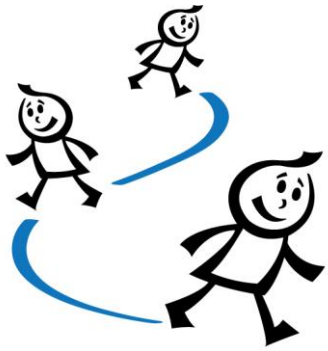

CDAS

CHILD DEVELOPMENT
ASSESSMENT SCALE

THE "CDAS" CHILD DEVELOPMENT ASSESSMENT SCALE

THEORETICAL BASES
TOOL DESCRIPTION
PSYCHOMETRIC DATA

MAY
2007

This text is based on the following:

Vézina, N. (2005). Élaboration et validation de la Grille d'évaluation du développement de l'enfant 0-5 ans (CDAS). Thèse de doctorat inédite, Université du Québec à Montréal, Montréal.

Centre de liaison sur l'intervention et la prévention psychosociales

"CDAS" Child Development Assessment Scale [Online overview]. Montreal: CLIPP. Access: http://www.clipp.ca

ISBN 978-2-922914-19-1

TABLE OF CONTENTS

The aim of this document is to describe the Child Development Assessment Scale or CDAS, a tool developed and perfected by the research team at the Laboratoire d'étude du nourrisson (LEN) of the Université du Québec à Montréal and the Université de Montréal. The text will begin by sketching a portrait of the theoretical context of child development assessment before describing the structure and administration of t11he CDAS. Finally, it will conclude with an examination of the standardization of the CDAS as performed at the LEN.

THEORETICAL BASES

Over the years, the researchers who have studied human development have devised a number of theories to explain this reality. Although often divergent and sometimes even contradictory, these explanations all share the same conviction, which is the importance of conceiving early childhood as a crucial period in life and one that in large part determines all subsequent stages (Sroufe, Cooper, & DeHart, 1992). The first years of life are indeed a critical phase in human development; theoreticians assert that cognitive, motor-related and social changes during this period are the most important ones in the entire lifespan (Calkins, 2004; Flavell, 1985).

Studies aimed at assessing child development usually identify and measure specific dimensions of development. Assessment tools generally divide young children's skills into three broad areas: cognitive (which includes language), motor and social (Barnett, Macann, & Carey, 1992). These skills, taken together, are referred to as "overall development."

Cognitive and language development

Infants are able to integrate, analyze and interpret information from their environment thanks to sensory and perceptual skills. Today, scientific observations based on increasingly sophisticated measurement techniques indicate that children's cognitive development begins very early in life, before they are even born. Very shortly after

birth, newborns will prefer the voices of their mothers over less familiar voices (Decasper & Prescott, 1984; Spence & Freeman, 1996). Floccia, Nazzi and Bertoncini (2000) for their part have demonstrated that infants learn to recognize and discern their mothers' voices during their intrauterine development based on prosodic clues such as phoneme length, intonation and vocal rhythms. In addition, researchers studying visual skills report that infants only a few days old show a preference for their mothers' faces (Bartrip, Morton, & Schonen, 2001; Bushnell, 2001; Field, Cohen, Garcia, & Greenberg, 1984). Furthermore, infants do not merely feel stimulation, but are able to recognize and distinguish between different forms thereof. Studies on the differentiation abilities of young infants suggest that they develop the capacity for memorization very early on (Bahrick, Gogate, & Ruiz, 2002; Bushnell, 2001). The fact that newborns can distinguish between two stimuli such as a mother's face and a stranger's face, for example, shows that very young infants are able to record information for future use. Research has also demonstrated that babies only a few months old can learn and memorize tasks, such as activating a mobile using a strap attached at the heel (Borovsky & Rovee-Collier, 1990; Bushnell, 2001; Robinson & Pascalis, 2004). As children grow older, they have more experiences and are able to generalize their learning in various contexts (Amabile & Rovee-Collier, 1991).

In order to properly represent the different dimensions of development, it is important to assess young infants' behavioural repertoire based on a set of abilities, as opposed to single measures (Pomerleau, Leahey, & Malcuit, 1994). This is why most developmental scales assess infant cognitive function based on a wide array of skills; among other things, tests focus on sensorimotor and perceptual-motor skills, such as the ability to turn in the direction of a sound, to visually follow a moving object, to grasp an object or to build a tower using blocks. These skills belong to the behavioural repertoire of children under one year old (Bracken & Walker, 1997; Slater, 1995), hence the importance of including them in development scales covering this period of life. Indeed, at this age, infants' cognitive skills are closely related to the quality of their motor development (Malcuit, Pomerleau & Lamarre, 1988).

Many authors also point out the crucial role of language in human cognitive development (Kagan, 1981; Shatz, 1994, Vygotsky, 1962). Children generally pronounce their first words toward the end of their first year of life (Reznick, Corley, & Robinson, 1997); it is therefore not surprising that scales measuring the development of children over 1 year old include language ability tests, in addition to assessing perceptual and motor skills (Slater, 1995). It is worth noting that language proficiency scales (Reznick et al.) often distinguish between receptive language (the ability to understand) and expressive language (the ability to express oneself) (Reznick et al.). In the second year of life, children develop their language skills and expand their vocabulary; their verbal exchanges grow longer and more complex as they begin to form sentences with multiple words and use the past and future tenses. Accordingly, development scales assessing the skills of children over 2 years old also contain items pertaining to both receptive and expressive language. Starting at 3 years old, children are able to chronologically describe a progression of daily events, for example what they did before going off to sleep. Assessing language proficiency therefore affords a way to measure mnemonic abilities, as well as the ability to logically and sequentially organize life events (Hayne & Herbert, 2004; Nelson, 1996; Reznick et al.). Moreover, in the area of problem-solving, language allows children to assess strategies before taking action; this explains why a number of authors consider that starting at 2 years old, children's cognitive skills are intellectual, as opposed to perceptual and motor as in the case of infants (Thompson, Fagan, & Fulker, 1991). This is also why, for children two years old and above, development scales include items intended to assess specifically intellectual skills. The related tasks in this regard address short-term and long-term memory as well as perceptual discrimination and concept comprehension, for example in terms of sizes, colors, numbers, categorization, classification, problem-solving abilities and prepositional understanding. Moreover, given that these cognitive skills are similar to those found in intelligence tests, it is easy to understand why development scales are likely to predict the intellectual functioning of children over 2 years old (Cardon & Fulker, 1991; Crowe, Deitz, & Bennett, 1987; Dezeote, MacArthur, & Tuck, 2003; McCall & Carriger, 1993; Molfese & Ache- son, 1997).

