CHAPTER 2
THEORETICAL ORIENTATION

Early identification and treatment of children with developmental problems, disorders and delay has emerged in recent years as a matter of growing concern among child psychologists and pediatricians. Early detection of developmental difficulties in children has received extensive and serious consideration owing to its implications for treatment, prevention of risk of future disabilities, and secondary problems related to family dysfunction, peer difficulties, and school failure (Malhi & Singhi, 1999; Oberklaid & Efron, 2005). Some of the methods of early detection include reviewing developmental milestones with parents, eliciting parental concerns, administering a developmental screening test, or referring a child for developmental assessment. In this chapter, the definitions and elaboration of the concepts under study are presented. An attempt has been made to elaborate upon the conceptual framework of the variables included in the present study, including the concepts of developmental problems and delay in children; prevalence and causes of developmental problems in children; early identification of developmental problems; an overview of some of the existing developmental screening and assessment tests; role of parents in developmental screening with special focus on parental concerns; and measures of accuracy of developmental screening tests.

Development Problems in Children

The trajectory of children’s physical and mental development and their prospects for health and well being as they grow older are established early in life (Glascoe & Squires, 2007). In other words, a child’s developmental path and life course is impacted by a number of environmental risk and protective factors which operate throughout the life course but are especially powerful in the early years of life. Early childhood is a time of rapid brain development. It is during this time that sensory, intellectual, physical, and emotional pathways are established. However, children who grow up in environments where their developmental needs are not met are at an increased risk for compromised health, safety, learning impairments, and developmental delay.
Early developmental problems are noticed when a child displays slower rate of milestone acquisition than normally expected and this is referred to as developmental delay.

**Streams of Development**

The domains of development can be conceptually categorized into 5 major areas including motor, communication, social, adaptive, and cognitive.

**Motor development**: Motor development encompasses both gross motor ability (control of large groups of muscles involved in walking, sitting etc.) as well as fine motor ability (manipulation of objects with hands in order to eat, play, and draw). Children move through motor milestones in an orderly fashion. Some of the overt motor milestones which can easily be observed by a clinician include rolling over, sitting, standing, hopping, walking, and running. Some of the subtle indicators can also be observed such as the early presence of unilateral dominance or handedness in a child less than eighteen months may suggest hemiplegia (Shalowitz & Gorkski, 1990). Fine motor skills can also be assessed in early infancy. For instance, the failure of the baby to unclench fist voluntarily by the age of 4 months may be one of the earliest indicator of cerebral palsy (Blasco, 1991). Hand-mouth activity, manipulation of small objects like blocks can all be used for observing fine motor skills in children. Failure of the child to master tasks involving large and small muscles may indicate problems in the development of motor domain.

**Language development**: A child’s language development is a function of both innate communication abilities and the environment which may or may not support the development of language. Language development refers to skills of articulation, comprehension, and the use of non verbal symbols. Children with language delay have difficulty understanding language (receptive language deficits) and/or producing language (expressive language deficits). For example, toddlers and preschool children with receptive language deficits may have difficulty selecting common objects appropriately following verbal directions, and may not understand questions. Children with expressive language deficits, on the other hand, have difficulty in naming objects, developing a spoken vocabulary, and using words and sentences to communicate.
In general, children delayed only in language production, with normal language comprehension, have a more favourable prognosis (Bishop & Edmundson, 1987; Thal, Tobias, & Morrison, 1991). Many scholars have argued that there is a close relation between language and cognitive development (Fagan & Montgomery, 2009; Silva, McGee, & Williams, 1983; Silva, Williams, & McGee, 1987) and this is the primary reason why language skills are considered the best indicator of cognitive development.

**Adaptive development:** Adaptive development refers to a range of behaviors a child acquires during the process of development to function independently. It includes the ability of the child in areas such as dressing, eating, toileting, grooming, appropriate behavior in different settings, and adjusting to new situations (First & Palfrey, 1994).

**Cognitive development:** Cognitive development refers to the increasing ability of the child to think, learn, know, reflect, and solve problems through intuition, perception, verbal and non-verbal reasoning. Cognitive development encompasses not only the ability to learn but also retain this information and apply this knowledge when the need arises. Cognition also includes processes such as attending, perceiving, interpreting, classifying, remembering, evaluating ideas, inferring principles and deducing rules; imagining possibilities; generating strategies; and fantasizing (Mussen, Conger, Kagan, & Huston, 1990). In infants and toddlers, motor and language milestones are the best proxy for cognitive assessment (First & Palfrey, 1994). One of the earliest milestones of cognitive development is the emergence of object permanence which appears at eight to nine months of age. The child who cannot recognize that a hidden object is still present may not be making the appropriate mental connections. Around one to two years the child begins to demonstrate an understanding of cause and effect. As the child grows older concepts such as shape, size, number, relations, symbolic thought as well as development of language which demonstrates concrete and abstract thinking can be tested. Children with undetected cognitive problems prior to school entrance commonly suffer from academic underachievement and delays, particularly in the basic skills of reading, spelling, writing, and mathematics (Levine, 1999).
Social and emotional development: Social and emotional development encompasses the child’s interactions as shown by the formation and maintenance of relationships and responsiveness to the presence of others. Problems in social-emotional development present itself over time as behavioral abnormalities that differ from normal behavior responses by their quantity, severity, nature and duration. Children with eating problems, pica, severe sleep disturbances, hyperactivity, apathy, fearfulness, extreme aggression, self injurious behavior should be evaluated for behavioral and psychosocial abnormalities.

