

## MEASUREMENT & EVIDENCE-BASED PRACTICE

### CLINICIAN'S CORNER

## When I Grow Up I Want to Be an NDT-Trained PT

### AN NDT COURSE TRANSFORMS A THERAPIST'S PRACTICE

By Jacy Bickham, MS, PT, NDT-Trained 2008

People always seem to ask children the same question: "What do you want to be when you grow up?" The most common answers are usually a doctor, a lawyer, or a teacher. The only answer I could ever come up with was that I wanted to help children with disabilities.

I eventually decided that one of the greatest ways to do that was to become the best pediatric physical therapist I could be. I went to PT school, got a great job, and began working. Little did I know I was missing the most important tool I needed to be truly effective in the lives of those children I grew up wanting to help.

### CONNECTING WITH NDT

When my supervisor approached me regarding enrolling in the Neuro-Development Treatment (NDT) course our clinic was planning to host, I admit my first thought was no. The course lasted eight months—one weekend a month and a period of *(continued on page 15)*

## The Good, the Bad, and the Ugly

### TEST SCORES IN THE BAYLEY SCALES OF INFANT AND TODDLER DEVELOPMENT

By Mary-Margaret Windsor, ScD, OTR/L

Okay, I confess—I wanted a catchy title to try to get you to read this article! I also confess that I *love* to use standardized tests (this includes reading the manual) that help me to evaluate and to understand my clients. I know that some clinicians don't like standardized tests and are intimidated by the manual and the psychometrics presented. However, reading and understanding this information is vital for professional use of the test. It also helps us to

measure change. I was using the wrong tool to try to demonstrate how a child had changed with therapy.

We now have entry-level doctoral degrees and evidence-based practice. I believe that advanced degrees and the mandate for using and producing evidence for what we do in the clinic bring a professional responsibility to clinicians to become experts in the use of standardized tests. However, there are

**One big test "a-hah" for me was that tests developed for diagnosis cannot be used to measure change. I was using the WRONG TOOL to try to demonstrate how a child had changed with therapy.**

make good test choices.

Many years ago as a doctoral student I was introduced to test development theory when reading the manual for the Gross Motor Scale. Who knew that tests were developed to perform three major purposes? They are: 1. Diagnosis/identification, which usually involves some kind of norm-referenced testing, 2. Evaluation of change, which usually involves measurement of a criterion or behavior, and 3. Prediction. One big test "a-hah" for me was that tests developed for diagnosis cannot be used to

many reasons that this doesn't happen. For instance, we don't understand the manuals and are embarrassed to admit it; we don't take the time (or aren't given the time) to adequately prepare to give new tests (this includes understanding the manual and practicing test items); and often we don't understand the purpose of a test and may find it unhelpful or misuse it.

It's easy to become overwhelmed with all the information available. Some suggestions that may help: attend *(continued on page 16)*

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# Turning Challenges into Opportunities in the New Year

I hope the holidays provided time for you to rest, relax, and enjoy friends. Here in Seattle we had snow—lots of snow—for almost two weeks. It was beautiful—if you were not among those trying to leave from the airport! But as difficult as it made travel, it filled our world with calm and silence that left the roads deserted and made walking delightful.

I think about all that snow as I contemplate 2009. The new year arrives with challenges to us both individually and as a nation—challenges that could cause anxiety, fear, and depression. However, just as with the snow, those challenges provide us with an opportunity to change and adapt. For me the slogan “Yes, we can” is both heartening and motivating; it can be applied to just about all aspects of life, including our plans for growing and expanding the services of NDTA.

NDTA enters this year with a need to continue developing the body of research related to our practice. It’s not by accident that the first issue of the *Network* for 2009 is devoted to measurement and is designed for clinicians interested in clinical research. This issue is, in effect, a useful handbook that covers a variety of topics related to measurement—it provides information about tests designed to measure change at all levels of the ablement/disablement model. I am planning to print my copy and keep it as a reference.

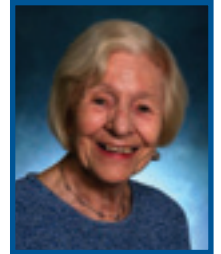
The strong response to the NDTA survey enquiring about interest in clinician/ academician partnerships for research was gratifying. It indicates that research is important to NDTA members and that they have a desire to share expertise in order to make good clinical research possible. I hope that we can develop a research community within NDT practice that combines clinical excellence with knowledge of research.

One of our challenges for 2009 is to increase services for the family/caregiver membership

category, which is part of our mission as an association. Family members and other caregivers, who are so vital to us in working with clients, could become strong advocates for NDT and for the association. We have an opportunity to increase interest in the parent/caregiver category of membership through *Network* articles contributed by family members and caregivers. By sharing their family experiences they not only help other families, but broaden therapists’ understanding of how therapy fits into the lives of clients and caregivers.

You can help us expand this category of membership. Suggest that your clients’ family members, partners, and other caregivers become members of NDTA. Suggest that they or their loved ones write about their experiences for our column in *Network*. Pass along to the NDTA office the names of any of your friends or clients who might be interested in expanding and developing this category of membership.

Thank you for your continued membership in 2009. Your financial and active support is vital to NDTA. I hope that by December of this year, we can look back together with pleasure at a year of progress towards meeting the challenges facing us. May 2009 create many opportunities for us to say, “Yes, we can!”



