deciding the focus of further detailed inquiry, judging the need for parental assurance and seeking advice and/or further referrals. The sensitivity and specificity of systematically elicited concerns is as good (70–80%) as standardised screening instruments for detecting developmental impairments.<sup>22</sup> However, if they are not asked or if poorly worded questions are used, up to 40% of parents may not mention a concern even when their child has a developmental difficulty.<sup>23</sup> Using a systematic and structured set of questions (box 1) elicits a more valid and useful response.<sup>24</sup>

The significance of parental concerns changes with children's age, for example, concerns regarding general development, expressive language and social abilities are predictive of impairments at any age, while receptive language and motor function become more predictive of impairments after the age of 3 years.<sup>25</sup> The relationship between parental concerns and the domain of impairment is not always direct – some areas of concern, such as poor language or social abilities, may also indicate global developmental delay.<sup>26</sup> The onset and course of concerns, including any regression, should always be noted.

**Asking parents about the child's current abilities**

Parents are good at giving information about their child's current abilities and their descriptions are sensitive indicators of the child's developmental status.<sup>27</sup> Specific questions to ask are given below with each domain. Information regarding any functional impairment in communication and socialising should be gathered from both parents and teachers. Current health status, any

treatment and self-care abilities should be noted. A brief inquiry is made about the child's mental health status: whether the child is generally happy or unhappy, tearful or irritable, compliant or defiant, cooperative or oppositional, fearful or anxious/worried, and if the parents have any concerns regarding behaviour, level of activity and impulsiveness.

#### Identifying risk and protective factors

Information on relevant biological and family-social risk factors (table 2) is gathered from parents, the Personal Child Health Record and other records/sources.<sup>28</sup> Children with multiple risk factors are at a higher risk for poor developmental outcomes and the management plan may primarily need to focus on risk and protective factors.

### EXAMINATION/OBSERVATION

#### How to observe?

Developmental examination combines informal and structured observations. It is crucial to note qualitative information, *how a task is done*, rather than being over-focused on success/failure on a domain-specific activity. Simultaneous information is gathered about multiple domains, for example, any non-verbal task gives information about visual perception, fine and gross motor skills and cognitive skills; likewise responses on verbal tasks combine social, speech-language-communication and cognitive skills. The examiner manages motivation and transitions, that is, structures the setting to reduce distractions, gives simple, active directions (eg, 'look at the —' vs 'show me —') and uses gestures where required to get attention, for example, saying 'listen' with a gesture of listening with the ear.

### VISION AND HEARING

The principles of surveillance of vision and hearing are applied.<sup>29</sup>

#### Vision

- ▶ Enquiry: do you have any concerns about your child's vision?
- ▶ Does your child: – notice you across the room and follow movement; – see or pick up crumbs on the floor?

- ▶ Observing: developmentally expected visual behaviour (table 3)
- ▶ Examination of eyes for red reflex in infants, abnormal eye movements, for example, nystagmus, and squint
- ▶ Early referral is made for orthoptic assessment for any concerns.

#### Hearing

- ▶ Neonatal hearing screen – check with parents/records
- ▶ Enquiry: do you have any concerns about your child's hearing? Does your child seem to hear quiet sounds; turn and locate a person talking?
- ▶ Eliciting a history of risk factors for hearing, for example, family history, ototoxic drugs, meningitis, NICU admission, palatal abnormality and cranio-facial abnormalities
- ▶ Early referral is made for hearing assessment for any concerns.

Subjective impressions or poorly carried out behavioural tests of hearing, which require proper training and a suitable testing environment, can lead to delay in identification of hearing impairment.

### DEVELOPMENTAL EXAMINATION: BIRTH TO 1 YEAR

#### Motor development

Motor abilities have a weak correlation with cognitive development.<sup>30</sup> However, delayed/disordered motor development may be a marker for motor disorders and may also significantly influence a child's experience and performance in cognitive and social domains.<sup>31</sup>

#### Typical developmental pattern

- ▶ Loss of primitive reflexes by 3 months and appearance of supporting reflexes (4 months onwards)
- ▶ Reducing flexor tone in the limbs and improving extensor tone in the trunk (3–5 months)
- ▶ Improving postural control and stability – in the *cephalo-caudal direction* – first head, then trunk followed by legs (3–12 months).

#### Atypical patterns

- ▶ Children with atypical prewalking movement patterns, for example, bottom shuffling, are late in achieving independent sitting and walking (table 4).
- ▶ Preterm infants commonly show early hypotonia, a strong and longer lasting asymmetrical tonic neck reflex (ATNR), increased flexor tone

**Table 2** Risk factors for poor developmental outcomes<sup>16 61</sup>

Biological	Family and social
Prenatal factors, for example, use of drugs or alcohol, anticonvulsants, severe toxemia and viral infections	Poverty
Perinatal factors, such as prematurity, low birth weight, obstetric complications	Child neglect or abuse
Neonatal factors, such as neonatal encephalopathy, infections (eg, sepsis or meningitis) and severe hyperbilirubinaemia	Low maternal education
Postnatal factors, such as injury or non-accidental injury, meningitis, encephalitis, exposure to toxins, iron deficiency anaemia, severe failure to thrive and severe epilepsy	Parental psychopathology
	Inadequate parenting: a lack of provision of developmentally appropriate opportunities and space (play material, environment and time for the child to initiate, act and succeed). Lack of positive response and warmth in interactions
	Disadvantaged neighbourhood
	Absence of a social network and community learning activities

**Table 3** Observable visual behaviour

Newborn	Blinks to flash and turns to diffuse light
6–8 weeks	Fixes and follows near face
4 months	Watches adult at 1.5 m
5 months	Fixates 1-inch cube at 30 cm
9 months	Fixates on '100s and 1000s' (cake decorations, 1.5 mm) at 30 cm

**Table 4** Prewalking movement pattern and motor milestones (97th percentile)<sup>62</sup>

Movement pattern	Sitting (months)	Crawling (months)	Walking (months)
Crawling	12	13	18.5
None – stand and walk	11.5		14.5
Creeping	13	15	30.5
Rolling	13	14.5	24.5
Shuffling	15		27

in the limbs, extensor hypertonia in the neck and trunk muscles and poorly co-ordinated movements. Their motor milestones are often delayed. There are large individual differences in outcomes<sup>32</sup> and follow-up is needed to identify those with lasting impairments.