Delays in Single or Multiple Areas of Development

Developmental delay may be restricted to one stream of development or to two or more streams of development which is referred to as global developmental delay (Majnemer & Shevell, 1995, Rydz, et al, 2005). A delay in a skill becomes evident only at the age when that developmental milestone is expected (American Academy of Pediatrics, 2001). Three primary patterns of developmental delay are recognized: general delay, developmental deviance, and developmental association. General delay refers to development at a slower rate and a significant lag in one or more areas of development. Developmental deviance is said to occur when there is a non-sequential acquisition of milestones within a specific developmental stream, i.e., milestones are accomplished in an atypical manner. Finally, developmental dissociation refers to an uneven rate of milestone acquisition when comparing two or more streams of development.

Developmental disabilities is a label given to a heterogeneous group of related chronic disorders of early onset sharing the core feature of disturbance in the acquisition of cognitive, motor, language, social, and adaptive skills that have a significant impact on the development trajectory of the child (Petersen, Kube, & Palmar, 1998; Shevell, Majnernar, Platt, Webster, & Birnbaum, 2005). Global developmental delay is the most common subtype of childhood developmental disability. It can be operationally defined as a significant delay in two or more developmental domains, and significant delay
usually refers to scores which are 1.5 or 2.0 standard deviations below the mean on norm-references age appropriate developmental tests (Shevell, 1985).

Mild delays are hard to detect, because children develop in spurts and many times discontinuously. Developmental disabilities encompass a spectrum of problems of varying kinds and severity. There is no consensus among professionals, including pediatricians and child psychologists, as to the severity at which evaluation and interventions become appropriate, despite the broad consensus as to what constitutes a clear cut deviance or delay (American academy of Pediatrics, 2001; King & Glascoe, 2003; Rosenberg et al, 2008).

Prevalence and Causes of Developmental Problems in Children

Evidence indicates that developmental problems, disorders and disabilities affect approximately 12 to 16% of children (Boyle et al, 1994; Malhi & Singhi, 1999; Oberklaid & Efron, 2005). At least 5 to 8% of children under the age of five years have some sort of disability or chronic condition such as autism, cerebral palsy, diabetes, epilepsy, mental retardation, or orthopedic problems (Pinto-Martin et al, 2005).

Risk factors associated with a child having developmental delay are many and are often the result of a complex interplay of biological and environmental factors (Shevell, 1998).

Biological Factors

Biological factors include prenatal factors such a maternal Phenylketonuria (PKU) or Human Immunodeficiency Virus (HIV), prenatal teratogen exposure (e.g., Dilantin or Valparin), prenatal alcohol or substance abuse, major congenital anomalies, multiple minor physical anomalies, small for gestational age, maternal tobacco use, lack of prenatal care, family history of deafness or early hearing loss. Biological factors also include perinatal and postnatal factors such as low birth weight (birth weight 2500 grams or less, especially if less than 1500 grams), respiratory distress requiring mechanical ventilation, asphyxia described as an Apgar score of four or less, neonatal seizures,
intracranial hemorrhage, hyperbilirubinemia (levels requiring exchange transfusion), microcephaly (head circumference less than 2 standard deviations below the mean) or macrocephaly (head circumference more than 2 standard deviations above the mean), central nervous system infection, congenital infections and failure to thrive.

**Environmental Factors**

Children's language, social, and other developmental skills are influenced by healthy environmental variables. For example, parents with adequate social support, education and mental health who mediate children's experiences by attending to them typically have children who perform in the average or above average range on measures of intelligence (Sameroff et al., 1987; Sidhu et al., 2009). Environmental factors which put children at risk for developmental delay may include maternal age less than 16 years, parent diagnosed with mental retardation, parental psychiatric disorder, parental alcohol or substance abuse, unemployment, lack of permanent housing, parental illiteracy or low level of education, inadequate care giving, history of abuse or neglect in parent or sibling, extreme poverty amongst other risk factors (Guttman, Sameroff, Cole, 2003; Kagan, 1999; Malik, Pradhan, & Prasuna, 2007; Najman, Aird, Bor, O'Callaghan, Williams, & Suttlewood, 2004). It is well established that children with social risk factors are more likely to have poor cognitive, social, and behavioral outcomes than children without these risk factors (Duncan, Brooks-Gunn, & Klebanov, 1994; Sameroff, Seifer, Baldwin, & Baldwin, 1994; Sidhu et al., 2009). Moreover, these early disparities in development not only have a profound impact on later school performance, but also on socio-economic and health outcomes in adulthood (Grantham-McGregor et al., 2007; Walker, Wachs, Meeks-Gardner, Lozoff, Wassrman, Pollitt et al., 2007).

**Early Identification of Developmental Problems in Children**

Early identification of children with developmental problems is important in the primary care setting and this has received extensive and serious consideration owing to its implications for treatment, and prevention of future disabilities (First & Palfrey, 1994; Dworkin, 2006). Majority of the children with subtle developmental problems have no
observable delays, physical or any neurological dysfunction, and rarely does birth or family history contribute to identification. These delays come to notice of parents/teachers only when children start school and the problems become more apparent when academic tasks require complex cognitive skills. Early identification and intervention matters most because untreated problems can seriously compromise children’s life prospects. However, even in those medical conditions, such as Downs’ syndrome and cerebral palsy, which cannot be reversed, early identification leads to early intervention which improves outcome and enables families to develop strategies for successful family functioning.

Developmental delay in children can be identified by a range of methods including developmental surveillance and screening. Surveillance and screening are related but different activities involving the detection of impairments with a view to prevention or amelioration of consequent disability or handicap. Developmental surveillance is a continuous, flexible, and comprehensive process which includes all activities related to the detection of developmental problems and the promotion of development during primary child health care visits (Dworkin, 1989; Johnson & Marlow, 2006). It is a largely informal process based on each professional’s experience and training. The process of surveillance involves gathering information about family well being including strengths and weaknesses, typically through report or observation, observing children’s behavior, eliciting parents concerns, and gathering data from medical and current physical examination (Dworkin, 2003).