*Pamela A. Mullens*  
Pam Mullens, PhD, PT • President, NDTA, Inc.



2009

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★ FROM AN NDT PERSPECTIVE



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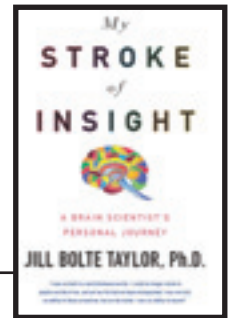
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# ILLUMINATING THE EXPERIENCE OF STROKE

## A FIRST PERSON ACCOUNT

A review of *My Stroke of Insight: A Brain Scientist's Personal Journey* by Jill Bolte Taylor, Ph.D., published by Viking, 2008. 183 pp.

By Marcia Stamer, PT



**QUESTION:** Would I be a more compassionate physical therapist if I could experience what my patient feels, or at least if I could empathize based on a desire to more fully understand that experience? I pondered the issue as I read *My Stroke of Insight: A Brain Scientist's Personal Journey*, by Jill Bolte Taylor, Ph.D.

Dr. Taylor was a neuroanatomist and researcher at Harvard who focused on severe mental illness (her choice in careers was influenced by her brother's schizophrenia). She was also a member of the Board of Directors of the National Alliance on Mental Illness. At age 37, she was winning awards, receiving grants for research, speaking nationally, and publishing.

But on December 10, 1996, she awoke with a severe headache centered in her left eye. Taylor describes in detail the morning of her stroke caused by a congenital arteriovenous malformation. She immediately noticed the silence of inner chatter—the self talk that all of us apparently do continuously, probably without conscious awareness. She then describes the deterioration of her speech, loss of sensation and perception, and a feeling that her body was a fluid rather than a solid. She describes her painfully arduous attempts to remember how to use a telephone and how to recognize and sequence numbers to call for help.

Although she struggled at first to survive the stroke and it took time to regain control of her life, Taylor is an optimist and in the book she emphasizes the positive outcomes of her stroke. She believes that the temporary loss of understanding language due to her damaged left cerebral hemisphere allowed her right hemisphere to express its unique abilities. She describes her terrible head pain and her desire to lie down and rest, or simply to let go of life while simultaneously feeling at peace and euphoric. “The energy of my spirit seemed to flow like a great whale gliding through a sea of silent euphoria.” (p. 67).

Taylor views her stroke as a blessing. She makes reference to the title of the book on page 133: “My stroke of insight is that at the core of my right hemisphere consciousness is a character that is directly connected to my feeling of deep inner peace.” She spends several

chapters advising her readers on paths they may wish to pursue to access the abilities of their own right hemisphere to find this peace.

### INCREASING THERAPISTS' UNDERSTANDING

Therapists may find that Taylor's descriptions of her reactions to sensory stimulation, the emergency room visit, medical students' visits and doctors' rounds, and her recovery and speech therapy hold additional insights for them as they strive to deepen their compassion for their patients. Taylor's descriptions of her sensitivities to light and sound, her awareness of her caregivers' body language that either engaged or frightened her (she could not understand their speech), and her feeling that her body was now a fluid rather than a solid are fascinating. However, they may leave the reader wanting more detail. For example, Taylor says that persistent requests made of her to understand and quickly respond to the verbal requests of professionals required “... the attention it takes to pay attention to someone who is speaking on a cell phone with a bad connection. You have to work so hard to hear what the person is saying...” (p. 76). More of such examples would have enriched Taylor's pleas for compassion and understanding of those who have suffered a stroke.

Therapists will feel empathy when reading Taylor's descriptions of the length of time it took for her to recover motor, speech, reading, and math skills. She responds to the oft-heard doctor's opinion that if abilities do not return within six months after the stroke, the patient won't get them back with a short statement: “Believe me, this is not true.” (p. 111). Many professionals who work closely in the rehabilitation of people with stroke would shout “Amen!” Taylor notes that it took her four years of walking with hand weights for three miles three times a week before her walking became smooth and rhythmical. And this is a person who was walking with assistance three days after her stroke.

### INCREASING PUBLIC AWARENESS

This book is clearly written for the general (continued on page 6)



*(Illuminating the Experience of Stroke continued from page 4)*

public, with the dual intent to increase public awareness of the symptoms of stroke and to describe Taylor's personal experience of the thoughts, feelings, losses, and recovery from her own stroke. She mentions inclusion of much of her information in other media sources—a PBS show, national magazines, National Public Radio, and the American Stroke Association. A quick Google of her name lists blogs, her own Website, videotapes for sale, and a You-Tube site for more.

The nagging concern with Taylor's book is that she talks about her recovery as complete (although she states it took her eight years). Are there no signs at all that she had a stroke? This is a risky statement to make and repeat, as she does several times in her book. She has every right to tell her story. But what does "complete" mean? Could her interpretation mislead those who cannot or do not return with all of their previous skills intact? Could patients and family members be left with guilt that they did not work hard enough?

Readers who are not familiar with the variability of severity of stroke, the effects of general health and age prior to stroke on outcome, the support system of the patient with stroke (Taylor's

mother moved in with her for several months and could devote herself full time to her care), and the variability of response to medical, surgical, and therapeutic treatment may be more vulnerable when comparing their loved one to Taylor. They may perhaps feel inadequate or guilty if they did not fare as well.