#### Enquiry

- ▶ Do you have any concerns about the way your baby moves his arms/legs or body? Have you ever noticed any odd or unusual movements?
- ▶ Has your baby ever been too floppy or too stiff?
- ▶ Does your baby have a strong preference for one hand and ignore the other hand?

#### Observations

Encourage and observe spontaneous posture and movements. Examine tone, movements and posture (eg, head control, hands (open or fisted), spine curvature, legs posture, weight bearing) in supine, pull to sit, supported/independent sitting and standing, ventral suspension and prone position (180° manoeuvre). Examine primary (Moro, grasp and ATNR) and support reflexes (downward, sideward and forward).

#### Significant delay or abnormality – limit ages

- ▶ Fisting of hands beyond 3 months
- ▶ Poor head control at 4 months
- ▶ Persistence of primitive reflexes beyond 6 months
- ▶ Persistence of flexor hypertonia in the lower limbs (popliteal angle <150°) beyond 9 months
- ▶ Not sitting independently with straight spine by 10 months
- ▶ Not walking by 18 months.

#### Fine motor development

Fine motor abilities are influenced by visual perception, postural balance and motor co-ordination, which should be further explored in the presence of any impairment of fine motor skills.

#### Enquiry

- ▶ Do you have any concerns about: the way he uses hands to reach for, pick up, explore and play?; any asymmetry or any unusual hand movements?

#### Typical developmental pattern

- ▶ Increasing co-ordination of vision with head movement (6–8 weeks) and hand movements – watches own hand (hand regard) or objects held in hands (3–4 months)

- ▶ Improving depth perception and differentiated hand movements – initial two-handed reach is replaced by single-handed reach (5–6 months)
- ▶ Achieving sharp visual focus and differentiation of movements – exploration with index finger (8–9 months)
- ▶ Maturing grasp: improving apposition of tips of fingers with the tip of the thumb (palmar – 6 months, pincer (thumb–finger) – 9–10 months) and finger tips (12 months) (figure 2)
- ▶ Releasing with open hands or with pressure (10–11 months); controlled release – puts one cube on top of another (13 months).

#### Observations

- ▶ Reaching, grasping, exploration and/or hand-to-hand transfer of a toy or 1-inch blocks placed in front of (offer in hand if the infant does not reach) the infant sitting supported
- ▶ Use of a bell with a clapper and a small object to prompt reach, grasp and exploration
- ▶ Encouraging release of a block/toy in the hand or a container
- ▶ Placing one brick on another, indicating a mature release.

#### Significant delay or abnormality – limit ages

- ▶ Not reaching with hands at 6 months
- ▶ Persistence of ‘hand regard’ after 9 months
- ▶ No index finger exploration by 12 months
- ▶ Lack of purposeful exploration of objects and toys by 12 months.

#### Speech, language and communication

##### Enquiry (note the language spoken at home)

- ▶ Do you have any concerns that your baby is too quiet?
- ▶ Do you have any concerns about the way your baby communicates with you? – makes sounds? – responds to you?
- ▶ What sounds does your baby make (spontaneously or in response to talking to him)?
- ▶ How does your baby respond to: your smile? – calling his name? – saying ‘no’ to him? – simple commands such as ‘come here’, ‘give it to me’?
- ▶ Does your baby say any clear words other than ‘Mama’ or ‘Dada’? (get examples)
- ▶ Does your baby look at family members or familiar objects when you ask for them or name them?
- ▶ How does your baby ask for things? Does he point to ask?
- ▶ How does your baby show you anything? Does he draw your attention by pointing to it?

#### Observations

Observations of the infant’s speech, language and communication are made throughout the examination, using common objects or large toys such as a ball, cup, plate, spoon, car or doll. Infants may respond better to the caregiver, who can be asked to give simple directions to the child for naming or giving of objects (table 5).

**Non-verbal communication**

Body movements to express distress or needs are co-ordinated with vocalisation (3 months), and become purposeful: pointing to ask (9 months) → pointing to show (9–12 months) → conventional gestures, for example, waving goodbye, blowing a kiss (9–12 months).

**Significant delay or abnormality**

Further assessment is indicated for: no smile or vocalising by 3 months; not looking at people talking by 6 months; no babbling by 10 months; not responding to name by 12 months and not pointing or using other gestures by 12 months. Impaired comprehension and/or poor interaction usually indicates abnormal development.

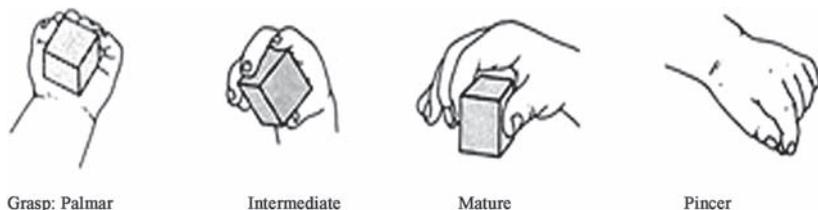
**Social development****Enquiry**

- ▶ Do you have any concerns about the way your baby responds to you?
- ▶ How does your baby respond to you:
  - when you smile at him; – play nursery games such as pat-a-cake or peek-a-boo?
- ▶ How does your baby: – get your attention to show you something? – react to another person not known to him?

**Observations**

Observations of the infant's social development are made throughout the examination:

- ▶ Initiating, responding, anticipation and turn-taking in play interactions



**Figure 2** Development of grasp: cube/pellet.

**Table 5** Observation of language development: birth to 1 year

Language component	Typical developmental patterns
<b>Comprehension</b> – Note the infant's response to speech sounds – Observe response to naming of common objects or large toys and to simple directions, for example, 'look at the –', 'give me –', without using gestures	<i>Selective attention to speech sounds:</i> turns head to look at the speaker by 4 months; appears to listen to conversation of others (8 months) <i>Situational understanding:</i> understanding 'No', responding to own and family names (6 months); looks at or gives common objects used at home (8 months); follows familiar requests (12–15 months)
<b>Expressive language</b> – Listen to the type and frequency of spontaneous or imitated sounds (vowels, vowel-consonant combination or words) in response to being talked to – Observe any gestures used to communicate	<i>From preverbal communication to first word:</i> cooing (8 weeks) → squeals, yells, repeated vowel sounds (4 months) → multi-syllable babble – vowel-consonant combinations (8 months) → 'word like' sounds with intonation 9 months (jargon) → consonant-vowel word 12 months Single words, other than mama/dada, with consistent meaning: 12–13 months. There is a large normal variation: emergence of first word ranges from 8 to 18 months (mean 13 months) <sup>63</sup>

- ▶ Use of eye contact
- ▶ Use of gestures, for example, pointing to ask and to show.

