Chapter 4
Screening Techniques

Abstract Child development involves the maturation and integration of an array of physical and cognitive functions. Although typical development occurs in a predictable sequence, there is also significant variability in rates of typical development. Screening techniques, such as standardized rating scales and observational tools, allow professionals to efficiently and accurately identify children who may be at risk for developmental delays or a developmental disorder. This chapter describes the benefits and limitations of developmental screeners in general and reviews a number of the screeners available to early childhood professionals.

Keywords Domains of development • Adaptive functioning • Communication skills • Motor development • Cognitive skills • Social/emotional development • Early identification • Screening • Assessment • Sensitivity • Specificity

Typical child development occurs in a predictable sequence marked by developmental milestones (Center for Disease Control and Prevention, 2011). Developmental milestones, such as taking a first step or saying a first word, are physical and behavioral signs of maturation that most children demonstrate within a certain window of time. The range for milestones can vary widely. For example, walking between 9 and 18 months is considered to reflect normal development. Milestones are achieved sequentially, where a child will first sit, then stand, walk, and run; but rates of development can vary significantly. For example, a baby might be very quiet and rarely make sounds or say words until her second birthday, and suddenly, she may not stop talking. For our convenience, developmental milestones are often categorized according to domains of development as if each were separate, when in fact they are all interrelated. These domains include (1) adaptive, (2) communication, (3) motor, (4) cognitive, and (5) social/emotional functioning and are described next.

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1. *Adaptive functioning,* also called self-help or independent skills, refers to skills, which help a child adapt to an environment or function independently. Early adaptive skills might include drinking from a cup or feeding oneself, while later skills include toilet training and dressing.
2. *Communication* milestones involve speaking, using and understanding body language and gestures, and understanding what others say. Early milestones include interest in sounds and words, while later milestones progress to describing play, answering questions, and engaging in conversations.
3. *Motor* skill milestones encompass maneuvering fingers and hands (fine motor skills) and large muscles movements of the arms and legs (gross motor skills). Examples of important motor early milestones are sitting independently and picking up small objects, while later milestones involve more complex skills such as running, navigating stairs, kicking a ball, or holding a crayon correctly.
4. *Cognitive* development milestones describe thinking skills, such as problem solving, maintaining attention, and understanding concepts. Early cognitive milestones involve exploration of objects with hands and mouth, while later skills include sorting objects by color, shape, and size.
5. *Social/emotional* development milestones describe emotions, interactions with others, and demonstration of feelings. Early social/emotional milestones include smiling at caregivers, while later milestones include playing with others, taking turns, and sharing.

For additional information on developmental milestones please refer to Web sites maintained by the American Academy of Pediatrics (AAP) (http://www.healthychildren.org/english/ages-stages/Pages/default.aspx; AAP, 2012) and the Center of Disease Control and Prevention (CDC) (http://www.cdc.gov/ncbddd/actearly/milestones/index.html; CDC, 2012).

The AAP recommends developmental surveillance at every Well-Child Visit and developmental screening using formal, validated tools at the 9, 18, 24, and 30 months Well-Child Visit or whenever a parent or provider concern is expressed (AAP, 2006). The AAP reports that 15–20 % of all visits to the pediatrician's office are developmental or behavioral in nature and 80 % of the parents' concerns regarding development are accurate. Therefore, early childhood professionals can anticipate having parents share developmental concerns with them, and these concerns should be considered as important sources of information. The following sections outline screening methods that may be useful to early childhood professionals.

Screening entails the administration of brief, standardized assessments to identify children who *may* have developmental delays (CDC, 2008). Screening tools can be categorized as general developmental screeners that cover all behavioral domains, or may be targeted screens which focus on one area of development. General screens can be completed by caregivers in offices or at home, or may be professionally administered by a trained professional.

When the results of the periodic screening tool are normal, an early childhood professional can inform the parents that their child's development is progressing well and continue with other aspects of the preventive visit. Normal screening

results provide an opportunity to focus on developmental promotion. However, if screening results are concerning, the child should be scheduled for appropriate developmental evaluations as quickly as possible. This follow-up evaluation is aimed at identifying the specific developmental disorder(s) or delay(s) affecting the child, thus providing further prognostic information and allowing prompt initiation of specific and appropriate early childhood interventions.