Development scales thus assess a wide repertoire of cognitive skills based on child behaviours. For younger children, these scales primarily contain items dealing with sensorimotor, perceptual-motor and language skills. For children ages 2 and above, the skills that are assessed are increasingly similar to those found in intelligence tests.

Motor development

From birth, children show reflex behaviors that can be used to assess their neurological functioning (McPhillips & Sheehy, 2004; Thelen & Ulrich, 1991); in most developmental scales, newborns' motor skills are assessed based on the presence of specific reflexes, such as the walking or grasping reflex. The area of motor development is generally divided into two spheres, namely gross motor skills and fine motor skills. In the Bayley (1993) development scales, for example, infants' gross motor skills are assessed by their ability to keep their heads upright when held in a vertical position, and fine motor skills by their ability to grasp small objects using their fingertips. Given that in very young infants, cognitive development is closely tied to motor development, development scales sometimes contain similar items that some authors associate with the cognitive sphere and others associate with the motor sphere. For example, in the Bayley development scales, the item intended to verify the infant's ability to transfer an object from one hand to another is part of the cognitive scale, whereas in the *Inventaire de développement de l'enfant de 0 à 7 ans* [inventory of development in 0 to 7 year old children] (Mayotte & Lalonde, 1995), this item is part of the motor scale.

In children 1 to 2 years old, gross motor skills are assessed using a number of items that address walking-related abilities, such as the ability to stand up with or without help, or to walk with good coordination. Fine motor skills, for their part, are assessed via more subtle tasks, such as grasping an object, building a tower using blocks, holding a pencil like an adult, eating with a spoon, or doodling by properly coordinating both hands. For children 2 years old and above, tests are often made up of items that verify the quality of movements, and especially their ease, fluidity and harmony. As Berger (2000) has noted, children at this age are generally thinner, stronger and better coordinated than infants; as a result, they are able to move quickly and gracefully, and to perform movements requiring greater precision. For example, the Bayley[1] contains items that assess the ability to stop in a controlled fashion when running (gross motor skills) and to copy a geometric shape (fine motor skills).

Infant motor development is thus assessed based on the presence of reflexes and abilities associated with gross motor skills. As children grow older, development scales, while continuing to measure gross motor skills, also begin to contain items focused on fine motor skills.

---

1 Throughout this document, the term "the Bayley" is used in reference to the Bayley Scales of Infant Development (Bayley, 1993).

Social development

Unlike the scales that measure cognitive or motor skills, the various scales that assess children's social development tend to measure very different dimensions. This diversity is a reflection of the wide range of young children's social skills. For infants, social skills are closely tied to cognitive skills and are therefore often assessed using cognitive-related items, such as a baby's preference for a familiar or smiling face. Of course, this preference implies several cognitive processes, such as the recognition, discrimination and categorization of a familiar face or of specific facial expressions (Bornstein & Arterberry, 2003), but it also involves a social dimension, namely the ability to become attached to a caregiver and to adjust behaviour according to the caregiver's facial expressions, both of which generate increasingly appropriate social relationships.

The quality of infants' behaviour toward an assessor can also be used to assess social maturity; behaviours observed over the course of assessment then serve as indicators of social skill level. Bayley (1993) accordingly evaluates attention, orientation and interest abilities with respect to the assessor and the assessment materials based on a scale that also verifies the child's motor activity level over the course of the assessment. Similarly, the socio-emotional scale in the *Inventaire de développement de l'enfant de 0 à 7 ans* (Mayotte & Lalonde, 1995) includes items that examine infants' interest in the people who take them into their arms, in addition to assessing manifestations of fear when the infants are confronted with strangers and the ability to create relationships with adults.

For children over 2 years old, the social dimension of development is assessed in detail, for instance by evaluating child behaviours of autonomy and adaptation in various areas of life (getting dressed, eating, hygiene and interactions with others). The *Inventaire de développement et de maturité préscolaire* (IDMP) [preschool development and maturity inventory] of Terrisse, Andreani and Boutin (1983) and the Denver Developmental Screening Test (TDCD) (Frankenburg, Dodds & Fandal, 1973) both contain a scale that measures behaviours related to child autonomy and social functioning. The social scale, in both tools, features items that assess children's autonomy in their social relationships ("is able to propose a game," "is able to express emotions to others") and in their everyday tasks ("is able to get dressed," "is able to brush his or her teeth").

Hence, social development measures for young children are rather disparate compared to measures assessing cognitive-language or motor development. This disparity, however, is due to the fact that social reality encompasses several areas of development that are not always easy to distinguish from one another.

Development assessment scales

The existence of a link between the development of young children's cognitive, motor and social skills and their future functioning has been clearly demonstrated and established (Calkins, 2004; Clearfield, 2004; DiLalla et al., 1990; Hay, Payne, & Chadwick, 2004; McPhillips & Shee- hy, 2004; Metcalfe, McDowell, Chang, & Chen, 2005; Siegel, 1989). These skills, which are acquired in early childhood, are also predictors of future performance in school (Ramey & Ramey, 1998). It is therefore important to be familiar with the repertoire of children's skills and to be able to analyze strengths and weaknesses early enough to optimize functioning and to prevent potential difficulties that might arise when they begin school (Bracken & Walker, 1997); the early identification of problem areas enables early and precisely targeted intervention (Dezoete, MacArthur, & Tuck, 2003). Achieving this goal, however, requires an effective assessment tool (Barnett et al., 1992; Dansereau, Terrisse, & Bouchard, 1990).