**Typical developmental patterns**

- ▶ Developing social responsiveness and anticipation
  - ▶ Social smile (6–8 weeks)
  - ▶ Responds to social games such as peek-a-boo and shows anticipation (6 months).
- ▶ *Developing joint attention* (a crucial step for the development of language and communication skills)<sup>33</sup>
  - ▶ Follows other's finger point to look at an object (8 months)
  - ▶ Uses finger and eye pointing to direct others' attention to share interest (9–12 months).
- ▶ *Becoming stranger aware* – reacting by withdrawing or crying (6 months)
- ▶ *Social referencing* – checking back by looking towards the caregiver in new situations (12 months).

**Significant delay or abnormality:**

Not responding to carer's interactions such as smiles by 8 weeks; no joyful engagement in fun activities by 5 months; lack of interest in social games by 9 months; no pointing or other gestures by 12 months.

**Cognitive development****Enquiry**

- ▶ Do you have any worries about the way your child uses common objects or plays with toys?
- ▶ Does your baby look for a toy that has fallen out of sight or is hidden from him?
- ▶ How does your child play with toys and common objects?

**Observations and typical developmental patterns**

Observations of infants' cognitive abilities are made during fine motor, communication, play and social interaction activities. The four main structured tasks used are:

1. Physical rules and object relationships: Play with 1-inch cubes, container and cause-and-effect toys
  - ▶ Offer one cube, note reach grasp and exploration, for example, hand-to-hand transfer
  - ▶ Offer another cube, note handling of two cubes; check imitation of clicking of two cubes
  - ▶ Ask for a cube back by putting open hand out – note release
  - ▶ Put an open container and encourage releasing a cube into it and taking it out
  - ▶ Put one cube on the floor/table and another on top – encourage the infant to do the same.

Improving eye–hand co-ordination enables infants to look at what they hold in their hands by 4 months and reach out to grasp by 5 months.

They relate objects together by banging or clicking them at 6 months, placing things in and out of containers at 9–15 months and inserting pegs into holes by 15 months.

2. Cause-and-effect understanding and goal-directed actions<sup>34</sup>
  - ▶ Use pop-up or other action toys
  - ▶ Place a toy out of reach and the connected string near the child. Check grasp of string and pulling the string to get the toy.

These concepts emerge as simple acts such as shaking of a bell (7 months), using cause-and-effect toys, for example pressing large buttons to activate a musical toy (9 months), intentional means-end actions such as pulling a toy with a string (9 months) and moving a car (12 months).

3. Object permanence: Finding a hidden toy (partially/completely covered with a cloth).

Understanding that objects continue to exist even when they are out of view – at 6–8 months infants begin to look for a partially hidden object and between 9 and 10 months they are able to search for a toy which has been completely hidden in their view.

4. Categorisation: Use of common objects/toys, for example, a toy car, cup, spoon, bell or telephone (on self/doll/mother).

By 10–12 months of age infants use similar looking objects/toys in the same way, for example, moving toys that look like a vehicle, and by 14 months they show ‘definition-by use’, for example, using a hair brush to brush their hair.<sup>35</sup>

#### Significant delay or abnormality

Not reaching for a toy placed in front of them by 6 months; not showing interest in exploration of toys/objects by 6 months; no purposeful use of objects/toys by 12 months; no cause-and-effect play by 12 months; not defining objects by their use by 18 months.

#### DEVELOPMENTAL EXAMINATION: 1–5 YEARS

After 18 months the focus of inquiry and observations changes from reflexive-sensorimotor patterns in infancy to problem solving, social and language abilities. The development of cognition, from cause and effect and object permanence to increasingly conceptual and complex thinking, is observed non-verbally in the matching of shapes, patterns and figures (deliberate rather than trial and error) and in the development of language and play.

#### Motor development

Beyond the onset of walking at 12–13 months, the main purpose of motor examination in children is to detect functional difficulties and impairment of co-ordination, movement and balance rather than to ascertain the developmental age of the child.

#### Enquiry

Do you have any worries about your child’s way of walking, running or participating in other physical activities?

#### Observations

- ▶ Note arm and leg posture and co-ordination. Initially when walking independently, at 12–18 months, arms are held spread out in a rigid manner. By 2 years most children begin to move their arms reciprocally and by the age of 4 years arms are held by the side and move reciprocally.
- ▶ Toddlers walk with a flat footed gait. The heel-toe gait emerges from 18 months and the walking base narrows.

#### Typical developmental patterns

- A. Increasing strength and co-ordination<sup>36</sup>
  - ▶ Running: a symmetrical pattern of limb co-ordination with a brief flight phase (both feet off the ground in mid-stride) emerges about 6 months after the onset of walking (range 15–24 months)
  - ▶ Hopping: a one legged gait with take off and landing on the same foot – about 2 years after walking
  - ▶ Skipping: a step and hop on each foot alternately, average age 5 years.
- B. Improving balance: walking in a straight line by 3 years and standing on one foot by 5 years.

#### Significant delay or abnormality

Not walking by 18 months; clumsiness of movements; poor balance – frequent bumping/tripping over; any asymmetry or presence of abnormal tone, posture or movements.

#### Non-verbal perceptual-cognitive development

From the second year onwards, children’s developing cognition results in improving differentiation and integration of visuo-spatial perception, mental representation of objects, working memory and flexible and sustained attention. These are reflected in improving ability in activities such as drawing, three-dimensional problem solving and, later, reading and writing, and are observed by using the developmental tools of block construction, shape sorting/form boards, and drawing.

#### Enquiry

- ▶ Do you have concerns about your child’s self-care activities, for example, managing a spoon or a fork, dressing/undressing?
- ▶ Do you have concerns about your child’s drawing or other constructive play activities?

#### Observations and typical developmental patterns Block (1-inch cube) construction tasks

*Imitating a model* (the child is shown how to do it) entails understanding the relationship of objects in space, directionality, attention and fine motor co-ordination (figure 3).