Taylor's book offers an astute first-person account that certainly educates the general public about stroke and portrays how one family managed. For physical therapists, the book also sheds light on how stroke truly feels from the inside and it may lead them to further inquiry about how others have perceived their experience. Many who have strokes will never be able to give voice to what happened to them. Professionals and families should feel grateful that those who can communicate, do so. Taylor's book is a big step in increasing our understanding. ■

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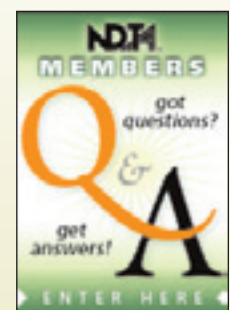
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# The NDT Difference

ACHIEVING NEW GOALS By Stephanie Cardenas

Just eight months ago my husband and I were presented with the opportunity for our daughter, Victoria, to participate in the NDT training course that was given by Jane Styer-Acevedo in Houston, Texas.

Victoria, whom we call “Tori,” was diagnosed with cerebral palsy at approximately three years of age, and has received physical and occupational therapy since she was four months old. My husband and I are always interested in providing her with the best and most beneficial therapies that are available. Naturally, when presented with the opportunity for Tori to participate in the NDT course, we jumped at the chance.

Although Tori is very interested in the daily happenings of her three siblings, communication is difficult, as she does not speak or use sign language. As a form of interacting, she expresses great interest in trying to stand and increase her mobility beyond crawling and tall-kneeling.

When Tori participated in the very first NDT demonstration eight months ago, she had only minimal control over her appendages. When she was asked to stand and given the cues to stand, she very closely resembled a cat being forced into a bath tub! (As her parents we were very familiar with this stance). By the end of this very first session with Jane, we could already see a difference in Tori’s mobility.

I’m not sure exactly what Jane did, I could see that when she placed her hands on Tori’s muscles, it almost seemed as though her hands became an extension of Tori’s muscles. Somehow that told Tori’s muscles exactly what they needed to do and when!

Something else happened in that first session. We could see that working with Jane had ignited a fire within our daughter—that certain spark that we had been hoping, waiting, and praying for. Something connected in Tori’s brain that made her more focused and more determined than we had ever witnessed. We were thrilled and looked forward to great progress during the next sessions.



**Above:** Tori on her seventh birthday. **Below:** The Cardenas family: Tori; her mother, Stephanie; her dad, Carlos; older brother, Andrew; younger brother, Hayden; and younger sister, Hannah



During the NDT course, Jane worked with Tori on tasks that other therapists had worked on; however, Jane’s instructions were different, both her verbal directions and those that she gave using her own body language. There was a connection between how Jane commanded Tori to do things and how Tori accepted her commands—and in turn performed the desired tasks.

After two or three months of NDT treatment, we noticed that when we placed Tori in a standing position, she actually initiated reciprocal movements with her legs without our guidance. She began helping us more with daily tasks, such as undressing at bath time. Before we knew it, she was even helping to lift her leg into the bath tub, using her arms to brace herself and lower her body into the bath tub.

What makes these tasks, or rather important milestones, even more amazing to us is that last April, Victoria celebrated her seventh birthday. By many text book standards pertaining to children with cerebral palsy, she had already passed the age of achieving such goals. Fortunately, we chose not to believe everything that text books publish and chose to believe that children with cerebral palsy are just like all children who very simply achieve milestones in their own time.

The NDT program proved to be a huge blessing, first and foremost for Victoria, but also our entire family. We will reap the benefits of Tori’s achievements for years to come. We are thrilled when we see her interacting not only with us, but also with her siblings. Neither my husband nor I are doctors or therapists, however we have witnessed first hand the benefits that Tori received as a participant in the NDT program. We are filled with excitement and can hardly wait to see what other goals Tori will achieve as a result of her participation. ■

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# In Search of Best Practices

## TESTS AND MEASUREMENTS IN AN NDT APPROACH

Janet M. Howle, PT, MACT

From the very beginning, best practice standards in an NDT approach have included informal, ongoing examinations as a way to identify the impact that treatment strategies have on various system impairments, ineffective posture and movement, and functional limitations.<sup>1,2</sup> These non-standardized, *self-referenced tests* also allow the clinician to collect and record information about changes (or lack of change) in a systematic and objective manner using the client as his or her own comparison.

However, in addition to informal testing, therapists now include objective measures for diagnostic, prognostic, and programmatic purposes. These measures serve as aids to differentiate immature or atypical behavior from typical behavior, assess the rate of progress, and verify the attainment of goals in a therapeutic program. Tests that assist with these purposes have a set of specific criteria and rules for administration and scoring. Including objective tests adds credibility to our treatment. *Norm-referenced tests* compare an individual's performance with the performance of peers who do not have a disability, using a standard format. *Criterion-referenced tests* are also standardized but designed to compare a client's performance to a predetermined behavioral criterion and report performance in terms of what the individual can do.

The following will briefly define the characteristics of these three types of tests and briefly describe what information can be gained from each one.

### TEST CHARACTERISTICS

**Self-referenced Test.** Self-reference testing is most familiar to clinical therapists and is easily incorporated into a treatment session. It provides a baseline measure for functional outcomes at a given time, organizes intervention, and serves as an aid to evaluating change, using the client's performance as the base of comparison.