In this regard, the Bayley is the tool of reference (Bendersky & Lewis, 2001; Bradley-Johnson 2001; Wilson & Cradock, 2004). This instrument assesses child development up to the age of 42 months. The Bayley is composed of three scales: a mental scale, which measures perceptual, mnemonic, communicational, verbal and problem-solving skills; a motor scale, which assesses gross and fine motor skills; and a behavioural scale, which analyzes child behaviour in relation to the assessor and the assessment situation. Each scale yields a standardized score. The Bayley has the advantage of assessing the development level of very young children, being reliable from a psychometric standpoint, and detecting developmental delays (Flanagan & Alfonso, 1995; Goldstein, Fogle, Wieber, & O'Shea, 1995); however, using this scale properly requires extensive training (Leonard, Piecuch, & Cooper, 2001; Wachtel, Shapiro, Plamer, Allen & Capute, 1994) and it is very expensive. Administering the Bayley also requires a quiet place that will ensure a child's concentration and listening for a 45 to 60 minute period. Finally, the test's results are not conducive to developing an intervention plan (Bradley-Johnson, 2001).

There are also other tools that enable child development assessment. The TDCD (Frankenburg et al., 1973), the IDMP (Terrisse et al., 1983) and the *Inventaire de développement de l'enfant de 0 à 7 ans* (Mayotte & Lalonde, 1995) all contain features that are similar to those of the Bayley. The TDCD assesses the fine motor skills, language, and personal and social development of children from 2 to 6 years old. This test situates the child's strengths and weaknesses

based on their age group and provides a result in the form of a success rate. However, the TDCD has shortcomings in terms of the choice of items and the areas that are assessed, it does not precisely distinguish between children with slight and major delays, and it does not allow the detection of severe delays. Another test, the IDMP put forth by Dansereau et al., (1990), assesses the cognitive, psychomotor and social-emotional development of children from 2 to 5 years old. This is one of the few instruments to have been validated with a Quebec population (Phan, 1987). However, the tool's concurrent validity was established using the criterion of the TDCD, which is scarcely discriminating. Moreover, the IDMP does not assess children under 2 years of age. Finally, the *Inventaire de développement de l'enfant de 0 à 7 ans* assesses many cognitive, motor and social-emotional skills. It is relatively easy to administer and to score, since it was designed for use by practitioners interested in developing intervention plans. This inventory reveals a child's strengths and weaknesses in several dimensions. However, it provides few instructions for administration and little information on success criteria, thereby diminishing the reliability of results. It is also very lengthy to administer.

Multiple tests are used to assess cognitive functioning in children 2 years old and above. The best known are probably the Stanford-Binet (5the edition, Roid, 2003) intended for individuals from 2 to 24 years old and the Wechsler scales for individuals from 3 to 17 years old. These tests classify intellectual functioning by obtaining an intellectual quotient (IQ) (Flanagan & Alfonso, 1995). They show good psychometric properties and their reliability has been widely demonstrated (Bradley-Johnson, 2001). Administering these tests and interpreting their results, however, requires specialized knowledge, thereby limiting their use to people with the requisite professional training. In the same vein, the McCarthy Scales of Children Abilities (McCarthy, 1976) assess the intellectual and motor functioning of children from ages 2.5 to 8.5. Although their results are not expressed in terms of IQ, these scales offer a way to identify the child's strengths and weaknesses; they cannot, however, be used for children suffering from mental retardation, as their basic items are already too difficult for these individuals (Bracken & Walker, 1997). Griffiths Mental Development Scales (Griffiths, 1954), for their part, are designed to assess the cognitive development of children up to 8 years old. However, the standardization of these scales is dated to the point of invalidating their use.

A number of other instruments also assess specific dimensions of young children's development. In the area of language, the Peabody Picture Vocabulary test [and its French adaptation, the EVIP] (Dunn, Thériault, & Dunn, 1993) measures the receptive vocabulary of individuals from 2.5 to 19 years old; the Reynell Developmental Language Scales (Reynell, 1987) for their part assess language comprehension and production in young children 1 to 3 years old. Other tools assess social or emotional skills associated with behaviours of adaptation and autonomy. The Vineland Adaptive Behavior Scales (Sparrow, Balla, & Cicchetti, 1984), for instance, assess adaptive behaviours from birth to 18 years old with respect to communication, everyday skills and socialization; they are primarily used by psychologists to confirm diagnoses of intellectual disability. The *Profil socioaffectif de l'enfant d'âge préscolaire* [preschool social-emotional profile] developed by Lafrenière, Dubeau, Janosz and Capuano (1990) offers a portrait of strengths and weaknesses in the social functioning of 2.5 to 6 year old children in terms of emotional expression and social skill. It also assesses adjustment difficulties and internalized and externalized problems; this profile is standardized, its psychometric features are well established, and it is relatively straightforward to complete.

As we have seen, it is not easy to find a tool that reliably, validly and easily assesses the overall development of young French-speaking children from 0 to 5 years old. The tools that are available do not adequately meet the specific needs of practitioners in Quebec, whether in youth centres (Centre jeunesse), day care centers (Centres de la petite enfance or CPE), local community service centres (CLSCs) or schools. Indeed, most of these assessment tools have significant drawbacks, whether owing to the extensive training they require, their high prices, the duration of administration or their low level of reliability or validity, which can affect the significance of their results. Some of these tests are strictly for use by professionals (Wachtel et al., 1994). To address the lack of tools available to them, practitioners sometimes use parts of scales or tests that they juxtapose in order to arrive at a global assessment of child development. This explains the emergence, in various communities, of 'makeshift' instruments whose psychometric properties remain unproven. As Barnett et al. (1992) have pointed out, the use of tools that are neither reliable nor validated is flawed and problematic. Even so, practitioners frequently use the results obtained by such means to confirm their clinical judgments and to make decisions that can affect children's futures.