There are many reasons why appropriate developmental surveillance is critical for promoting the optimal development of young children. Firstly, clinically significant delays in development are common. Second, early intervention is effective for children with developmental delays. Finally, even children who are at risk for poor developmental outcomes, such as poverty, also benefit from early identification (Anderson, Shinn, Fullilove, Schrimshaw, Fielding, Normand, et al., 2003). Therefore, child practitioners have an obligation to be vigilant in monitoring children’s early development, because
they are well positioned to identify and refer children with developmental delays at an early stage (King & Glascoe, 2003).

The task of early detection of developmental delay can be challenging owing to time limitations, minimal reimbursement, poor and irregular attendance by at-risk children in well child health supervision clinics designed for developmental surveillance, difficulties with the accuracy or length of popular screening tests, and the difficulty in getting young children to cooperate with measurement tasks (First & Palfrey, 1994; Shevell, 1998). An additional challenge is that the children who most need screening are asymptomatic and not observably delayed or impaired. Most disabilities have subtle manifestations, especially during the pre-school years, and are virtually invisible in the absence of measurement.

**Screening Children for Developmental Problems**

Developmental screening is a brief assessment procedure designed to identify children who should receive more intensive diagnosis or assessment (American Academy of Pediatrics, 2001; Committee on Children with Disabilities, 1994; Meisels, 1987). Early childhood developmental screening not only consists of administration of a screening test at a single point of time, but repeated evaluation and assessment of a child over the entire period of development. It is important to understand that developmental screening does not measure the child’s intelligence; rather it is aimed at identifying those children who may need a more comprehensive evaluation. Screening also has the advantage in communicating to the parents that the clinician has an overall interest in the child. Developmental evaluation may lead to a definitive diagnosis, development of an interdisciplinary comprehensive plan of remediation, or that an additional evaluation is warranted.

The major difficulty in predicting future developmental status of children is that they undergo two types of changes as they grow older (Frankenburg, 1994). One change in developmental status as the child grows older is due to the addition of new skills. For
example, a child may be normal as compared to his peers at age 2, but start to lag behind at age 4 when new skills such as perceptual motor skills or abstract thinking are tested. It is important to recognize that this is not due to the failure of earlier developmental testing but rather due to the testing of new skills at age 4 which the child was slow to acquire. In other words, children who appear to developing normally at one age may appear delayed at a later age. The second problem with predicting later development from an earlier evaluation is that a child’s circumstances may change thereby altering the rate of development. For example later health problems like meningitis, ear infections, and seizures may greatly change the course of development. Environmental changes such as divorce of parents, loss of financial status, change of school may also enhance or delay development.

Research findings indicate that development is malleable, is discontinuous at times, and developmental disabilities manifest with age. Early risk factors can change during childhood, including divorce of parents, unemployment in parents, medical illness, addition of new siblings, and involvement in a stimulating school environment. Development may change, for better or for worse, thus there is a need to monitor changes in development status by repeated developmental screening. Secondly, development problems arise as children grow older (Bell, 1986). The concept of age related developmental manifestations means that every child has an increasing risk of disabilities. Only 1 to 2% of the children between the age of 0 to 24 months of age have developmental problems, while the prevalence increases to 8% when children up to age 6 are added and to 11.8% in the 0 to 22 age range (Algozinne & Korinek, 1985, Glascoe, 1998, 2005).

These are the primary reasons that repeated screening is recommended at regular age intervals (Frankenburg, 1994). Periodic use of quality screening tools has been also been recommended by the various professional bodies including the British Joint Working Party on Child Health Services and the American Academy of Pediatrics (American Academy of Pediatrics, 2001, 2006; Dworkin, 1989). These societies suggest that developmental surveillance and screening should take place at all well child visits.
from infancy through school age. The American Academy of Pediatrics emphasizes the use of development screens at 9, 18, 24 and 30 months of age.

Moreover, since delay must be monitored within various areas (fine and gross motor, language, cognitive, and psychosocial development), it is not unusual for one of these areas to be overlooked (Glascoe, 2005; Glascoe & Dworkin, 1995). The central dilemma for professionals working with children is that identification of developmental disabilities must precede services, and the act of identifying a child as one that requires further assessment provokes anxiety in parents. This concern may create a tendency to identify only markedly delayed children at early stages, thereby ignoring children with subtle but serious delays.

Evidence indicates that fewer than 50% of children with serious developmental and behavioral problems are identified before school entrance, although most of these children receive immunization, attend play schools, and come in contact with health professionals (Bierman, Conor, Vaggi, & Honzik, 1994; Glascoe & Dworkin, 1995). Using only clinical judgment detects fewer than 30% of children who have mental retardation, language disabilities, or other developmental disabilities (Glascoe, 2000). It has been recommended in the literature that one approach to early detection that may circumvent some of the challenges of screening is to recruit the help of parents (Lipkin & Allen, 2005; Glascoe, 2005). There is a research evidence to indicate that parent reports’ containing parental concerns about more subtle aspects of child’s social, emotional, behavioural, and / or language development is one of the most effective methods for identifying children with developmental delay (Glascoe, 2002). It is important to recognize that developmental screening does not give a definitive diagnosis but improves the accuracy with which children are identified when compared with the decisions based on clinical judgment alone.