For example, if the goal of the OT session is to increase dexterity and speed of manipulation, the therapist may record, at the beginning and end of a single treatment session, how long it takes for the client to unbutton his or her coat. A reduction in the time it takes for the same activity at the end of the treatment can show progress within the context of the intervention setting. Since this type of testing is non-standardized and criteria for administration are not consistent within or between therapists, comparisons can not be made between

clients or even with the same client in different settings.

Self-referenced testing is non-invasive, requires no special equipment, and takes little additional time because the targeted goal or anticipated outcome is part of the treatment. The client and the family as well as the therapist can participate in deciding whether the goals or outcomes have been met and whether they see progress toward the targeted goal. The use of self-referenced testing helps the clinician decide which strategies to continue and which to discard for the next treatment session. This informal testing is motivating to the client, family, and the therapist because it provides immediate feedback on the results of treatment and requires no special test interpretation. For example, the therapist can say, "See, you were able to unbutton your coat in less than 30 seconds at the end of today's treatment."

However, self-referenced tests do not provide data that directly compares outcome to intervention and they are not truly objective because the tester and the client have a vested interest in the outcome. Therapists must be cautious when interpreting findings based on self-referenced tests and recognize that the results can not be generalized to other clients or to other settings.

**Norm-referenced Tests:** Norm-referenced tests use a standard format to compare an individual's performance with the performance of peers who do not have disabilities. Norm-referenced tests have standards or reference points which represent average performances derived from a representative group. Standard deviations above or below the norm are used to describe how much an individual differs from the normative group. Examples include; Denver II, Milani-Comparetti Motor Development Screen Test, Alberta Infant Motor Scales (AIMS), the Bayley Scales of Infant Development-II, Test of Infant Motor Performance (TIMP) and the Bruininks-Oseretsky Test of Motor Proficiency-II.

Since norm-referenced tests are standardized on groups of individuals, they are used in the discrimination process to determine if a child's performance is typical of a child of a similar age. Norm-referenced tests are used when assessment is a means of determining the appropriate placement of a child in a special service because they allow the examiner to relate the child's performance to children with typical development. In *(continued on page 10)*

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addition, they are useful in following a child's development to determine if the child is catching up or falling behind a peer group over time. Because these tests are designed to compare performance to a group without disabilities, they are often not responsive to changes in children or adults with motor impairments and are not used for this purpose.

**Criterion-referenced tests:** Criterion-referenced tests compare a client's performance to a predetermined behavior criterion and report performance in terms of what the individual can do. Many of these tests have been designed specifically to evaluate skills in children or adults with physical disabilities and therefore are more responsive to changes over time than norm-referenced tests. On criterion-referenced tests, the child or adult is compared to him- or herself at different points in time rather than being compared to a normed group. These types of tests are useful for program evaluation and to track progress in individuals with disabilities. Criterion-referenced tests of function and disability gives the therapist knowledge of what the child can do and how that changes with (or without) intervention.

Examples of criterion-referenced tests are the Gross Motor Function Measure (GMFM), the Neonatal Behavioral Assessment Scale, Movement Assessment of Infants (MIA), Pediatric Evaluation of Disability Inventory (PEDI), Berg Balance Scale, Functional Reach, and the Sensory Profile for Adolescents/Adults.

#### **Psychometric properties of norm- and criterion-referenced tests:**

Both norm-referenced and criterion-referenced tests are standardized scales with acceptable psychometric properties of reliability, validity, accuracy, and sensitivity and specificity.<sup>3-5</sup>

1. **Reliability** refers to the consistency between measures in a series. Types of test reliability include inter-rater, intra-rater and test-retest reliability.
2. **Validity** is the extent to which a test measures what it claims to measure. Three types of validity are used to assess the viability of a test.
  - a. **Construct validity** examines the theory underlying the test.
  - b. **Content validity** examines how well the content of the test samples the behaviors about which the conclusions are to be drawn.
  - c. **Criterion validity** is measured by examining concurrent validity and predictive validity.
    - **Concurrent validity** represents the relationship of the

performance on the test with performance on another well-reputed test.

- **Predictive validity** examines the relationship of the test to some actual behavior of which the test is supposed to be predictive.

3. **Accuracy** refers to the ability of a test to provide either positive or negative predictive validity.

- a. **Sensitivity** indicates the responsiveness of a measurement to detect dysfunction or abnormality.
- b. **Specificity** indicates the responsiveness of a measurement to detect normality.

NDT therapists use self-referenced tests in conjunction with appropriate norm- and criterion-referenced measures to demonstrate the degree to which change has occurred in response to intervention or to non-intervention. We need to carefully select standardized and non-standardized measures to accurately document the effects of our NDT interventions, including tests with sound measurement properties that are sensitive and specific to changes in clinical status. This adds validity to clinical reports, documents effective intervention, objectifies changes in performance, and supports best practice standards in an NDT framework. ■

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# Objective Tools to Measure Treatment

## A REVIEW OF STANDARDIZED TESTS

By Jodi Renard, PT, NDTA Instructor-Candidate

**P**hysicians and third party payers want numbers and objective findings to justify treatment and reimbursement. Standardized testing can serve as a means of communicating those findings as well as a way to meet the demands of evidence-based practice for the therapy professions.

The challenge—and responsibility—for therapists in clinical practice is to research the available standardized testing for their clients, whether adults or children. It is of even greater importance to research the validity and appropriateness of each test before its use. For example, has the test been assessed and confirmed for the specific diagnosis? Is there an age range for which it is no longer valid?