Two broad techniques may be selected for the screening process: rating scales and observation. Rating scale screeners rely on caregiver reports of a child's behavior, and may be completed by the caregiver independently or through an interview between the examiner and the caregiver. Caregiver completed screening tools are an economical way to collect information about development, and in most cases, parents are excellent resources about their child's behavior. However, this type of screening may not be appropriate in certain instances, for example, with parents with mental retardation, parents with history of drug or alcohol problems, or families who do not speak English. Caregiver report measures should be easy to read, complete, score, and interpret. An example of a recommended caregiver report measure is *Ages and Stages Questionnaires*, which will be covered later in this chapter.

Observation screeners, on the other hand, require direct elicitation and observation of a child's skills by a trained professional. These screeners are more difficult and expensive to administer, as they require adherence to standardized administration procedures, and may not capture the skills a child possesses due to factors such as misunderstanding, lack of motivation or fatigue.

When selecting a screening tool, there are several factors to take into account. Technical adequacy refers to the psychometric properties of an instrument, and includes an examination of the instrument's validity and reliability. Thus, the screener should measure what it is intended to measure (validity), and perform consistently (reliability) over time. Secondly, the test floors and item gradients need to be considered, especially in the case of very young or delayed children. This means there must be enough early items so that a child at-risk can be identified, and enough incremental items to document even small gains in progress. Constructive validity refers to the degree to which the screening tool measures a construct of interest. This means that the tool should screen for the problem of concern, for example, if communication milestones are a worry, the tool should assess communication skills. Lastly, predictive validity refers to the assumption that screeners accurately and predictably identify concerns.

And practically, the screening tool is meant to be brief (no longer than 30 min), easy to administer and score, and of low cost. The objective for screening is to quickly and accurately identify children in need of more intensive assessment. The primary purpose of a screening tool is to identify children at-risk, in order to refer them for more comprehensive assessment and possible services. The utility of a screening tool is often referred to as its hit rate, or its success in identifying children who do or do not need additional assessment.

Screening outcomes are described as *true positives, false negatives, false positives, and true negatives*. A true positive correctly identifies child at-risk, who will need additional assessment. A false negative fails to identify a child at-risk, who

Table 4.1 Formula to calculate sensitivity and specificity of screening tool

	Developmental delay		
	Present	Absent	
+	*a* (true positive)	*b* (false positive)	*a*+*b*
–	*c* (false negative)	*d* (true negative)	*c*+*d*
	a+*c*	*b*+*d*	*a*+*b*+*c*+*d*

Table 4.2 Practice example calculating sensitivity and specificity of a screening tool

	Developmental delay		
	Present	Absent	
+	*a* (80)	*b* (10)	*a*+*b*=90
–	*c* (10)	*d* (50)	*c*+*d*=60
	a+*c*=90	*b*+*d*=60	*a*+*b*+*c*+*d*=150

Sensitivity = 80/90 = 89 %
Specificity = 50/60 = 83 %

should receive additional assessment. A false positive identifies risk when it is no risk, and a true negative correctly identifies children who do not need additional assessment. Thus, one wants to select a screening tool which maximizes true positives and true negatives.

Two additional terms are used to describe how well the screening tool performs: Sensitivity and Specificity. Sensitivity refers to the proportion of children with developmental delays who are detected by the screener (true positives) and if the tool has higher sensitivity, you are better able to rule out the delay. Specificity refers to the proportion of children without developmental delay who are not identified with delay by the screener (true negative). High specificity will rule in the delay.

Table 4.1 represents screening results for four possible groups of children, labeled *a*, *b*, *c*, *d*. Sensitivity is calculated as $a/(a+c)$. Specificity is calculated as $d/(b+d)$. We want to find tools which achieve sensitivity and specificity of greater than or equal to 80 %, to be able to say with confidence that we have a good *hit rate*.

Here is a practice example using the formula shown above in selecting a new screener. You will screen 150 2-year-old children (you already know whether or not they have developmental delays). Eighty children with delays screen positive for a delay. Ten children with a delay are not picked up by the screener, and screen negative. Another ten children without delay are incorrectly identified by the screener with a delay. And 50 children without delay are correctly screened as negative or no delay. Table 4.2 graphically depicts these numbers.

Using this example, your calculations tell you that 89 % of children with developmental delay screen positive with the screening tool, and 83 % of children who do not have a delay screen negative. The cutoff score used to indicate acceptable sensitivity and specificity is 80 % or higher. Thus you would conclude that this tool does an adequate job in identifying children who should be referred for additional assessment, and does not overidentify delays in those without delays.