DESCRIPTION OF THE CDAS

We have noted that few suitable tools are available to practitioners seeking a fast, accurate and global assessment of child development (Moreau & Graton, 1998). The need to fill this gap, and to meet a specific request from the Centre jeunesse de Montréal (CJM), was the impetus that led the LEN team to develop the CDAS development assessment grid. Indeed, the staff at CJM had expressed the need for a tool that would help assess the level at which development was compromised in the children referred to them, and that would guide treatment plans in accordance with observed problems. The tool needed to be quick and easy to administer, inexpensive and accessible to individuals who were not child assessment professionals. It also needed to have good psychometric properties and yield easy-to-interpret results. Throughout the process of developing the CDAS, home and institutional day-care centres, primary schools and CLSCs took part in the process in order to ensure that the CDAS would meet their needs, to test it out, and to validate it with children in various settings.

The following section presents the CDAS development process, explains its structure, and describes how it is administered. Finally, it will describe the technique for using the CDAS "Scoring Checklist" and for adjusting scores and interpreting results.

Development of the CDAS

The CDAS was designed by a team of infant development specialists made up of three professor-researchers, one research professional and one doctoral student. This kernel was supplemented by a team of external researchers (researchers, psychologists and pediatricians) tasked with ensuring the tool's content validity.

The CDAS was designed to assess young children's overall development in terms of cognitive, language, motor and social-emotional development. The tool was constructed based on pre-existing grids, inventories and scales currently used in intervention and research. Some of the items and some means of evaluation were therefore borrowed from the Bayley, the Stanford-Binet (4the edition, Thorndike, Hagen, & Sattler, 1986), the TDCD (Frankenburg et al., 1970), the *Inventaire de développement de l'enfant de 0 à 7 ans* (Mayotte & Lalonde, 1995), the Griffiths (Griffiths, 1954) and the *Inventaire de développement et de maturité préscolaire* (Terrisse et al., 1983). The CDAS was designed to be easy to understand and simple to administer and score. It was also intended to avoid the need for extensive training or the use of complex or expensive materials, and to have sufficiently good psychometric properties to be able to reliably and validly detect strengths and weaknesses in child development.

Structure and administration of the CDAS2

The developmental dimensions assessed by the CDAS are grouped under three scales, namely cognitive and language, motor and social-emotional. For young children, the cognitive-language scale contains items that assess sensory and perceptual-motor integration, causality, object permanence, memory and the ability to produce language-related sounds. For older children, it assesses attention, memory, general knowledge, and problem-solving and concept understanding abilities. In addition, the scale assesses the child's level of vocabulary, understanding, form of speech, and ability to use language to convey a message. The CDAS motor scale, for young infants, is comprised of items that verify the existence of certain perinatal reflexes, gross motor skills, and fine motor skills; it also assesses the child's degree of physical activity and muscle tone. For older children, the motor scale examines the quality, ease, fluidity and harmony of moments. The social-emotional scale assesses the quality of child social interaction with adults and peers, behaviours of attachment to parents, and sensitivity to other adults and to peers. The items that make up the cognitive and motor scales vary from easy to very difficult, in accordance with a level of difficulty established based on standardized tests or tools. The social-emotional scale does not contain any difficult items; it merely verifies the presence of essential social-emotional skills for a given age. Each of the three scales includes a variable number of items depending on the age of the child (from 8 to 24 items per scale and per age group).

Child development is characterized by rapid development in the first years of life, followed by

[2] The Centre de liaison sur l'intervention et la prevention psychosociales (CLIPP) is the only authorized distributor of the CDAS. To order a "CDAS Kit" complete with all the materials needed for testing, the User Guide and the Scoring Checklists, or to register for training to administer the CDAS, contact the CLIPP at info@clipp.ca.

progressively slower growth. The analytical grids of the CDAS are designed precisely to reflect this progression. Hence, the first two years of life are divided into three-month sections, which explains the existence of eight grids for child development between 0 and 2 years old (0-3, 3-6, 6-9, 9-12, 12-15, 15-18, 18-21, and 21-24 months). For children 2 to 4 years old, four grids are required, with each year being divided into six-month sections (24-30, 30-36, 36-42, and 42-48 months). Finally, for the fourth and fifth years of life, when developmental changes have comparatively slowed down, the two final grids are used to cover one 12-month period each (4 and 5 years old).

The child's age at the time of assessment determines the choice of age grid to use. For example, the first age group, 0-3 months, is used to assess newborns up to three months less a day; from 3 months old, a 3-6 month grid will be used. However, since children born before the 37th week of gestation are penalized when assessed within the group of their chronological age (Wilson & Cradock, 2004), premature children's chronological age must be adjusted to take into account biological age. Therefore, to assess a 9 month and 15 day old child who was born after 35 weeks of gestation, 5 weeks need to be subtracted from the chronological age and a 6-9 month grid needs to be chosen to match the child's actual biological age. This age correction taking into account child prematurity, as recommended by Bayley (1993), applies in the CDAS up to the age of 2, after which children generally catch up the delay resulting from prematurity (Greenberg & Crnic, 1988; O'Connor, 1980).

The CDAS must be administered in a standardized way by following the instructions contained in the "User Guide" that gives directions, describes the child's position during each task or situation, and sets out the materials needed to administer the tests. The instructions for administering the CDAS are designed to expose the child to tasks or situations that prompt directly observable behaviours; scoring the results is therefore very simple, since the assessor need only note down success or failure for each item. The goal of the person administering the CDAS must be to elicit the best results of which the child is capable. As a result, even though the User Guide suggests a sequence of items for each age group, the sequence can always be changed in order to adapt to the child's state; for example, if the child is agitated, it is suitable to provide an opportunity to spend energy by alternating between motor scale items and cognitive scale items. The average time needed to administer the CDAS is 30 minutes. The required materials are easy to use and to transport.