The demand for evidence-based practice continues to grow within the therapy profession. Because NDT treatment techniques are individualized to the patient's impairments and abilities, the need is great to demonstrate that the approach and treatment techniques not only deliver functional gains, but change the lives of clients. Therapists are challenged to document objective findings and gains as patients with neurological impairments are assessed.

Countless standardized tests are available to assess our patients so it is important to first decide on the focus of the assessment, such as balance, functional reach, motor control of extremities, gait parameters, and/or participation in home and community activities. A test can aid in documenting progress with each functional goal pertaining to one of these areas. When choosing a test, it is important that the goal does not become an improved test score, but improvement of function and life. The therapist must determine the measure that is most effective for each client.

### USING THE LEVELS OF THE ICF

The International Classification of Functioning, Disability, and Health (ICF) provides a conceptual framework that can help to classify the outcome level most appropriate to demonstrate change. There are several levels of classification by ICF: body function/structure, activity, and participation.

#### Body Function/Structure

Under body function/structure, a test could be used to measure impairments. For example, the Clock Drawing Test looks at constructional apraxia, executive functioning and visual/spatial deficits; the Mini Mental Exam looks at cognition; and the Modified Ashworth Scale measures muscle tone or resistance. The Fugl-

Meyer Assessment, which measures sensorimotor impairments, has been widely used and is a valid scale, offering the ability to quantify motor control. It can be used as an outcomes measure across the continuum of care for stroke-specific patients. The Fugl-Meyer is also an appropriate alternative to Manual Muscle Testing for neurologically impaired clients.

#### Activity

The therapist must identify the specific function before looking for outcomes of an activity to determine functional limitations. For upper extremity function and dexterity, research studies have often used the Action Research Arm Test and/or the Wolf Motor Function Test. Both of these tests are longer and more complex tests which make them less applicable to a clinical setting.

The Action Research Arm Test has been found to be reliable and valid. However, it has also been noted to be limited by floor and ceiling effects and inaccurate measurement at the end ranges. This standardized test requires specific equipment that may make it less feasible to clinicians.

The Wolf Motor Function Test has been found useful, with high reliability for characterizing the motor status of chronic patients who have had a stroke and brain injury. Again, this test requires specific equipment and a template. Because several modified tests have been developed for the Wolf test, therapists must be aware which one they are using. Box and Blocks determines manual dexterity against norms and is commonly used but has not been fully researched specifically for the stroke population.

The Berg Balance Scale is an assessment of balance in older adults, but research has also supported its use with stroke patients. It is an easy test to clinically manage with high reliability and validity. However, it is not sensitive to small balance improvements and has been shown to have a ceiling effect. Although it is widely used in research and clinics, the interpretation of scoring for fall risk seems to be variable dependent on the study. A study by Harris et. al. reported that caution was needed when applying Berg categorization to patients with chronic strokes because no difference was seen in the Berg total scores in subjects that were at low versus high risk for falls. Generally, a score that is lower than 45/56 is considered fall risk.

The Dynamic Gait Index is a scale used to assess the ability to modify gait in stroke patients. There is stated high reliability and validity, and it is a short and feasible outcome measure to *(continued on page 12)*



*(Objective Tools to Measure Treatment continued from page 11)*

use clinically. Scores lower than 19/24 are predictive of falls in older adults. Another measure of gait which is widely used is timed walking tests. The 10 Meter Walk Test is easy to administer and velocity of gait may become a prognostic indicator of function after stroke. The 6-Minute Walk Test measures overall mobility and endurance. All three tests give important information regarding function but have some limitations in predicting the ability to become a community ambulator. However, these measures are widely used and clinically applicable.

### Participation

The final level of standardized testing is the measurement of participation in the ICF framework. The Stroke Impact Scale is commonly utilized in research and in outpatient, home health, and skilled nursing facilities to gather the perspective from the patient or caregiver regarding the patient's disability. It covers the areas of strength, hand function, mobility, ADLs and IADLs, emotions, memory, communication, and social participation. This is not the only measure of participation available, but it is easy to administer and allows for a proxy or caregiver to complete the survey.

At this time, my clinic has not found a way to benchmark the scores against other patients nationally but is working to utilize the information gathered clinically. Medical Outcomes Study Short Form-36 is a tool to assess quality of life; however it has a high ceiling effect, in which the client's abilities are too high to detect a change on the scoring, and a floor effect, in which the abilities of a highly involved or impaired client cannot be measured due to his or her inability to perform the easiest item on the measure.

### CONSIDERING PSYCHOMETRIC PROPERTIES

When reading research studies, it is often faster and easier to read the abstract rather than looking carefully at why the researchers selected the measurements they did and how those measures selected impact findings and conclusions of the study. But in order to transfer research information into responsible clinical practice, clinicians must understand the psychometric properties of the tests and measures used. Croarkin (2004) states, "...although tests may not meet all of the standards..., test users incur the responsibility of knowing the limitations of measurements and making logical arguments to support their test selection."

Let's review the important psychometric properties of tests that clinicians must understand when making educated conclusions about their use in research studies and daily clinical practice. We will focus on reliability, validity, and sensitivity to change.

**Reliability** is described as the degree to which the test would report the same results in repeated trials, including inter-rater and intra-rater. It can be thought of as a consistency in measurement. It is often

noted using a reliability coefficient ( $r$ ). An  $r$  of .9 is best practice for test acceptance. The Fugl-Meyer Assessment, 9 Hole Peg test, Berg Balance Scale and Dynamic Gait Index are some of the outcome measures that show high reliability. Other terms used to demonstrate reliability are measurements of reproducibility and internal consistency.