*Copying a model* (the child is shown a completed model) recruits the additional abilities of planning and rotating objects mentally. Additional working memory and recall abilities are needed

## Best practice

to construct a model when the model is shown and removed.

**Shape sorting/jig-saw puzzles/form boards**

Children progress from manipulating shapes which are easier to mentally rotate in space, such as a circle, to more geometric and irregular shapes. Observations are made of the child's visual scanning before placing the shape, any pushing of shapes in wrong holes and the ability to mentally rotate shapes by completing a reversed form board. By 30 months most children can match three basic geometric shapes (circle, triangle and square) even when the form board is turned around.

**Colour matching and naming**

Infants have perceptual awareness of colours by 6 months. Observations of children's ability to categorise objects by colour is made by using objects or cards of different colours for naming and matching. By 30 months, 50% of children can match cubes/cards by colour. By 42–48 months they can name four colours correctly.

**Sorting objects by size**

Children show a good awareness of the size of objects in matching tasks by 30 months. They are able to point to big/small cube/spoon/cup by the age of 3 years, and 50% can point to a long/short line drawn on paper by 42 months and 90% by 54 months.

**Drawing**

Cognitive abilities of left and right orientation, visual attention, working memory and fine motor skills underpin drawing ability. Initial jabbing/stabbing at the paper with some disconnected strokes at 12–15 months reflects a child's exploratory interest and relational understanding.

*Scribbling*

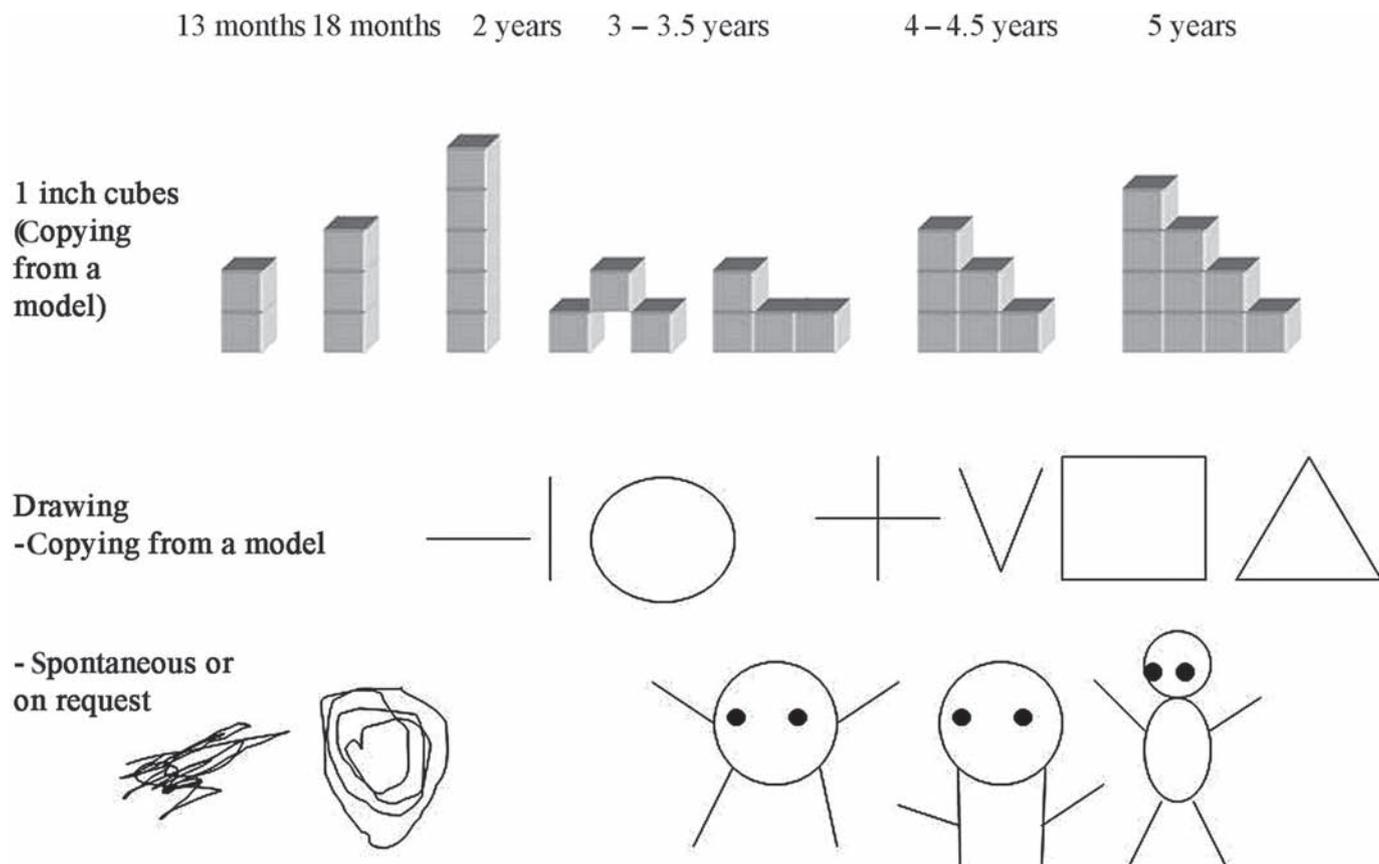
Initially, at 15–18 months, the scribble is a rhythmic back and forth or side to side motion; by 2 years the motion becomes smoother and has a circular or wavy appearance. Gradually the drawing becomes more 'contained' and shapely. These drawings may not be visually recognisable but children often name them, showing their representational ability.

*Draw-a-man*

There is a developmental progression to the 'draw-a-man' task (figure 3); however, many children at times lapse into earlier forms such as scribbling.<sup>37</sup> As an isolated ability, 'draw-a-man' has poor correlation with children's intellectual ability or their academic performance.<sup>38</sup>

*Copying shapes*

Predrawn figures (figure 3) are presented with a request 'draw one like this one' – without naming. Any immaturity of figure drawings, for example, poor closure of shapes and wrong number of angles, is noted. *Imitation* of drawn shapes



**Figure 3** Non-verbal skills tasks, 1–5 years.

and block constructions, for example, where the shape of the model is demonstrated for the child, is achieved earlier than the ability to copy from a completed model.