Table 4.3 Ages and Stages Questionnaires-Third Edition (ASQ-3; Bricker & Squires, 2009)

Domain(s):	Communication, motor skills, cognitive development, social/emotional development	For:	Children 1–66 months of age
Type:	Rating scale	Length:	10–15 min to administer 2–3 min to score
Description:	ASQ-3 consists of 21 age-specific questionnaires that allow for developmental screening at different intervals, such as at the recommended 9-, 18-, and 24- or 30- month Well-Child Visits. Parents respond *Yes*, *Sometimes*, or *Not Yet* to each item		
Strengths:	Requires minimal training; reproducible materials; easy to read items (Hanig, 2012); available in several languages	Limitations:	Validity data are somewhat weak (Hanig, 2012)
Web site:	http://www.agesandstages.com/		

Table 4.4 Ages and Stages Questionnaire: Social Emotional (ASQ-SE; Squires, Bricker, Twombly, & Yockelson, 2001)

Domain(s):	Social/emotional (i.e., self-regulation, compliance, adaptive behaviors, communication, affect, autonomy, and social interactions)	For:	Children 3–66 months of age
Type:	Rating scale	Length:	10–15 min to administer; 2–3 to score
Description:	ASQ-SE screens for social-emotional problems with eight different questionnaires each covering 3 month intervals		
Strengths:	Available in Spanish; easy to use and understand (Vacca, 2005)	Limitations:	Generalizability of scores across gender, race, and ethnicity is unknown (Vacca, 2012)
Web site:	http://www.agesandstages.com/		

Several screeners are available for use with young children that are quick and simple to administer and score, as well as reliable and valid for identifying developmental delays. Screener descriptions, domains assessed, appropriate age groups for use, length of time for administration and scoring, as well as the strengths and limitations of the screening tools are provided within each table (Tables 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9, 4.10, 4.11, and 4.12).

Table 4.5 Battelle Developmental Inventory-Second Edition screening test (BDIST; Newborg, 2005)

Domain(s):	Social/emotional, adaptive functioning, motor skills, communication, and cognitive development	For:	Children from birth to 7 years 11 months of age
Type:	Observation and direct elicitation of skills	Length:	10–30 min
Description:	Consists of 100 items from the full battery assessment and results of this screening indicate whether or not the full battery should be administered		
Strengths:	Available in other languages; flexible administrative procedures (Athanasiou, 2007)	Limitations:	Scoring criteria of some items are ambiguous (Athanasiou, 2007)
Web site:	http://www.riverpub.com/products/bdi2/details.html		

Table 4.6 Bayley Infant Neurodevelopmental Screener (BINS; Aylward, 1995)

Domain(s):	Basic neurological functions (i.e., auditory and visual receptive functions, verbal and motor expressive functions, and cognitive processes)	For:	Children 3–24 months of age
Type:	Observation and direct elicitation of skills	Length:	10–15 min to administer 3 min to score
Description:	The BINS contains selected items from the Bayley Scales of Infant Development-Second Edition (BSID-II) and neurological assessments		
Strengths:	Exceptionally clear and concise administrative instructions; kit provides all necessary materials; works well in setting where many infants have to be screened daily (Benish, 2007)	Limitations:	A structured observation and clinical interview would likely be just as effective as the BINS in a setting with fewer infants (Benish, 2007)
Web site:	http://www.pearsonassessments.com/HAIWEB/Cultures/en-us/Productdetail.htm?Pid=015-8028-708&Mode=summary		

Table 4.7 Brief Infant-Toddler Social and Emotional Assessment (BITSEA; Briggs-Gowan & Carter, 2006)

Domain(s):	Social-emotional (i.e., externalizing, internalizing, dysregulation, and competence)	For:	Children 12–35 months of age
Type:	Rating scale	Length:	7–10 min to administer
Description:	The BITSEA is a 42-item Parent Form that can be completed quickly to screen for social-emotional problems in children. The infant-toddler social and emotional assessment (ITSEA) is designed to be used subsequently		
Strengths:	Requires minimal training; available in Spanish; provides a childcare form to allow for multiple raters; computer scoring	Limitations:	Little information in the manual about empirical support for the reliability and validity of scores from the childcare form (Konold, 2007)
Web site:	http://www.pearsonassessments.com/HAIWEB/Cultures/en-us/Productdetail.htm?Pid=015-8007-352&Mode=summary		

Table 4.8 Brigance Early Childhood Screens (Brigance & Glascoe, 2010)