CDAS scoring checklists, score adjustment and interpretation of results

The CDAS results achieved by the child are analyzed using "scoring checklists." For each of the 14 age groups of the CDAS, the checklists calculate a score for each of the three scales of the test. This score, expressed as a percentage, represents the proportion of items the child has successfully completed in relation to the total number of items for each scale.

To avoid unduly penalizing children at the bottom of an age group, or conversely favouring those at the top, the CDAS proposes a score adjustment. Children at the bottom or middle of certain age levels are assigned additional points; each scoring checklist presents the adjustment method when applicable. For the cognitive scale, a score adjustment is required for the 14 groups; for the motor scale, a score adjustment is required for the first 4 groups only, that is, for children under 12 months old; and for the social-emotional scale, a score adjustment is required for the 0-3 months old group only.

Finally, once the proper checklist is completed for a child, the results can be interpreted. An interpretation grid situates the score obtained on each scale with respect to the average score expected for children in a given age group. If the child's results are in the "comfort" zone, no particular action needs to be taken. If the child's results are in the "to be monitored zone," a two-week observation and stimulation period is recommended, followed by another assessment. Finally, if the child is in the "referral zone," he or she requires immediate attention and it is important to urge the parents to refer their child to a child development specialist as soon as possible.

PSYCHOMETRIC DATA

The following section deals with the psychometric validation of the CDAS, that is, analysis of its validity as a measurement instrument. A measurement instrument is considered to be valid when it correctly measures what it is intended to measure, and it is considered to be reliable when it always yields the same measurement for the same phenomenon. The example of the thermometer provides a good illustration of these concepts; a thermometer is valid if it accurately measures body temperature, and it is reliable if it gives the same temperature after a two-minute interval.

To ensure the validity and reliability of the results obtained using the CDAS, the LEN and CLIPP teams undertook a study of the psychometric properties of the instrument. The following paragraphs describe the subject sample that was used for the study, and summarize the reliability

and validity analyses performed on the CDAS.

Validation sample

The final version of the CDAS was developed based on an analysis of the results obtained by 264 children (130 girls and 134 boys) assessed over the course of the validation study. Since this analysis was performed by the LEN, this sample, in the following pages, will be referred to as the "LEN sample." Sixty-two percent of these children were in day care; of these, 50% were attending a CPE and 50% spent between 20 and hours per week in day care. On average, the parents of these children had 15 years of schooling and 43% of them had an income of more than $60,000. Finally, French was the everyday language of 76% of the sample. A second sample of 280 children from a study by the Fondation Lucie et André Chagnon (FLAC) was used to complement the validity analysis for the social-emotional sub-scale; in the following pages, this group will be referred to as the "FLAC sample."

Reliability of the CDAS

The reliability of CDAS scores was verified in three ways, namely a test-retest method, inter-assessor agreement and inter-item consistency. The results obtained through these psychometric techniques were all from the LEN sample; they are summarized in the next paragraphs.

Analysis of test-retest reliability, which is done by administering the same test to the same subjects several times, gives an indication of whether they retain their respective scoring or rank, or whether their scores change from one assessment to another; in other words, the analysis examines the temporal stability of CDAS scores. To obtain the data needed for this test-restest study, 32 randomly chosen children from the LEN sample were assessed on two different occasions approximately two weeks apart. Table 1 (see Appendix) presents the detailed results of this analysis. The score averages obtained in the two occurrences of the test scarcely vary and the correlations between the two are very satisfactory given the rapid development of children's motor and social-emotional skills, particularly in young infancy.

The study of inter-assessor agreement indicates whether two assessors testing the same child will achieve similar results. The results of analysis on Kappa agreement coefficients shows excellent agreement between evaluators on all three scales of the test. The details of the results are shown in Table 2 (see Appendix). They suggest that the scores obtained using the CDAS are scarcely influenced by variables associated with the person performing the assessment. It can therefore be suggested that

the CDAS's standardized procedure is conducive to diminishing any bias that may be introduced by assessors' individual characteristics.

Finally, the examination of inter-item consistency offers an indication of whether the items in the same scale measure the same skills. The CDAS's inter-item consistency analysis, calculated using the Kuder-Richardson coefficient (KR-20), verified the degree of homogeneity between the items in the cognitive-language and motor scales. The results are shown in Table 3 (see Appendix); they reveal that consistency ranges from moderate (0.50) to very good (0.80) depending on the age group. Inter-item consistency for the social-emotional scale cannot be calculated, given that it is designed for children to pass almost all of the items for their age group, hence leaving little room for the possibility of variance between scores.

Vailidity of the CDAS

The validity of the CDAS was examined via two procedures. First, throughout the tool's development, content validity was ensured by means of outside experts who were called upon to verify that the items on the tool's three scales truly belonged to the dimensions with which they were associated, and that the measured behaviours were indeed a representative sample of the intended areas of ability.