#### *Grasp of crayon/pencil*

Tripod grasp is achieved at 3 years by 50% and at 4 years by 80% of children, and the presence of any tremors should be noted (figure 4). The frequently associated 'overflow' movements of hands and tongue gradually disappear by age 7 years. Excessive associated movements which interfere with normal function and/or asymmetry or persistence, may indicate a neurological abnormality. Handedness appears from 2 to 4 years – early appearance (before 12 months) or early fixed handedness should prompt neurological examination.

#### Significant delay or qualitative abnormality

A child with severely delayed (functioning at less than 50% of chronological age) non-verbal abilities across a range of tasks is likely to have a significant impairment. Mild to moderate delay associated with qualitative abnormalities of movement, poor co-ordination or poor attention should prompt further assessment. Poor performance on non-verbal tasks may also relate to low motivation, poor vision and, in some cases, lack of stimulation.

#### Speech, language and communication

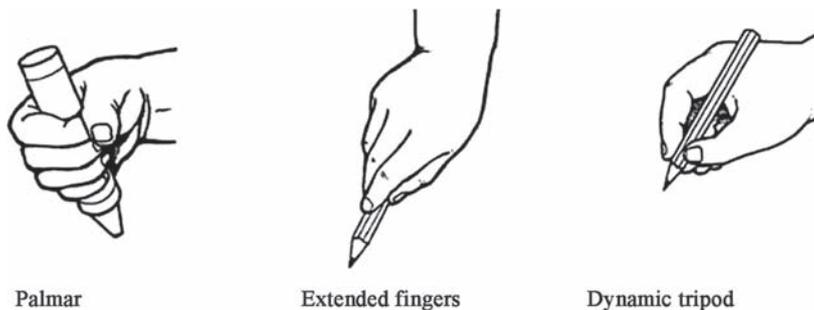
##### Enquiry

Asking 'how much does your child understand?' tends to produce a response 'everything' because of children's situational understanding and carers' use of gestures. Asking specific questions about current development<sup>39</sup> and getting examples where possible is most informative.

##### Comprehension

Does your child

- ▶ Recognise common words, for example, daddy or juice, by looking/pointing? (10–14 months)
- ▶ Point to body parts, for example, nose/eyes/hair/feet when asked? (12–18 months)
- ▶ Follow two keyword instructions, for example, *throw the ball*? (18–24 months)
- ▶ Identify objects for functional use, for example, which one do we eat with? (24–30 months)



Palmar

Extended fingers

Dynamic tripod

**Figure 4** Development of grasp (crayon/pencil).

- ▶ Follow instructions with:
  - ▶ 'In' or 'on', for example, put the cup on the table? (18–30 months)
  - ▶ 'Under'/'behind', for example, put the ball under the table/behind the door? (30–36 months)
  - ▶ Two directions given together, for example, 'get your shoes and give me the keys'? (36–48 months)
- ▶ Comprehend two or more tasks in succession (eg, 'first, you have to tidy your toys before you can play outside')? (48–60 months).

##### Expression (get examples where possible)

- ▶ When your child wants something how does he ask for it? Does your child point to request an item?
- ▶ Does your child say any clear words or name any picture object when you point to it? Approximately how many words does he say: two to five (15–18 months), 10 to 20 (18–24 months), 50 or more (20–27 months)?
- ▶ Does he put two words (18–24 months); three or four words (25–36 months) together?
- ▶ Can your child tell his name when asked? (30–36 months)
- ▶ Does your child echo/repeat back what you/others have said to him?
- ▶ Does your child use – words like 'I', 'mine' or 'you' (30–36 months); – 'what'/'why' to ask questions? (36–42 months)
- ▶ Does he tell you something that has already happened? (42–48 months)
- ▶ Does he offer explanations? (48–60 months).

##### Speech sound and fluency

- ▶ Can you understand most of what your child says? If no, give an example of any difficulty.
- ▶ Does your child stumble, repeat words or the beginnings of words or get stuck on words? How often does this happen?
- ▶ (Children's use of strategies to simplify word sounds continues up to the fourth year: words with two or more consonants may be pronounced as a single consonant; the initial or final consonant may be deleted or whole syllables might be deleted. Only half of the child's speech may be intelligible at 2 years, becoming fully intelligible by 4 years.)

##### Pragmatics

- ▶ Does your child take turns in conversation? (2½–3 years; can hold conversation skilfully by 4 years).

##### Observations

###### Step 1

Place some toys/objects (eg, a cup, spoon, plate, 1-inch cubes, key, fork, pencil, empty box or car, adding miniature toys and pictures for 24 months and above) near the child and ask:

For comprehension:

- ▶ *Object labels* (15–18 months): 'Look at the –'; 'where is the –'; 'give me the –'

- ▶ *Identifying by use* (24–30 months): ‘Which one do we eat with/drink with/sleep in?’ (avoid pointing by finger or looking at the objects while asking).

For expression:

- ▶ Objects labels (18–20 months): ‘What is this one’ or ‘This is a – (in an expectant voice)?’

#### Step 2

Put action pictures (eg, of sleeping, eating, washing, running, eating and reading a book) in front of the child:

*For comprehension* (30 months): ask without pointing: ‘Show me who is eating/sleeping/running?’

*For expression* (30–36 months): ask while pointing at a picture: ‘What is the boy/girl doing?’

#### Step 3

For comprehension:

Concepts:

- ▶ *Prepositions*: Put toys and objects in front of the child and give instruction to ‘Put the cube in/on (24–30 months)/under/in front of/behind (30–36 months) the cup/plate/box/car’.
- ▶ *Colour*: Ask the child to identify the cube/card of a certain colour from an assortment. They can identify or name two colours by 36 months and four by 48 months (the ability to match objects of the same colour is seen earlier – by 30 months).
- ▶ *Size*: Ask the child to identify the size (bigger/smaller) of an object or picture (36 months), a longer line (42 months), the weight (heavier) of cubes (48 months).
- ▶ *Numbers*: Children first begin rote counting, almost as a nursery rhyme, in their third year. By the age of 3½–4 years they can count four to six cubes/objects correctly in a stable number order. They can follow a direction to ‘put just three cubes in the box’ by 4–4½ years.
- ▶ *4+ keyword sentences* (~42 months): Give directions in a single sentence without breaking it into parts, for example, ‘Put the big cube and the spoon in the box’.
- ▶ *Joined up sentences* (~48 months): ‘Put the spoon in the box and the pencil on the plate’.