**Developmental Screening Tests**

**Types of Screening Tests**

Screening can be broadly divided into level 1 and level 2 screening. Level 1 screening refers to screening of all the children. It includes a review of their cognitive,
motor, language, adaptive, and social-emotional development. Level 1 screening also includes addressing parental concerns about the child’s growth and development and reviewing of family risk factors including parental stress and maternal depression. On the other hand, level 2 screening refers to screening of those children who are identified as being at risk during the initial screening. Level 2 screening is thus administered to only a subset of patients identified by briefer measures as at higher risk. Children with suspected impairments in one or more developmental domains are put through level 2 screening. Screening can also be broadband or narrow band. Broadband screening refers to those measures that tap all domains of development, whereas, narrowband screening refers to those measures where the focus is on a single domain of development such as motor skills, or on a specific condition such as autism or attention deficit hyperactivity disorder. It has been recommended that broadband developmental and mental health screens should be administered before narrowband screens to ensure that common conditions as language impairments or learning disabilities that may mask themselves as behavioural problems, are detected and targeted for interventions that may reduce behavioural co-morbidities (Glascoe, 2005).

**Screening Tests**

Identification of developmental delay is improved when explicit developmental screening procedures and instruments are used. These instruments not only accurately identify potential problems in children but also enable child health professionals and parents to form strategies for overcoming the problem. Developmental screening tests are brief measures that differentiate children who are at risk for atypical development from those who are not. Only 30% of children with developmental disabilities are identified without the use of standardized screening procedures. However, this figure increases to 70 to 80% when standardized instruments are used (Palfrey et al., 1987).

Several developmental screening tests are available for use with infants and children. Some are well constructed, while others lack empirical support. A brief description of some of the screening tests is provided. Some of the developmental screening tests developed for Indian children are also discussed.
Denver Developmental Screening Test (DDST): The DDST (Frankenberg & Dodds, 1967) is the most popular and well known screening test. It is used worldwide because of its brevity and ease of administration. It screens children from two weeks through six years of age in four developmental domains: gross motor, fine motor-adaptive, personal-social and language. The test contains 105 items but only those items are administered which are appropriate to the child’s age. Each item is scored pass or fail. A delay score is given to an item, which is failed by a child that is passed by more than 90% of children in the normative age group. Scores are interpreted as ‘abnormal’, ‘questionable’ or ‘normal’ in each sector. The DDST has also been adapted for the Indian children (Puri, Singhi, Pershad, & Verma, 1995). Across a large number of different studies conducted with a variety of age ranges, samples, base rates, time intervals and criterion measures, the DDST has been shown to have a high specificity and low sensitivity (Meisels, 1989).

Denver II: The DDST underwent a major revision and restandardization in 1990 and the test was called the Denver II (Frankenberg et al, 1990). The revised version test contains an expanded language section, speech-intelligibility items, a new age scale, and updated forms. The Denver II consists of 125 items which assess four developmental domains: personal-social, fine motor-adaptive, language, and gross motor. Pass/fail/refusal scores are assigned to all items and item performance is then re-interpreted in relation to children’s ages in terms of caution, delay, no opportunity, or normal or advanced performance. A normal result is produced when the child has no delays and a maximum of one caution. Two or more delays produce an abnormal overall test score while one delay and/or two or more cautions result in a questionable score. Very little information about its validity or accuracy in identifying children with and without problems is available (Glascoe, Byrne, Ashford, Johnson, Chang, & Strickland, 1992).

Clinical Adaptive Test / Clinical Linguistic Auditory Milestone Scale (CAT/CLAMS): The CAT/CLAMS (Capute et al, 1986) is a screening test to assess development in two domains, language and visual motor behavior. It can be used with children in the age range of 1 to 36 months. The two scales yield development quotients for non-language visual-motor (CAT DQ) and language (CLAMS DQ) abilities, as well
as a composite score of cognition function (Full Scale IQ). An advantage of this instrument is that the scores help in discriminating children with mental retardation (i.e. both language and visual motor delay) and those with communication disorders (discrepancy between separate score with language DQ below visual motor DQ).

**Developmental Profile II (DP II):** The DP II is a 186 items inventory which assesses the child’s developmental status from birth to 9½ years. The DP II assesses child’s developmental age in five domains namely physical, social, self help, academic, and communication. Each sub scale produces a developmental age that is subtracted from the chronological age. The resulting “months differential” is compared with a cut off that reveals whether children are advanced, normal, borderline or delayed in their development. One of the most important features of the DP II is that its academic scale can be converted into an IQ score. The academic scale assesses a range of skills necessary for success in school including language, cognition and scholastic accomplishments. The IQ calculated from the academic scale has been found to have moderate to high correlation with conventional measures of intelligence (Alpem et al., 1986). The DP II has been extensively used in India (Malhi and Singhi, 2003; 2008).

**Early Language Milestone Scale (ELMS):** The ELMS (Coplan, 1987) is a screening test for the speech and language development of children from birth to 36 months of age. The scale consists of 41 items and covers 3 areas of language function: auditory receptive, auditory expressive and visual language. Majority of the items are scored on the basis of parental report. The scale can be scored in two different ways. The pass/fail scoring technique is ideally suited for rapid screening of large number of low risk subjects. The author reports a sensitivity of 86% and a specificity of 100%.