Second, the tool's concurrent validity was measured by comparing CDAS scores with the scores achieved by children in the LEN sample on two other development tests, namely the Bayley and the Stanford-Binet. This study of concurrent validity gives an indication of whether the CDAS aligns with a well known and valid instrument. To take the example of a body temperature thermometer, a study that measures the concurrent validity of such a thermometer could assess whether the temperature obtained using an ear thermometer is the same as the one obtained using an oral thermometer. All of the children assessed during the validation test were evaluated using the CDAS and another standardized test; children from 1 to 42 months of age took the Bayley, and, starting at 42 months and 16 days old, children took the Stanford-Binet intelligence scale (4th edition, Thorndike et al., 1986). The two scales indeed show very strong concurrent validity (Slater, 1995; Verreault, 2005). The concurrent validity analysis between the CDAS and the other development scales focused on cognitive-language and motor scales only. The results of this analyses are presented in Tables 4 and 5 (see Appendix); they suggest that the correlations between CDAS and Bayley scores range from moderate (0.40) to very good (>0.60) depending on the age group and the functions that are measured. The CDAS's concurrent validity for the social-emotional scale was

also measured based on the results achieved by subjects in the FLAC sample who were assessed using the CDAS as well as the motor, social and cognitive development scale of the *Étude longitudinale du développement des enfants du Québec* (Institut de la statistique, 2001). The following sub-scales of this last instrument were correlated with CDAS scores: hyperactivity/inattention, pro-sociability, pure physical aggression, emotional disorder, social withdrawal and anxiety. These scales were chosen based on their similarity to elements covered by the social-emotional scale of the CDAS. The sub-scales most strongly associated with this social-emotional scale are, respectively, hyperactivity/inattention, pro-sociability, emotional disorder and pure physical aggression (see Table 6 in the Appendix). A total intensity score for an emotional disorder was calculated by adding up negative scales (hyperactivity/inattention, emotional disorder and pure physical aggression) and subtracting the score obtained for pro-sociability. The convergence between the social-emotional CDAS and this last score is very acceptable at 0.46.

Aside from this analysis of concurrent validity, the use of the Bayley and Stranford-Binet enabled the identification of a cut-off point in the CDAS at which a child can be said to show difficulty in one or another developmental sphere. Indeed, children with a score of 60% or above on the CDAS generally achieve a Bayley developmental score or a Stanford-Binet intelligence quotient situated in the average population or above; conversely, children with a score of less than 50% on the CDAS generally achieve a score below the average using comparison tools. As a result, the cut-off point on the CDAS can be located between the scores of 50 and 60%. This data is shown in Table 7 (see Appendix).

CONCLUSION

Psychometric analyses show that the CDAS yields stable, reliable and valid measures of cognitive, motor and social-emotional skills in children, from birth to 5 years of age. This tool, which was developed to detect and distinguish between child strengths and weaknesses in the principal dimensions of psychological development, offers a way to determine a child's level of functioning. The CDAS gives practitioners information that is likely to help them gear intervention plans toward specific skills; it can therefore be used to establish activities that stimulate the developmental areas that prove problematic over the course of assessment.

The CDAS is a user-friendly tool, but it is also sufficiently accurate and sensitive to provide a reliable and valid assessment of child development. Administering this tool requires no specialized prior training. However, the assessor must have experience with children and a good knowledge of their developmental stages; it is also recommended that users undergo a brief training session in order to ensure a thorough understanding of the tool and the way it is administered. Before assessing a child using the CDAS, it is essential to be familiar with the descriptions and instructions given in the User Guide, as well as to have a good handle on how to use the scoring checklists. The standardized administration procedure described in the guide must be followed in order to guarantee valid results.

APPENDIX

STATISTICAL

DATA

Table 1

Temporal validity of the CDAS

	Cognitive/ language scale	Motor scale	Social-emotional scale
Average time 1 ± SD	64.3 ± 17.0	76.7 ± 16.2	90.4 ± 9.6
Average time 2 ± SD	64.7 ± 18.7	71.6 ± 20.5	88.5 ± 10.2
t value	0.09	1.04	0.77
p value	0.93	0.27	0.45
% variance	0.025	3.69	1.82
R test-retest	0.71	0.49	0.41
p value	0.000	0.004	0.019

Table 2

Inter-assessor agreement

	Cognitive/ language scale	Motor scale	Social-emotional scale
N	43	43	43
% sample	16	16	16
Kappa	0.87	0.90	0.94

Table 3

Internal consistency by age group (Kuder-Richardson, KR-20)

Age group	Cognitive/ language scale	Motor scale	Social-emotional
0 – 12	0.52	0.69	--
12 – 24	0.65	0.75	--
24 – 36	0.80	0.52	--
36 – 48	0.68	0.66	--
48 – 72	0.66	0.60	--

Table 4

Correlations between the cognitive/language scale of the CDAS and the Bayley or Stanford-Binet

Age group	Number of subjects	Correlation coefficient	Significance level
0 – 12	72	0.40	0.0005
12 – 24	49	0.69	0.0000
24 – 36	35	0.77	0.0000
36 – 48	39	0.65	0.0000
48 – 72	21	0.69	0.0004

Table 5

Correlations between the motor scale of the CDAS and the Bayley or Stanford-Binet

Age group	Number of subjects	Correlation coefficient	Significance level
0 – 12	81	0.62	0.0000
12 – 24	71	0.52	0.0000
24 – 36	17	0.80	0.0001
36 – 48	25	0.61	0.0009
48 – 72	--	--	--

Table 6

Multiple regression between BEH sub-scales and the social-emotional scale of the CDAS

Sub-scale	Hyperactivity inattention	Pro-sociability	Agressiveness	Emotional disorder
Social-emotional scale of the CDAS	-0.223	0.208	-0.087	-0.103
p	0.0001	0.0002	0.1195	0.0644

Table 7

CDAS cut-off points

	Cognitive/ language scale				Motor scale			
Age group	2-ET Bayley	1-ET Bayley	10th CDAS	25th CDAS	2-ET Bayley	1-ET Bayley	10th CDAS	25th CDAS
0 – 12	46	57	50	56	--	--	40	53
12 – 24	42	50	35	50	--	--	22	46
24 – 36	32	44	27	48	--	--	31	46
36 – 48	43	57	41	48	--	--	21	36
48 – 72	29	47	23	48	--	--	30	57

REFERENCES

Amabile, T. A., & Rovee-Collier, C. (1991). Contextual variation memory retrieval at six months. Child Development, 62, 1155-1166.

Bahrick, L. E., Gogate, L. J., & Ruiz, I. (2002). Attention and memory for faces and actions in infancy: The salience of actions over faces in dynamic events. Child development, 73(6), 1629-1643.