For expression:

- ▶ Have a conversation with the child about any preferred topic or what he likes about school or playtime.
- ▶ Present a picture depicting multiple activities and ask: ‘Look at the picture and tell me what is happening’ (describing narrative: 4½–5 years).
- ▶ Ask the child to describe common objects or concepts, for example, ‘What is a key/friend?’ (defining words: ~52 months).

#### Key features to note

- ▶ Speech clarity and fluency
- ▶ Sentence construction: examples of words/sentence length, use of prepositions, pronouns and grammar

- ▶ Non-verbal communication – use of eye contact and gestures
- ▶ Use of language for conversation, any repetitive use of words/phrases and amount and use of any self-directed language.

#### Significant delay or abnormality

No clear spontaneous words used by 18 months; not showing understanding of common familiar objects/giving on request (eg, give me the cup) by 18 months; unable to follow simple requests by 27 months; no word combinations used by 30 months; not routinely using two to three word sentences by 3 years; not understanding ‘what’ and ‘why’ questions at 4 years; speech very unclear at 4 years; unable to use sentences at 4 years; most of language consisting of ‘echoed’ words or sentences addressed to child; repetitive utterances (delayed echolalia); signs of being frustrated or struggling when talking or family history of stammering and any period of loss of language or social skills.

#### Prognostic indicators

Good receptive language, symbolic play skills and use of language for a range of communicative and social functions, for example, for expressing needs, answering, describing and greeting indicate a good prognosis.<sup>40</sup> Early speech and language delays are often associated with later reading, spelling and behaviour problems.<sup>41 42</sup>

#### PLAY AND SOCIAL DEVELOPMENT

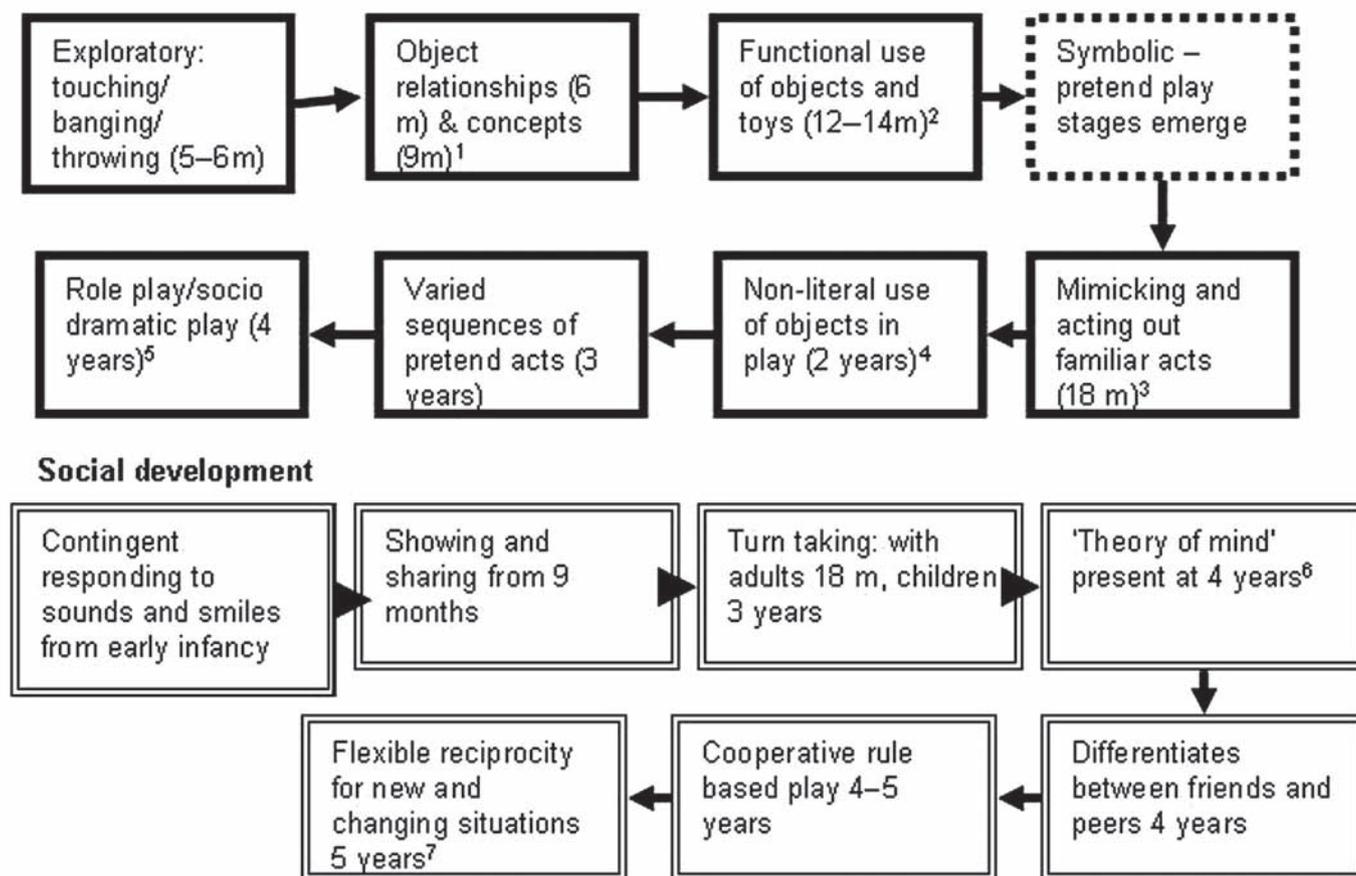
In early childhood, the development of communication, play and social abilities is intertwined (figure 5).<sup>43</sup> Social development includes the child’s emerging understanding of desires, feelings and intentions of self and others. This enables them to form and maintain relationships and learn about the effect of their behaviour on others.

#### Inquiry

- ▶ Do you have any concerns about the way your child plays, for example, that they do not play like other children?
- ▶ Does your child engage in pretend play (eg, feeding a doll or teddy, putting a toy in a truck and pretending to drive it along)?
- ▶ Does your child appear isolated from others?
- ▶ Are there any difficulties in getting eye contact with your child?
- ▶ Does your child ever bring any items of interest, for example, a drawing or a toy, to show to you?