**Vineland Social Maturity Scale (VSMS):** The VSMS (Doll, 1965) is a development schedule which measures level of social competence and adaptive behavior functioning, in eight areas including self-help general, self-help dressing, self-help eating, communication, self-direction, socialization, locomotion and occupation. The Indian adaptation of the VSMS is also available (Malin, 1971). The Indian adaptation consists of 89 items that are arranged in order of increasing difficulty. The VSMS is administered in
an interview fashion to the parents or caregivers. The examiner, on the basis of the information obtained in the interview, scores each item as pass or fails depending on the presence or absence of the behavior relevant to the items in question. Scoring takes into account successes, failures, and no opportunity to perform an activity. The final score is computed from the total number of items successfully passed. The resultant score is converted into an age equivalent score. Two scores are generated by the VSMS, Social Age (SA), and Social Quotient (SQ). The SQ is calculated by dividing the SA by the chronological age (CA) and the product multiplied by 100. The test retest reliabilities after an interval of two years for the original version are satisfactory for the SA but less satisfactory for the SQ (Kaplan and Alastishe, 1976). Correlations between the VSMS and various intelligence tests are moderate and in the range of 0.40 to 0.50 (Fromme, 1974). For Indian children, the sensitivity of the VSMS is reported as 58% and specificity as 94% (Malhi, Kaur, Manchanda, & Sidhu, 2006).

**Ages and Stages Questionnaire** - The Ages and Stages Questionnaire (Bricker et al, 1995) is a parent report measure that spans child’s development in the age range of 6 to 60 months. ASQ assesses development in five developmental domains: communication, gross motor, fine motor, problem solving, and personal social domain. The choice of responses for each item is “yes”, “sometimes”, or “not yet” receiving scores of 10, 5, and 0, respectively. The test is graded according to the domain tested and compared with an empirically derived screening cutoff score. The ASQ has been standardized on 2008 children and has an overall sensitivity of 75% and specificity ranging from 81% to 92% (Irton 1992).

**The Battelle Developmental Inventory Screening Tests (BDIST):** The BDIST (Newborg, Stock, Wneck, Guidubaldi, & Suinicki, 1984) screens children from 6 months to 8 years of age. It was especially designed for normal as well as developmentally delayed children to identify children eligible for intervention and educational services. The test consists of 96 items divided into seven subtests which measure personal-social, adaptive, gross and fine motor, receptive and expressive communication, and cognition. Each subtest produces an age equivalent score and a pass/fail, with a fail measured as 1.5 or 2 standard deviations below the mean. The test has acceptable levels of accuracy, with
sensitivity and specificity values of 80% and 74%, respectively. It also demonstrates an adequate reliability and good correlation with other intelligence tests including the Stanford Binet, Wechsler Intelligence Scale- Revised, Vineland Social Maturity Scale (Newborg et al., 1984).

**Bayley Infant Neurodevelopment Screener:** The Bayley Infant Neurodevelopment Screener (Aylward, 1995) is an increasing popular neurodevelopment screen for infants ranging in age from 3 to 24 months. Four areas of development are assessed: basic neurologic functions, such as posture and muscle tone; expressive functions (gross motor skills, oral or verbal function); receptive functions (visual, auditory, verbal), and cognitive functions (object permanence, problem solving). The test consists of six item sets that are grouped according to age. Each set contains 11 to 13 items and takes about 15 minutes to administer and score. Items are given a score of optimal or non-optimal. Optimal scores are summed, and the total score is classified into high, medium, or low risk. The sensitivity and the specificity of the test are in the range of 75 to 80%. Test-retest reliabilities range from 0.71 to 0.84, whereas inter rater reliability ranges between 0.79 to 0.96 (Aylward & Verhulst, 2000).

**Parents’ Evaluation of Developmental Status (PEDS):** The PEDS (Glascoe, 1998) is a widely used screening tool intended for children between 0 to 8 years. It consists of 10 questions which systematically elicit parental concerns in all the developmental domains. The concerns of the parents change with age of the child, and only some concerns are considered as reliable indicators of actual delay. Concerns which are related to developmental delay are considered as significant. The sensitivity of the screening measure ranges from 74% to 79% and specificity ranges from 70% to 80%. Details regarding this screening instrument are provided in Chapter 4.

**Trivandrum Developmental Screening Chart (TDSC):** The TDSC (Nair et al, 1991) was designed by selecting 17 test items from the Bayley Scales of Infant Development (Baroda norms) spread over the first two years of age. A child, who fails even one item which 97% of the children at that age are passing, is considered as having failed screening. The TDSC has been validated both at the hospital and at the community level.
by using the DDST as the gold standard and the sensitivity is reported to be 66.7% and specificity as 78.8%. However, because of the limited age range and items, the test has not been used widely (Malhi & Singhi, 1999).

**Baroda Development Screening Test for Infants (BDSTI):** The BDSTI (Phatak & Khurana, 1991) is a screening test for the assessment of the motor-mental development of infants under 30 months of age. It consists of 54 items, 22 motor and 32 mental, which have been selected from the Bayley Scales of Infant Development (Bayley, 1993). The BDSTI yields a developmental quotient (DQ). Based on a study of 730 records of 130 babies (101 of them ‘at risk’), 101 records of 6 month old and results of assessment of 50 children, the authors reported a sensitivity and specificity of 65% to 95%, respectively.

**Developmental Assessment Tests**

Once children have been identified as high risk for developmental disabilities by a developmental screening test, the results of the screening test have to be verified by a standardized developmental test or battery. Standardized developmental assessments are ideally suited for the identification, quantification, and monitoring of children with developmental problems. In this section a brief description of some of the available development assessment batteries is presented.