Barnett, D. W., Macmann, G. M., & Carey, K. T. (1992). Early intervention and the assessment of developmental skills: Challenges and direction. Early Intervention and Developmental Assessment, 12, 21-43.

Bartrip, J., Morton, J., & Schonen, S. (2001). Responses to mother's face in 3-week to 5-month-old infants. British Journal of Developmental Psychology, 19(2), 219-232.

Bayley, N. (1993). Bayley Scales of Infant Development. Second Edition. San Antonio, TX: The Psychological Corporation.

Bendersky, M., & Lewis, M. (2001). The Bayley Scales of Infant Development: Is there a role in biobehavioral assessment? In L. T. Singer & P. S. Zeskind (Eds.), Biobehavioral assessment of the infant (pp. 443-462). New York: Guilford Press.

Berger, K. S. (2000). Psychologie du développement. Mont-Royal, QC : Modulo.

Bornstein, M. H., & Arterberry, M. E. (2003). Recognition, discrimination and categorization of smiling by 5 months-old infants. Developmental Science, 6(5), 585-589.

Borovsky, D., & Rovee-Collier, C. (1990). Contextual constraints on memory retrieval at six months. Child Development, 61, 1569-1583.

Bracken, B. A., & Walker, K. C. (1997). The utility of intelligence tests for preschool children. In D. P. Flanagan, J. L. Genshaft, & P. L. Harrison (Eds.), Contemporary intellectual assessment: Theories, tests, and issues (pp. 484-502). New York: Guilford Press.

Bradley-Johnson, S. (2001). Cognitive assessment for youngest children: A critical review of test. Journal of Psychoeducational Assessment, 19(1), 19-44.

Bushnell, I. W. R. (2001). Mother's face recognition in newborn infants: Learning and memory. Infant and Child Development, 10(1-2), 67-74.

Calkins, S. D. (2004). Early attachment processes and the development of emotional self-regulation. In R. F. Baumeister & K. D. Vohs (Eds.), Handbook of self regulation: Research, theory, and applications (pp. 324-339). New York: Guilford Press.

Cardon, L. R., & Fulker, D. W. (1991). Sources of continuity in infant predictors of later IQ. Intelligence, 15, 279-293.

Clearfield, M. W. (2004). The role of crawling and walking experience in infant spatial memory. Journal of Experimental Child Psychology, 89(3), 214-241.

Crowe, T. K., Deitz, J. C., & Bennett, F. C. (1987). The relationship between the Bayley scales of infant development and preschool gross-motor and cognitive performance. The American Journal of Occupational Therapy, 41, 374-378.

Dansereau, S., Terrisse, B., & Bouchard, J. - M. (1990). Dépistage précoce d'enfants en difficulté d'adaptation et d'apprentissage : L'Inventaire de développement et de maturité préscolaire. Québec, QC : Agence d'ARC.

Decasper, A. J., & Prescott, P. A. (1984). Human newborn's perception of male voices: preference, discrimination, and reinforcing value. Developemental Psychobiology, 17(5), 481-491.

Dezoete, J. A., MacArthur, B. A., & Tuck, B. (2003). Prediction of Bayley and Stanford-Binet scores with a group of very low birthweight children. Child: Care, Health and Development, 29(5), 367-372.

DiLalla, L. F., Plomin, R., Fagan III, J. F., Thompson, L. A., Phillips, K., & Haith, et al. (1990). Infant predictors of preschool and adult IQ: A study of infant twins and their parents. Developmental Psychology, 26(5), 759-769.

Dunn, L. M., Thériault, W., & Dunn, L. M. (1993). Échelle de vocabulaire en images Peabody-ÉVIP. Toronto, ON: Psycan.

Field, T. M., Cohen, D., Garcia, R., & Greenberg, R. (1984). Mother-stranger face discrimination by the newborn. Infant Behavior and development, 7(1), 19-25.

Flanagan, D. P., & Alfonso, V. C. (1995). A critical review of the technical characteristics of new and recently revised intelligence tests for preschool children. Journal of Psychoeducational Assessment, 13, 66-90.

Flavell, J. H. (1985). Cognitive development (2nd ed.). Englewood Cliffs, NJ: Prentice-Hall.

Floccia, C., Nazzi, T., & Bertoncini. (2000). Unfamiliar voice discrimination for short stimuli in newborns. Developmental Science, 3(3), 333-343.

Frankenburg, W. K., Dodds, J. B., & Fandal, A. W. (1973). Denver developmental screening test. Denver, CO: University of Colorado.

Goldstein, D. J., Fogle, E. E., Wieber, J. L., & O'Shea, T. M. (1995). Comparison of the Bayley scales of infant development second edition and the Bayley scales of infant development with premature infants. Journal of Psychoeducational Assessment, 13, 391-396.

Greenberg, M. T., & Crnic, K. A. (1988). Longitudinal predictors of developmental status and social interaction in premature and full-term infants at age two. Child Development, 59, 554-570.

Griffiths, R. (1954). The abilities of babies. London: University of London Press.

Hay, D. F., Payne, A., & Chadwick, A. (2004). Peer relations in childhood. Journal of Child Psychology and Psychiatry, 45(1), 84-108.

Hayne, H., & Herbert, J. (2004). Verbal cues facilitate memory retrieval during infancy. Journal of Experimental Child Psychology, 89, 127-139.

Institut de la statistique (2001). Étude longitudinale du développement des enfants du Québec (ÉLDEQ 1998-1002). Les nourrissons de 5 mois. Aspects conceptuels et opérationnels. Collection la santé et le bien-être, 1(12). Québec : Gouvernement du Québec.

Kagan, J. (1991). The second years: The emergence of self awareness. Cambridge, MA: Harvard University Press.

Lafrenière, P. J., Dubeau, D., Janosz, M., & Capuano, F. (1990). Profil socio-affectif de l'enfant d'âge préscolaire. Revue canadienne de psycho-éducation, 19, 23-41.