- **Reproducibility** provides the extent to which the score of the test would be free from random error.
- **Internal consistency** determines that all questions or items on a test would assess the same construct, such as impairment, skill, or quality.

**Validity** is important as a criterion for outcome measures. There are several types of validity to consider:

- **Content validity** reports that the instrument accurately measures what it intends to measure. An example is whether the Berg Balance items test balance appropriately or whether the Fugl-Meyer measures the neurological change in upper extremity or lower extremity movement precisely.
- **Internal validity** reports the precision with which the study was conducted. Specifically, a sample selected for the study, procedure.
- **External validity** determines to what extent the results of a study can be generalized and it is particularly important when choosing a test to determine if the client is included in the appropriate population to which the study pertained. For example, when a test is studied with a population of patients who have had a CVA with hemiplegia, does the study show that the evidence can be used and generalized appropriately for all patients that have sustained a neurological hemiplegia from a traumatic brain injury or brain tumor?
- **Convergent validity** reports the general agreement among different measurements, theoretically measuring related constructs.
- **Predictive validity** is the ability to predict the future level of performance based on the specific score. This is very beneficial, especially in terms of goal writing and the determination of a plan of care. Interpretation of predictability is important: it has been shown that timed walking tests can not predict community ambulation as a stand-alone entity. (Lord 2005)

**Sensitivity to change** is the final psychometric that is important when choosing an outcome measure. It is also called responsiveness. This is a measure that, according to Patrick and Chiang, detects minimally important clinical changes through *(continued on page 13)*

(Objective Tools to Measure Treatment continued from page 12)

the description of the items on the test. This is an extremely important concept for us in NDT. Many of the standardized tests do not have items on them that can detect small increments of change, and so when we administer these tests, they “show” that no changes have occurred. Then researchers conclude that therapy was not effective.

As previously noted, measurements in many tests are impossible because of a floor effect (the client is unable to perform the easiest item on the measure). These include the Barthel Index, Action Research Arm Test, and 9 Hole Peg Test. In the same respect, the ceiling effect in many tests makes it difficult to score a client whose abilities are too high to detect a change on the scoring. Assessments with a ceiling effect include Berg Balance Scale Test, Barthel Index, Action Research Arm Test, and the Functional Ambulation Categories.

Therapists must become familiar with available objective tools that are appropriate for our individual clients. Some outcome measures are still difficult to locate due to the lack of use in the clinical setting versus the use in research. Along the continuum of care, not all tests will be appropriate or clinically feasible. This is where clinical judgment and evidence-based practice are imperative.

This article is far from being inclusive of all the available standardized testing. Therefore, all clinicians must individually seek outcome measures that are appropriate for their clinical setting and their population of patients and that have researched psychometric properties. ■

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*(When I grow up... continued from page 1)*

two weeks straight. I did not have time for that in my schedule. Fortunately for me, my manager had and continues to develop an incredible passion and belief in NDT. I will always be grateful to her for her push to bring this course to my awareness, and for encouraging me to be involved.

At the beginning of the course on March 28, 2008, I experienced a mix of feelings. I was intimidated. I wondered if this course would really be beneficial to my practice or if I would even enjoy it. But as the months went by, I found myself amazed. Looking back, I don't think I could have prepared myself for the transformation, both professional and personal, that occurred in my life.

We began with a focus on the typical and atypical development of children, and from that first weekend on I found myself absorbing every word spoken, every lab completed. I knew I would be a different therapist by the time October came.

### **BUILDING AN NDT FOUNDATION**

During the course, I felt that I wasn't just learning some "extra information" that would assist me in my treatment sessions, but that I was building a foundation on which to stand as a therapist. The course gave me the tools to thoroughly evaluate my clients, looking not only at their limitations but at their abilities. It gave me the skills to effectively evaluate a client's posture and movement behaviors that directly impact a functional outcome and to assess system-specific impairments. I gained the knowledge to establish functional treatment goals and treatment strategies for my clients. I learned and will continue to develop therapeutic handling/facilitation techniques that allow amazing progress to be achieved by my clients, affecting their life in the present and for years to come.

The NDT course included both classroom and lab. Whether practicing techniques on classmates or completing treatment sessions with patients, we were constantly challenging and putting our handling skills and treatment plans to the test.

### **AN EPIPHANY IN THE LAB**

One moment in the lab that I will always remember was while I was treating a young girl with cerebral palsy. We were working on her transition from sit to stand. Our instructor had told us to always expect more from a client. I kept that in mind as I wrote up this young girl's treatment session plan. I had not seen her complete the transition from sit to stand in my evaluations, so my aim was high for this session.

We had been working for a while and I had used all the facilitation techniques and ideas I could come up with. My instructor gave me some helpful advice: "Lighten up your hands and wait for her to

respond. Let her own it!" We tried again and as we began the transition, I guided her movement with my facilitation, gave her time to respond, and there it was. She moved from sit to stand and she owned it!

That day I understood that not only should we expect more from our clients, but also that our clients should expect more from us. The tools that I developed through the NDT course have made me a stronger therapist. I am more confident in my ability to treat children with disabilities because I am confident in the foundation upon which I stand. This is my way of living up to my clients' expectations.