#### Observations

A semistructured play session is useful for gathering information about the child’s language, communication, social interaction and play abilities. Such a session usually begins with ‘free play’ with some developmentally appropriate toys, for example, cause-and-effect and construction toys



**Figure 5** Play and social development.

and/or a doll/family/tea set toys and/or action figures. The examiner then guides the child through the following set of activities:

- 1) Interactive play activities to observe turn-taking
- 2) Encouraging the child to make a choice, or to ask for more, by starting and pausing activities, such as blowing balloons or bubbles
- 3) Setting up pretend play and role play activities to check the child's creativity
- 4) Using play situations for to-and-fro conversations.

#### Significant delay or abnormality

No pointing or other gesture by 12 months; no joint attention by 18 months; lack of showing with toys or other objects by 18 months; absence of simple pretence play (eg, feeding doll) by 24 months; and repetitive play with toys (for example, lining up objects). From 3 to 4 years, lack of social interest in, or odd approaches to, other children with preference for solitary play; minimal recognition or responsiveness to other people's happiness or distress; limited variety of imaginative play, especially a lack of social imagination (that is, not joining with others in shared imaginary games); odd relationships with adults (too friendly or ignores).

#### DEVELOPMENT OF ATTENTION

There is a dynamic developmental course for attention (table 6) and the inter-related self-regulatory skills in early childhood.<sup>44</sup> Attention to tasks and events is essential for learning. A variety of medical conditions are associated with attention problems in preschoolers, including epilepsy, hypothyroidism, low birth weight, hearing loss and prenatal exposure to teratogens (eg, fetal alcohol syndrome). Behavioural difficulties, language impairment and co-ordination difficulties are common in children with deficits of attention.

#### Enquiry

Enquiry is made about duration of attending to, or difficulties in staying on, a task, for a range of activities, for example, watching TV, reading and mealtime; any difficulty in listening to questions or instructions and impulsivity (difficulty waiting for turn, interrupting). Information from multiple informants, for example, teachers, is useful in determining the type of problem and its functional impact. Parent, teacher and child rating scales yield useful information about a child's functioning along multiple dimensions of behaviour and help form a basis for a referral for further assessment. One such tool, the Strengths and Difficulties Questionnaire, is a brief behavioural

**Table 6** Typical developmental pattern for attention

Birth to 18 months	Infants sustain attention in exploring toys by 5 months and, by 9–12 months, show sustained purposeful activities, correcting errors in looking for hidden objects. However, they are easily distracted towards dominant stimuli.
18 months to 3 years	Children become able to undertake planned sequential activities of increasing complexity, such as matching of shapes/forms, with sustained attention and get better at inhibiting their impulsivity. However, they remain somewhat resistant to interference and need adult help in shifting their attention to a different task.
3–4 years	Attention now becomes more flexible (easily shifting between tasks), selective (able to ignore irrelevant stimuli) and sustained, for example, sorting cards by colour (36 months)
4–5 years	Children now voluntarily ignore stimuli which are irrelevant to the task, controlling their focus of attention. They sustain attention to sort objects on two dimensions, for example, colour and shape. By 5 years of age children integrate information from different sources, for example, listening to directions without losing focus on the task. They can now make a plan and carry it out with sustained and flexible attention.

screening questionnaire for 3–16 year olds and is available free from [www.sdqinfo.org](http://www.sdqinfo.org).

### Observations

Observations of attention are made throughout the examination, not necessarily to diagnose attention deficit hyperactivity disorder (ADHD) per se, but to inform the analysis and management planning, as attention difficulties may contribute to poor performance at developmental tasks and/or to poor or disinhibited interactions.<sup>45</sup> Observations are made of children's orienting and sustaining attention on tasks, listening to instructions, shifting attention between verbal and non-verbal tasks, impulsiveness, distractibility, fidgetiness, activity level and any shift in attention with time or with change of activity.

### EMOTIONAL REGULATION AND TEMPERAMENT

Difficulties with emotional regulation and temperament are commonly present in children with developmental impairments. Temperament is observable as a mix of activity level, positive or negative affectivity and self-regulation.<sup>46</sup> It is a major influence on how a child adapts and learns, and on parental care and responsiveness.<sup>47</sup> Non-supportive environments are important contributors to a dysfunction in self-regulation and extremes of temperament.<sup>48</sup>

Enquiry and observations are made regarding children's compliance/defiance, mood (happy/sad/irritable/aggressive), fears/worries and general behaviour. Between 12 and 18 months children begin to comply with caregivers' requests to initiate or stop actions. They are not yet able to modulate their own actions or avoid distressing situations. By 24 months children acquire some self-control of their behaviour by delaying action on request. By 36 months children regulate their behaviour even in the absence of external monitoring. From 3 years of age children show the capability to modify behaviour based on situational rules (active play on the playground/sitting and paying attention in class). They now show self-conscious emotions and seek help in stressful situations. From 4 years onwards children begin

to hide or modulate their emotions in a socially appropriate manner.<sup>49</sup>

### PARENT–CHILD INTERACTION

Parental sensitivity and their responses to the child's behaviour are indicators of parent–child interaction. Parental negativity towards the child, as expressed in their description of the child or as observed in their misattribution of the child's behaviour, for example, believing that the child intentionally upsets them, may be a cause for concern. However, observations of parent–child interactions in structured or artificial settings may not necessarily be representative of those normally taking place at home.<sup>50</sup>

### PHYSICAL EXAMINATION

The most relevant aspects of physical examination are growth (height and weight), head circumference, dysmorphic features, hyper/hypopigmented skin spots, eye movements, abnormal reflexes, tone, power, posture and movements and any evidence suggestive of non-accidental injury. Neurological soft signs (eg, dysdiadochokinesis, mirror movements) are commonly found in preschool children with developmental difficulties but are non-specific for diagnostic purposes.<sup>51</sup> The distribution and type of any stereotypical motor movements, motor or vocal tics, any periodicity in their presentation, functional impact and any associated stress or anxiety should be noted.