**Mullen Scales of Early Learning (MSEL):** The MSEL (Mullen, 1995) is a combination of the Infant MSEL (Mullen, 1989) and the Preschool MSEL (Mullen, 1992). The MSEL is used for assessing fine motor, visual perception, receptive language, expressive language, and gross motor skills in children from birth to 68 months. T-scores, percentiles, and age equivalents are derived for each sub-test and an Early Learning Composite (ELC) standardized score can be obtained as a measure of global cognitive functioning. It is quick to administer in comparison to other developmental batteries, and takes about 15 to 35 minutes depending upon the age of the child. The MSEL provides a good profile of a child’s strengths and weaknesses within the domain of cognition. The psychometric properties of the scale are adequate though the norms are outdated to some extent (Johnson & Marlow, 2006).
Griffiths Mental Development Scales-Revised: The Griffiths Mental Development Scales (Griffiths, 1996) comprise of two scales: the “Baby Scales” for children from birth to 23 months and the “Extended Scales” for children aged 2 to 8 years. Baby scales are most applicable for use through out the first two years and assesses functioning in five domains: locomotor, personal-social, hearing and language, eye and hand coordination, and performance. The test yields standardized scores (Mean = 100, SD= 16) for each domain and a composite general quotient (Mean=100, SD= 12). Even though the test has been normed on 665 children, aged 0-24 months, its psychometric properties are poorly detailed. Test-retest reliability is particularly poor for the first year and information regarding inter-scorer reliability and validity are not provided.

Vineland Adaptive Behavior Scales (VABS): The VABS (Sparrow, Balla, & Cicchetti, 1984) is available in three forms, which differ in the number of test items and the manner of administration. The Survey Form has 261 items, the Expanded Form has 577 items, and the Classroom Edition has 244 items. All the three tests examine the personal and social sufficiency of individuals with and without disabilities between 0 to 19 years. The VABS assess 4 domains, namely communication, daily living skills, socialization, and motor skills. In addition the survey and expanded forms have a “maladaptive section” assessing the number of maladaptive behavior when compared with children of the same age group. Standardization results demonstrate high-test retest reliability ($r = 0.76$ to 0.93), internal consistency ($r = 0.76$ to 0.99) and inter rater reliability ($r = 0.62$). The test has adequate validity (Rosenbaum, 1998; Vig & Jedrysek, 1995).

Bayley Scales of Infant Development (BSID- II): The BSID-II (Bayley, 1993) is the most widely used standardized developmental test. It assesses the developmental status of children between 0 to 30 months of age. It comprises of three scales: the Mental Scale, the Motor Scale, and the Infant Behaviour Record. The Mental Scale assesses functions such as perception, memory, learning, problem-solving, vocalization, the beginnings of verbal communication and rudimentary abstract thinking. The Motor Scale measures gross motor abilities, such as sitting, standing, walking and stair climbing. The Infant Behaviour Record is a rating scale completed by the examiner and is designed to assess...
various aspects of personality development, such as emotional and social behaviour, attention span, persistence and goal directedness. The BDI-II yields standardized index scores and age equivalents for both the subscales. Norms for the test were established on 1262 children. Psychometric properties of the scale are adequate, with moderate to high correlations for various measures of reliability and criterion referenced validity. Split-half reliability coefficients within separate age groups ranged from 0.81 to 0.93 for the mental scale; and from .68 to .92 for the motor scale. The BSID is however, lengthy to administer, particularly for children with disordered or delayed development.

The BSID has been adapted for use with Indian infants and the Indian adaptation is known as the Developmental Assessment Scales for Indian Infants (Misra & Phatak, 1996). The Indian adaptation consists of 67 items for motor development and 163 items for mental development. The test has excellent psychometric properties and development of norms for Indian children has made this test the gold standard in assessing development of infants in India.

Child Development Inventory (CDI) – The CDI (Ireton, 1992), a restandardized version of the Minnesota Child Development Inventory, is completed by parents to measure the developmental progress of their children aged birth to 6 years. The CDI is a 300 item questionnaire used to assess the various sensory, physical, motor, language, and behavioural problems of children. These items are grouped into 8 subscales: social, self-help, gross motor skills, fine motor skills, expressive language, comprehension, letters and numbers. Each scale is scored by tallying the “yes” answers. Child scoring a score of 1.5 SD below the mean is graded as “borderline” whereas a child more than 2 SD below the mean is graded as “delayed”. The CDI is quick to administer and takes about 20 minutes to complete. The scale has been standardized on 568 children. The overall sensitivity of the inventory is 73% and the specificity is 87. The CDI is a cost effective measure for determining developmental outcome. Correlations with the other developmental batteries are high, demonstrating its overall validity (Doig, Macais, Saylor, Craver & Ingram, 1999).
Battelle Developmental Inventory II (BDI II): The BDI II (Newborg, 2005) is a criterion referenced, individually administered, standardized assessment battery used to measure the developmental skills of children from 0 to 8 years. It consists of 450 items grouped into five developmental domains: Adaptive, Personal/Social, Communication, Motor, and Cognitive. Each domain has several sub-domains. The BDI-II can be administered in 3 ways: structured method, observation method, and interview with parents or other reporters. The BDI-II provides several scores including Total DQ, Motor DQ, Personal Social DQ, Cognitive DQ, Adaptive DQ, and Communication DQ. All the DQs are standard scores and have a mean of 100 and a standard deviation of 15. The battery has very good face validity, internal consistency, and concurrent and criterion validity. The internal consistency reliability coefficient for the Total DQ score is high and reported as 0.91. The details regarding the BDI II are provided in Chapter 4.

Parental Involvement In The Process Of Screening

Parents offer a wealth and variety of valuable information about children’s development. This information can be elicited in varying ways, with several formats clearly emerging as superior in accuracy and ease of evocation. Parent completed measures have practical advantages. A study showed that almost 70% of mothers were more worried about their child’s behaviour or development than medical issues but only slightly more than a quarter (28%) actually discussed these concerns with their pediatricians (Hickson, Alteimer & O’Connor, 1983). A parent filled questionnaire can easily bring these concerns to light.