October 6, 2008, the day I became an NDT-trained therapist, will always be a special day for me. The questions and doubts I started with were answered. I am so thankful for the ways in which this course challenged me. The intimidation I started with has been met head-on with confidence. I now know that this was not only beneficial to my practice, but vital. I feel honored to have had the opportunity to participate.

So to answer that old question "What do you want to be when you grow up?" My answer now is, "I can't imagine being anything else but an NDT-trained physical therapist." ■

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training for the test's administration and interpretation; find a mentor who is experienced with tests and measurements; read about standardized tests and measurements and/or form a discussion/study group with other therapists using the measurement.

This article will review information about standard scores. I will discuss the standardized test scores provided by the Bayley Scales of Infant and Toddler Development, 3<sup>rd</sup> edition (Bayley-III). This is an important standardized assessment that has become the gold standard in the United States.

The Bayley assessment can help early identification of the child who shows difficulties or delays in specific areas of development by comparing him or her to other children within the same age group (Composite Scores, Scaled Scores, Percentile Ranks). It can compare differences between various skill areas, e.g., Gross Motor to Fine Motor, Expressive Language to Fine Motor, etc. (Discrepancy Comparisons) and help to determine if the difference has clinical meaning. It can also chart the skill development of a child with special needs over a period of time (Growth Scores); in the past, this has been problematic because the child was compared to a typical age group rather than to himself or herself.

are caregiver questionnaires: Social-Emotional (developed by Stanley Greenspan) and Adaptive Behavior (derived from the Adaptive Behavior Assessment System 2<sup>nd</sup> edition by Harrison and Oakland).

In my view, the survey format greatly strengthens the evaluation of young children, particularly those with special needs. As so eloquently argued by authors in *New Visions for the Developmental Assessment of Infants and Young Children*, we need ecological and meaningful contexts to truly appreciate the capability, knowledge, understanding, and resourcefulness of the young child. What better way than to ask caregivers questions about the child's behavior and skills within the child's familiar, meaningful environment? Social and emotional areas are familiar concerns to most therapists. The "adaptive behavior" questionnaire provides additional dimensions of capabilities and performance in daily life, which include communication (i.e., listening and nonverbal communication), functional pre-academics, self-direction, leisure, social (i.e., manners, awareness of others and their emotions), community use, home living, health and safety, self-care, and motor (locomotion and object manipulation).

There is a plethora of scores, four of which are norm referenced. A word to the wise: you need not include *all* available scores when

## Age- and Grade-Equivalent Scores are GROSSLY MISUSED and WIDELY MISUNDERSTOOD. In my opinion, they should never be used to explain test results.

Some of you may be familiar with the EPICure Studies that have been examining the survival rates and later health status of preterm infants (less than 26 weeks) born in the United Kingdom and Ireland. One cohort has been followed since 1995. The Bayley Scales are the measurement standard for these studies. Better understanding of developmental needs across the age span will result in better treatment in the present and better anticipation/preparation for treatment in the future.

### UNDERSTANDING THE BAYLEY-III

The Bayley-III is an individually administered assessment of developmental functions. It is not an intelligence test—it does not predict achievement. Its use is not appropriate for children with severe physical or sensory impairments, and it does not identify the cause of a delay. The age range is 1 to 42 months. In 2006 it was updated but has maintained the basic qualities of the previous Bayley Scales. There are five scales. The first three, Cognitive, Language, and Motor scales, are performance based (the examiner observes behavior/sometimes parent report is accepted). The remaining two

writing a report. Test scores are merely additional "data points" that help the professional to understand behavior and to measure its change. The raw score is only meaningful for computing the standard scores. Test scores should reflect the purpose of evaluation and the test report reader or audience. They should never be viewed in isolation; interpretation should always include the therapist's clinical understanding and parent/caregiver report. Use professional reasoning to choose the appropriate test score(s) to report.

The following test scores are available on the Bayley-III:

#### I. Raw Score:

- For performance-based Bayley subtests: total number of credited items (i.e., 1 point) summed with the number of non-administered items preceding the basal.
- For the Bayley questionnaires: sum of behavior frequencies. A sensory processing scale is calculated by summing behavior frequencies for Items 1-8.

Raw scores are used to calculate standard (continued on page 17)

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(norm referenced) scores from tables in the test manual. Briefly, scores of well developed tests (why you need to read the psychometrics in the manual) are expected to follow a “normal probability distribution” (known to most of us as a bell curve). Using mathematical procedures, standard scores are computed from raw scores. The use of standard or derived scores allows different test scores to be compared. They also provide a better, more objective understanding of the individual’s performance by comparing it to that of a representative sample of children of the same age. The raw score alone is not helpful in test interpretation and is seldom reported.