### MAKING SENSE OF FINDINGS

#### Understanding limitations

Development rapidly changes over time for a given child, with large variations within the population and for the same child. A single developmental examination only gives a view of the child's abilities at that time. The long term stability of a one-off developmental score is limited.<sup>52</sup> This restricts the sensitivity and specificity of any developmental examination measure or method and, at least initially, the interpretation is often presumptive. An acknowledgement of this should be made in discussion with parents and in reports. Some other specific limitations to consider are:

- ▶ *Measurement:* Conventional norm-referenced tests of development have neither been developed nor field-validated for children with developmental difficulties. They only give an indication of the difference from the norm and provide a limited view of the child's functional abilities.
- ▶ *Narrow focus:* Identification of developmental delay may not be the most useful activity, as the delay in some cases may be a short term phenomenon, while in other cases qualitative developmental impairment may be present without any 'delay'.
- ▶ *Setting:* Clinical settings are different from natural environments in which young children

typically function and may affect their performance significantly.

- ▶ Children's performance may be affected by other factors, for example, anxiety or poor attention.

### Developmental diagnosis and clinical decision-making

The outcome of the examination is a profile of the child's current developmental performance and difficulties. Clinical interpretation of this profile requires combining the examination findings with information regarding any biological (birth, physical, neurological, hearing and vision) and social (family and environmental) risks, significant psychological attributes (behaviour, affect, attention and anxiety), any functional difficulties in real-life settings, for example, in communication, socialising or learning, and any risk taking behaviour.<sup>48</sup> A narrow focus on the child's difficulties in one particular domain without attention to other factors may lead to a wrong conclusion such as diagnosing developmental delay in the presence of sensory impairment or poor social environment.

The combined picture may point to one of the following scenarios:

- A. A specific neuro-developmental disorder (eg, autism, ADHD, severe learning difficulties). The clinician needs to be aware of the common behavioural phenotypes and should seek further specialist assessment for confirmation and management planning.
- B. A 'significant' delay in one or more domains, which needs further investigation and assessment. Assessing the significance of any developmental delay requires clinical interpretation – simple descriptions of developmental ages are not helpful – as the range of normal is descriptive, not diagnostic.
  1. A severe delay (where development is equivalent to 50% or less of the expected milestones at that chronological age) should be considered significant, requiring further investigations.
  2. Mild to moderate delay is likely to be significant when it is global (affecting many domains of development) and/or associated with social or biological risk factors as identified from history and examination and/or associated with functional difficulties.
  3. Functional difficulties in communication, movement, co-ordination or learning may require referral for specialist assessments (eg, speech and language therapy, occupational therapy, physiotherapy) even where there is no specific diagnosis or significant delay.
  4. Any plateauing or regression of development needs further investigations.
- C. Children, whose parents express excessive concerns, even though their development

is within the normal range, have a higher prevalence of later educational, behavioural and social difficulties.<sup>24</sup> Clinicians should not simply reassure the parents but offer facilitative advice on promoting development and shaping behaviour, and communicate with other professionals/agencies for exploring other risk factors and further monitoring.

### Planning investigations

Investigation planning is a clinical decision that is aided but not dictated by protocols.<sup>53–55</sup> A constellation of features such as the course and severity of developmental difficulties, examination findings,<sup>56</sup> knowledge of likely causes and associations and the impact of the investigation results on subsequent management influence the initial investigation plan. First line genetic and other investigations (figure 6) followed by other tests, as indicated, in a stepwise manner is a sensible approach. Finding an underlying cause is most likely for severe global developmental delay (approximate yield of 50%), particularly when associated with other findings from history and examination, for example, dysmorphism or abnormal motor findings, while isolated language delays are common and have a low diagnostic yield.<sup>57</sup> Severe receptive language delay associated with regression or a fluctuating course may warrant a sleep EEG to exclude Landau-Kleffner syndrome. Developmental regression is rare and there should be a low threshold for an urgent neurological referral, particularly in the presence of seizures or other neurological abnormalities. More commonly, plateauing of development is seen with transitional loss of functional skills in the context of some associated social or physical problem – this should first be monitored before embarking on investigations.

### Feedback to parents and management plan

The multi-dimensional profile of the child's abilities, difficulties, risks and needs guides the management plan. Explaining this profile to parents requires empathetic listening and good communication skills. The term 'developmental delay' implies an expected 'catch up', which may not be the case depending on other variables such as social or biological risk factors. Anticipatory guidance regarding any likely future difficulties/risks should be offered, for example, delayed language development may also be an early marker for later difficulties with, for example, reading, learning or behaviour.<sup>58</sup> The focus of the discussion should be on how best to promote the child's development and function and prevent any likely future difficulties. Parents should be offered support, generic facilitative advice and relevant information. An agreement should be reached with parents for accessing further assessment, therapy, educational help, parental support and other services as required.

**SUMMARY**

The proposed framework for developmental examination is based on the current scientific knowledge of development, methods of enquiry, and practical skills of eliciting and making observations. It has a broad focus of identifying children at risk of adverse outcomes rather than simply providing norm-oriented descriptions. The findings of this examination, and any management plan, should contribute to the wider process, involving other professionals and agencies, of identifying and addressing children's developmental needs,

through good communication with parents, carers and other services.

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**Essential work-up:**

Children with severe developmental delay; or moderate delay which is global or is associated with other significant findings in history and examination.

- Chromosome analysis (array CGH)
- Fragile X<sup>1</sup>
- CK in boys
- TFT<sup>2</sup>
- Toxoplasma, rubella assay and CMV urine culture<sup>3</sup>

**In addition**, the following and other targeted investigations should be considered, as indicated by history, examination or investigation findings.

Micro/macrocephaly  
Behaviour suggestive of Seizures  
Behavioural phenotype of Angel an syndrome  
Focal Neurological features  
Severe oro-motor impairment

- EEG
- Neuroimaging (MRI)
- Eye exam/ERG/VEP

Organomegaly  
Coarse features  
Failure to thrive  
H/o Decompensation episodes  
F/H of consanguinity, neonatal deaths/ life threatening episodes in siblings

- Amino acids
- Urine OA
- Mucopolysaccharides
- White cell enzymes
- VLCFA
- Urates
- Biotinidase
- Urine purines
- Transferrin IEF

1. Most unlikely in boys with normal intelligence, classic 'aloof' severe autism or microcephaly
2. Irrespective of neonatal screening results
3. in children less than 2 years of age

**Figure 6** Investigations for significant developmental delay/disorder (with permission from Dr S Mohammed, Consultant Clinical Geneticist, Guy's Hospital, London). ERG, electroretinogram; TFT, thyroid function tests; OA, organic acid; VEP, visual evoked potential; VLCFA, very long chain fatty acid.

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