Parental information can be grouped into categories: - descriptions (including recall and report) – meaning non-judgmental depictions of children’s skills; appraisals meaning judgments, opinions and evaluations of children’s developmental status, estimations and prediction of children’s development and parental concerns regarding children’s development (Glascoe & Dworkin, 1995; Glascoe, 1998). The various parental measures when combined with screening instruments leads to an increase in accuracy of the screening process, with a decrease in misclassifications (Henderson & Meisels, 1994; Meade, Sweeney, Chandler, & Woodward, 2009).
Defining Parental Concerns

Parental concerns regarding their child are one of the first and most important indicators that help in directing the professionals to any probable developmental problem (Dunst & Trivette, 2004; Glascoe, 2005). These concerns are often the basis for seeking professional advice and guidance (Ellingson et al., 2004). It has been recommended in the literature that one approach to early detection that may circumvent some of the challenges of screening is to recruit the help of parents (Johnson & Marlow, 2006; Glascoe & Dworkin, 1995). Much information about children’s development can be gleaned from parents. Since parents are with their children most of the time, they are quick to notice when something is amiss, even though they may be unable to sometimes verbalize their apprehension.

Parental concerns are defined as subjective judgments of child’s social behavior and development by the parents, expressed in terms of the quality and quantity of functioning that is perceived to be atypical or not like that of other children (Glascoe, 1998; 2005). Parental concerns are a parent’s appraisals or judgments about their child’s development (Glascoe & Dworkin, 1995). Parental concerns are reliable and valid and helpful in developmental screening (Committee on Children & Disabilities, 2001; Squires, Nickel, & Eisert, 1996) despite differences in parental education, child rearing experiences, socio-economic status, and geographic location (Glascoe, 1998). Systematically eliciting parental concerns about development is an important new method of identifying infants and young children with developmental problems (American Academy of Pediatrics, 2001).

Seminal work in the area of parental concerns by Glascoe et al. (1989) suggests that parental concerns are multi-faceted. Some concerns are clearly better current and future predictors of developmental and behavioural problems than others. Hence the authors emphasized that careful questioning is needed to elicit and categorize parental concerns. Lichtenstein and Ireton (1984) found that parents responded well to the question, “Please tell me any concerns about the way your child is behaving, learning and developing.” However, use of the words “worries” or “problems” instead of “concerns”
deterred responses, because many parents were reluctant to endorse terms that potentially sounded ominous or significant. Good quality information about children with possible developmental problems can be obtained from standardized parent report measures. More specifically, parental concerns and quality standardized parent report measures, capitalize best on parents’ observations and insights about their children. In combination, these two types of parental information offer an effective method for early detection of behavioural and developmental problems (Glascoe & Dworkin, 1995).

Parental concerns about behavior often suggest lags in development and evidence indicates that parental disclosure is the best predictor of physician identification of psychosocial problems (Oberklaid, Dworkin, & Levine, 1979; Wildman, Kizilbash, & Smucker, 1999). Parents of children with global delays may raise concerns not about global development, but rather about speech and language (Montgomery, 1988; Shapiro, Plamer, & Capute, 1987; Oberklaid et al., 1979). Most children who fail screening have been found to have parents with concerns about articulation, language, fine-motor skills, or global development (Glascoe et al., 1989). The literature supports the use of parental concerns to detect speech and language delays or psychosocial problems.

**Parental Concerns vs. Parental Recall**

It is important to distinguish parental concerns from parental recall. Parental recall of skills or developmental milestones are non-judgmental depictions of the child’s skills. Parents are asked to remember events such as birth history, developmental milestones, and child rearing practices (Pless & Pless, 1995). The accuracy of responses to such questions has been both criticized (Wenar, 1963) as well as lauded (Pless & Pless, 1995). Criticisms have centered on the wording of questions used to elicit recall. Moreover, the discrepancies between parent report and professional measures increases with the passage of time. Parents were found to be more accurate in recalling developmental details of three year old than five year old children (Majnemar & Rosenblatt, 1994). Moreover, parents who professed beliefs in permissive child rearing recalled milestones much later than they actually occurred, while parents with authoritarian beliefs recalled milestones much earlier. Even with highly accurate recall of developmental milestones, parental
recall lacked validity in terms of predicting future (Robin, 1982). Parents typically have difficulty recalling the ages at which children achieve various milestones (Kliman & Vukelić, 1985). Thus, the accuracy of parental descriptions and recall has been questioned as reporting errors have been found to be rampant (Majnemer & Rosenblatt, 1994). It has been argued that parental concerns and parental recall are two different methods of evaluating the child’s development, with concerns emerging as better predictors of developmental status of the child (Glascoe, 1997, 1998).

**Parental Concerns vs. Parental Report**

Parental report refers to descriptions of children’s current achievements. Evidence indicates that parent reports containing parental concerns about more subtle aspects of child’s social, emotional, behavioural, and /or language development is one of the most effective methods for identifying children with developmental delay (Glascoe, 2002). Parent reports help parents organize their thoughts as well as their concerns regarding the health, behaviour, and development of their child (Ireton, 1997; Tervo, 2005). In addition, parental reports are also convenient and take advantage of parents’ depth of knowledge of the child across many situations (Gartstein & Rothbart, 2003). However, like parental descriptions and recall, parental report has also been a controversial issue. Blacher-Dixon and Simmeonson (1981) suggested that parents may report positively about skills that children demonstrate inconsistently and only in familiar environments.