Domain(s):	Communication, motor, adaptive functioning, social/emotional, and cognitive	For:	For children 0–60 months of age
Type:	Observation and direct elicitation of skills	Length:	10–15 min to administer
Description:	These early childhood screens, which are part of the comprehensive Brigance early childhood system, can identify both learning delays and giftedness. Three screens are available, with one specifically for children 0–35 months of age		
Strengths:	Free online training	Limitations:	Not yet reviewed
Web site:	http://www.curriculumassociates.com/products/detail.aspx?title=brigec-screens&topic=CEC0		

Table 4.9 Communication and Symbolic Behavior Scales Developmental Profile (CSBS DP) infant/toddler checklist (Wetherby & Prizant, 2002)

Domain(s):	Communication	For:	Children 6–24 months of age
Type:	Rating scale	Length:	5–10 min
Description:	This instrument is composed of 24 multiple choice items grouped into social, speech, and symbolic composite scores		
Strengths:	Free to download online	Limitations:	Lack of national norms and may not be appropriate for use with minority and low socioeconomic populations (Carey, 2012)
Web site:	http://firstwords.fsu.edu/index.php/early-identification-of-communication-delays		

Table 4.10 Modified Checklist for Autism in Toddlers (M-CHAT; Robins, Fein, & Barton, 1999)

Domain(s):	Screener for autism spectrum disorder	For:	Children 16–30 months of age
Type:	Rating scale	Length:	5–7 min to administer Under 2 min to score
Description:	Parents complete a 23-item form with *Yes* and *No* responses to assess characteristics of an autism spectrum disorder		
Strengths:	Available for free online, available in multiple languages	Limitations:	High false-positive rate
Web site:	http://www2.gsu.edu/~psydlr/Diana_L._Robins,_Ph.D..html		

Table 4.11 Parents' Evaluation of Developmental Status (PEDS; Glascoe, 2010)

Domain(s):	Cognitive development, communication, motor skills, social/emotional development, adaptive functioning	For:	Children from birth to 7 years and 11 months of age
Type:	Rating scale	Length:	2 min to administer and score
Description:	This ten-item screener elicits parent concerns across the different developmental domains		
Strengths:	Brief, inexpensive easy to administer and score, ideal for use by healthcare providers (Bischoff, 2012; Roberts, 2012)	Limitations:	None identified in the independent review
Web site:	http://www.pedstest.com		

Table 4.12 PEDS: Developmental Milestones (PEDS:DM; Glascoe, 2008)

Domain(s):	Motor skills, communication, adaptive functioning, social/emotional development	For:	Children from birth to 7 years and 11 months of age
Type:	Rating scale	Length:	5 min to administer 1 min to score
Description:	PEDS:DM ranges from 6 to 8 items and is best used in combination with the PEDS but it can also be used alone		
Strengths:	Not yet reviewed	Limitations:	Not yet reviewed
Web site:	http://www.pedstest.com		

Conclusions

In sum, screeners are important tools for early intervention professionals because they provide valuable information about a child's development. Screening information can be helpful towards identifying concerns and determining if more in-depth assessment and intervention is needed. If screener results suggest that there may be a developmental delay then a comprehensive evaluation should follow. However, not all screening tools are equally useful. In selecting a screening tool, one should make sure that the tool is able to assess the problem, has adequate specificity and sensitivity, is brief to administer, easy to score, is useful in providing information about important and meaningful skills, and can be used repeatedly on a frequent basis (Ikeda, Neessen, & Witt, 2008).

Assess Your Knowledge

1. Please list and describe the five domains used to categorize developmental milestones.

   a.
   b.
   c.
   d.
   e.

2. What is the advantage of using a screening tool with young children?

   a. To obtain comprehensive evaluation results
   b. To diagnose a child as having a developmental delay
   c. To determine if more in-depth evaluation is needed to identify a developmental delay
   d. Both a and b

3. True or False: Screeners should be able to assess the identified problem, specific and sensitive, brief to administer and score, useful in providing information about important and meaningful skills, and be used repeatedly on a frequent basis.
4. What are the two broad techniques used for screening?

   a.
   b.

5. If screener results suggest that there may be a developmental delay then what should be done next?
6. Calculate the following rates of sensitivity and specificity for screening tool A and decide whether this tool will do an adequate job in screening children for developmental delay:200 children are screened with screening tool A for developmental delay. It identifies 100 as true positives, 20 children as true negatives, 20 children as false positives, and 60 children as false negatives.

   a. Sensitivity
   b. Specificity

Assess Your Knowledge Answers

1) adaptive, communication, cognition, motor, social/emotional 2) c 3) True 4) observational, rating 5) Refer 6) Sensitivity = 83 %; Specificity = 75 %