Leonard, C. H., Piecuch, R. E., & Cooper, B. A. (2001). Use of the Bayley Infant Neurodevelopmental Screener with low birth weight infants. Journal of Pediatric Psychology, 26(1), 33-40.

Malcuit, G., Pomerleau, A., & Lamarre, G. (1988). Habituation, visual fixation and cognitive activity in infants: A critical analysis and attempt at a new formulation. European Bulletin of Cognitive Psychology. 8, 415-440.

Mayotte, A., & Lalonde, D. (1995). Traduction et adaptation à la population francophone canadienne de l'inventaire de développement de Brigance. Ottwa, ON : Centre Franco-Ontarien de ressources pédagogiques.

McCall, R. B., & Carriger, M. S. (1993). A meta-analysis of infant habituation and recognition memory. Child Development, 64, 57-79.

McCarthy, D. (1976). Manuel des échelles d'aptitudes pour enfants de McCarthy. Paris: Les Éditions du Centre de Psychologie appliquée.

McPhilips, M., & Sheehy, N. (2004). Prevalence of persistent primary reflexes and motor problems in children with reading difficulties. Dyslexia, 10, 316-338.

Metcalfe, J. S., McDowell, K., Chang, T-Y., & Chen, L-C. (2005). Developmental of somatosensory-motor integration: An event-related analysis of infant posture in the first year of independent walking. Developmental Psychobiology, 46(1), 19-35.

Molfese, V. J., & Acheson, S. (1997). Infant and preschool mental and verbal abilities: How are infant scores related to preschool scores? International Journal of Behavioral Development, 20(4), 595-607.

Moreau, J., & Graton, J. (1998). Client outcomes in child welfare: Client-based measures. In N. Trocmé (Ed.), Proceeding of the first canadian roundtable on child welfare outcomes (pp. 112-116). Toronto, ON: Bell Canada Child Welfare Research Unit.

Nelson, K. (1996). Language in cognitive development: The emergence of the mediated mind. Cambrigde, UK: Cambridge University Press.

O'Connor, M. J. (1980). A comparison of preterm and full-term infants on auditory discrimination at four months and on the Bayley Scales of Infant Development at eighteen months. Child Development, 51, 81-88.

Phan, T. T. (1987). Qualité métrologiques de l'Inventaire de développement et de maturité préscolaire de 2 à 5 ans. Mémoire de maîtrise inédit, Université du Québec à Montréal, Montréal.

Pomerleau, A., Leahey, L., & Malcuit, G. (1994). Évaluation du développement de l'enfant au cours de la première année: l'utilisation de regroupement d'items du Bayley. Revue Canadienne des Sciences du Comportement, 26, 85-103.

Ramey, C. T., & Ramey, S. L. (1998). Early intervention and early experience. American Psychologist, 53(2), 109-120.

Reynell, J. K. (1987). Reynell Developmental Language Scales. Windsor, UK: NFER Publishing.

Reznick, J. S., Corley, R., & Robinson, J. (1997). A longitudinal twin study of intelligence in second year. Monographs of the Society for Research in Child Development, 62(1), Serial No. 249.

Robinson, A. J., & Pascalis, O. (2004). Developmental of flexible visual recognition memory in human infants. Developmental Science, 7(5), 527-533.

Roid, G. (2003). Stanford-Binet Intelligence Scales (5th ed.). Montréal, QC: Institute of psychological research.

Shatz, M. (1994). A toddler's life. New York: Oxford University Press.

Siegel, L. S. (1989). A reconceptualization of prediction from infant test scores. In M. H. Bornstein & N. A. Krasnegor (Eds.), Stability and continuity in mental development. Behavioral and biological perspectives (pp. 89-103). Hillsdale, NJ: Erlbaum.

Slater, A. (1995). Individual differences in infancy and later IQ. Journal of Child Psychology and Psychiatry, 36(1), 69-112.

Sparrow, S., Balla, D., & Cicchetti, D. (1984). Vineland Adaptative Behavior Scales. Circle Pines, MN: American Guidance Service.

Spence, M. J., & Freeman, M. S. (1996). Newborn infants prefer the maternal low-pass filtered voice, but not the maternal whispered voice. Infant Behavior and Development, 19(2), 199-212.

Sroufe, L. A., Cooper, R. G., & DeHart, G. B. (1992). Child development. Its nature and course. Cornell: McGraw-Hill.

Terrisse, B., Andreani, P., & Boutin, G. (1983). Inventaire de développement et de maturité préscolaire. Montréal, QC : Université du Québec à Montréal.

Thelen, E., & Ulrich, B. D. (1991). Hidden skills. Monographs of the Society for Research in Child Development, 56 (Serial No. 223).

Thompson, L. A., Fagan, J. F., & Fulker, D. W. (1991). Longitudinal prediction of specific cognitive abilities from infant novelty preference. Child Development, 62, 530-538.

Thorndike, R. L., Hagen, E. P., & Sattler, J. M. (1986). Échelle d'intelligence Stanford-Binet (4^{ième} ed.). Guide d'administration et de dépouillement. Montréal, QC: Institut de recherches psychologiques.

Verreault, M. (2005). Programmes d'Activités de Lecture Interactive et développement cognitif de jeunes enfants: Mesures d'impact et comparaison d'échelles d'évaluation (Bayley et Stanford-Binet). Thèse de doctorat inédite, Université du Québec à Montréal, Montréal.

Vygotsky, L. S. (1962). Thought and language. Cambridge, MA: MIT Press.

Wachtel, R., Shapiro, B. K., Palmer, F. B., Allen, M. C., & Capute, A. J. (1994). A tool for pediatric evaluation of infants and young children with developmental delay. Clinical Pediatrics, 33, 410-415.

Wilson, S. L., & Cradock, M. (2004). Review: Accounting for prematurity in developmental assessment and use of age-adjusted scores. *Jounuû of Pediatrie Psycho/ogy*, 29(8), 641,649.