**Parental Concerns vs. Parental Estimations**

Some of the earliest research on parents’ abilities to judge how well their children were developing required parents to provide numerical estimates of children’s developmental ages. This was elicited by asking parents a question such as, “Even though your child is X months old, about how old she seems to you?” Parents’ age estimates were converted to ratio quotients and compared with measured IQs. Parents’ have been found to estimate children’s mental ages usually within one standard deviation of measured intelligence (Blacher-Dixon & Simmeonson, 1981; Coplan, 1982; Malhi, Kashyap & Dua, 2005). Although parents’ estimations of child’s development meet
developmental screening criteria, there are several problems related to estimations. Firstly, parents do not seem to think spontaneously in terms of estimations and often need prompting and examples before they can offer age estimates. Secondly, obtaining estimates across several developmental domains is necessary for identifying children with developmental problems. Evidence indicates that more educated parents are better able than less educated parents to produce accurate estimates (Wolfensburger & Kurtz, 1971), thereby indicating that use of parental estimates as a developmental screen may fail in identifying delayed children of less educated parents, who in any case are more at risk for developmental problems. Clearly then, parental concerns are more reliable than parental estimations in the process of early detection of children.

**Parental Concerns vs. Parental Predictions**

This is another approach to elicit parents’ opinions regarding how their child would function in the future. Although research on this topic is limited, one study asked two groups of parents, one with 2 year old children with cerebral palsy or mental retardation and a second group whose 2 year old children were developing normally, to predict how well their children would function at 18 years of age. Although all parents overestimate how their children would function in the future, there were clear differences between parents of children with and without disabilities (Shapiro, Ostroff & Howe, 1986). Limited research has been done on this area and the studies available reported parental predictions as insufficiently sensitive or specific to warrant their use as a stand alone screening tool (Wake, Gerner, & Gallagher, 2005).

**Evaluating Screening Tests: Measures of Accuracy**

There are several well-accepted criteria by which various tests are judged to be appropriate for use in screening programs. It is recommended that screening tests should be simple, brief, convenient to use, cover all areas of development, have adequate construct validity, be applicable to a wide age range, and have referral criteria that are both specific and sensitive (Committee on Children with Disabilities, 1994; Frankenbarg, 1994). One of the major purpose of a screening test is to move up the time of diagnosis in order to identify a delay at the earliest age when remediation is most useful. For this
reason it is important that the developmental screening tests being used must have predictive validity.

A number of methods are available for judging the predictive value of a test, such as correlations, percentage of agreement, and discriminative tests of validity (Sackett, Haynes, & Tugwell, 1985). The most useful way to evaluate a test’s concurrent or predictive accuracy is through an individual classification decisions; i.e., true positives (TP), true negatives (TN), false positives (FP), and false negatives (FN). True Positives are those which are correctly identified by the test. False Negatives are when a test incorrectly identifies someone with the disease as negative. True Negatives are when a test correctly identifies someone without the disease as negative. False Positives are when a test incorrectly identifies someone without the disease as positive. Classification analysis (Sackett et al., 1985; Galen, 1975) combines these data into several useful clinical indexes to measure a test’s accuracy. Specifically, this approach is used to calculate a test’s sensitivity, specificity, negative predictive value, and positive predictive value. A brief description of each of these measures is presented.

**Sensitivity**

Sensitivity refers to the proportion of individuals in the screened population who are truly at risk and who are correctly identified by the screening test. In other words, it is the percentage of children with actual problems (as measured by diagnostic tests) correctly identified by a screen (e.g., via failing, abnormal or positive results). It is calculated by the formula: Sensitivity = True positive (TP)/ [True Positive (TP) + False Negative (FN)].

Generally, a sensitivity level of 70% or more is acceptable for developmental screening tests (Glascoe, 1997). A screening test that has high sensitivity would result in few under-referrals or false negatives.

**Specificity**

Specificity, on the other hand, is concerned with the proportion of normal subjects who are correctly excluded by the test from further assessment or evaluation. In other
words, it is the percentage of children without actual problems (as measured by diagnostic tests) correctly identified by a screen (e.g., by passing, normal or negative scores). It is calculated by the formula: Specificity = True Negative (TN)/ [True Negative (TN) + False Positive (FP)]. Specificity values of 70% to 80% are acceptable for any given screening tests (Barnes, 1982; Glascoe, 1997). Tests with high specificity lead to few over-referrals and thus have only a small number of false positives. Barnes (1982) suggested that the predictive accuracy rate of screening measures be set at 75%. However, a 75% sensitivity ratio is considerably less favourable than a 75% specificity proportion. Hence, Meisels (1989) suggested that a more conservative criterion should be used, with cutoff points for both sensitivity and specificity of no less than 80%.

**Positive Predictive Value**

Positive predictive value (PPV) is the percentage of children who fail a screening test and are found, upon diagnostic testing, to have disabilities. Positive Predictive Value is calculated by the formula: PPV = True positive (TP) / [True positive (TP) + False positive (FP)].

**Negative Predictive Value**

Negative predictive value is defined as the proportion of children who are developmentally at risk who are not identified by the screening test. Negative Predictive Value (NPV) is calculated by the formula: NPV = False Positives (FP) / [True positives (TP) + False negatives (FN)]. This proportion is the converse of sensitivity (i.e., 1-sensitivity) and is a shorthand way of focusing on the proportion of individuals with the condition who are incorrectly classified as not at risk.

**Relative Risk**

Some authors have argued that the concept of relative risk should be used when discussing the results of screening tests (Frankenburg, 1994). Relative risk is the likelihood ratio that a child failing an initial screening test will later manifest actual developmental problems. A high likelihood ratio is an indicator that a child has a higher probability of developing a delay in future as compared to child having a lower likelihood
The concept of relative risk recognizes that not all children at risk will manifest a problem, but that there is a greater likelihood of developing the problem if there is a greater risk. Since many children at risk develop normally, and many children who are not at risk subsequently grow up to have cognitive problems, many errors arise in predicting who is at risk (Kirby, Swanson, Kelleher, Bradley, & Casey, 1993). For this reason, it is recommended that all children, whether or not previously identified at risk, be monitored in terms of the child’s rate of development, and this rate of development has been termed as changing risk factors.