- 2. Scaled Scores:** These are norm-referenced scores calculated from subtest raw scores (the child’s score is compared to those of other children with the same age). For the Bayley-III subtests, the range is 1-19, the mean is 10, and the standard deviation is 3. Subtest results are interpreted using scaled scores. A typical child would achieve a scaled score between 8-12 in any skill area. Anything below suggests risk or deficit and should be further investigated.
- 3. Composite Scores:** These are derived from the sums of various subtest scaled scores. They are calculated in the Bayley-III Scales for Language (receptive and expressive), Motor (fine and gross), and Adaptive Behavior (communication, community use, functional pre-academics, home living, health and safety, leisure, self-care, self-direction, social, motor). The mean is 100, the standard deviation is 15, and the range is 40 to 160. Composite scores are also calculated on the Cognitive Scale and the Social-Emotional Scale to allow comparison of the child’s performance across the five Bayley-III Scales. A typical child would achieve a Composite Score between 85 and 115. Anything below suggests risk or deficit and should be further investigated.
- 4. Confidence Interval:** This describes the range in which the child’s true score is most likely to fall. The raw or observed score is comprised of the child’s true score and error (influences that might inflate or reduce the true score, such as poor test conditions, illness, etc.). Confidence intervals provide a range (to be 95% confident the range would be  $\pm 2$  standard errors of measurement) in which the true score lies. The Bayley-III provides 90% and 95% confidence intervals for all composite scores.

Using confidence levels can be very helpful when advocating for a child whose observed score falls outside but close to the cut-off score for a program or service. If the cut-off score can be shown to fall within a range that includes the child’s “true score” there

may be justification for including the child in a special program.

- 5. Percentile Ranks:** For the Bayley-III the range is 1-99; the mean and median are 50. This is a rank score that shows the child’s relative position/order compared to children in the standardized sample. Usually, a percentile rank below 10 suggests risk or deficit and should be further investigated.

Percentile Ranks are easily understood and often used to interpret test results. Care must be given not to confuse percentiles with percentage-correct scores, e.g., 50% would mean only one half of the test items were correct.

- 6. Developmental Age Equivalents:** This score represents the average (mean) score achieved for a specific age group. They are available for the Cognitive, Receptive Communication, Expressive Communication, Fine Motor, and Gross Motor subtests. The term is misleading because it is not really “equivalent” to a specific age group; as stated, it is merely the typical score achieved by that age group. Without getting too technical or invoking test hubris, I will just say that Developmental Age Equivalents do not control for “variance,” a statistical term that describes variability within a sample or individual. (For example a 15-year-old person with a mental age of five years is very different from the typically developing five-year-old.) Age- and Grade-Equivalent Scores are grossly misused and widely misunderstood. In my opinion, they should never be used to explain test results.

- 7. Discrepancy Comparisons:** The Bayley-III allows comparisons between Cognitive, Receptive Communication, Expressive Communication, Fine Motor, Gross Motor, and Social-Emotional scaled scores. To determine if the difference between two scores is meaningful, two factors must be considered: 1) Is the difference significant statistically (the difference does not occur through chance), and 2) What is the base rate (frequency) of the difference within the norming group. The base rate reflects clinical significance: a difference in scores can be statistically significant but not clinically meaningful. A difference is usually considered clinically significant only when it occurs in less than 10% of the reference group. This is a more advanced level of test interpretation, and the clinician may seek mentorship or guidance to better understand these concepts.

- 8. Growth Scores:** The raw score of each Bayley-III subtest have been “mapped” to corresponding Growth Scores. The mathematical procedure is called Item Response Theory (IRT); through scaling and other processes an *(continued on page 18)*



*(The Good, the Bad, and the Ugly continued from page 17)*

equal-interval scale is developed that can measure change over time. Bayley-III Growth Scores have a mean of 500 and a standard deviation of 100. Unlike the previously discussed standard scores that compare the child's performance to that of a normative group, these scores allow comparison of the child's performance to himself or herself at different time intervals (usually around 6 months).

Growth Scores are very important for children who may never perform within the average range for their age group. Just because a child has a special need (e.g. neuromotor disorder or Down Syndrome) does not mean that functions do not change. Growth scores allow measurement of change for the individual. There should be at least three data points (or more) for determining developmental patterns. They can direct intervention planning, contribute to treatment efficacy, and provide greater understanding of the individual.

The relevance of the above "ivory tower babble" might get lost in everyday clinical demands. However, this information should be a helpful reminder to encourage therapists to choose and use standardized tests effectively and with confidence. It's a pleasure to share information with colleagues as we continue to support each

other to perform best practices. We are all sometimes "baffled by the babble" of standardized assessment; I hope this information will stimulate more discussion, study, and training. ■

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# Finding the Ideal Versatile Toy

## CREATIVE USES OF THE BABY BARBELL™

By Vickie Dakin, PT

I am a pediatric physical therapist currently working in home health and with the Florida Early Steps program. As you know, when therapists travel from house to house, one of the challenges is to carry all the equipment, toys, etc. needed for treatment. To prevent my “bag of tricks” from becoming a health risk for me and my back, I like to carry things that I can use with a wide variety of babies and toddlers. The ideal toy must be versatile enough to use with many children, easily cleanable, and lightweight. I have been using one product for a while now that meets all three requirements: the Baby Barbell by Magical Innovations.



One of the children I treat is an 18-month-old boy with Down syndrome. As we often see with Down syndrome, his trunk has low tone and his core strength is decreased. I love to use a therapy ball with many types of children but especially with those with low tone. This little guy holds on to any external support—whether it’s me or his legs or the ball—instead of sitting up straight as I want him to.

My solution is to give him a Baby Barbell in each hand. He begins shaking and banging the rattles together and he soon forgets about holding on. We accomplish so much more this way. While he is on the ball, I also encourage him to reach in all planes. Because the rattle is easy to grasp, it makes reaching activities much easier. With him, we also use it for transferring objects.

Many of the children I treat have problems with indwelling thumbs. I like using Benik splints at night to keep their thumbs out of their palms. During the day, an alternative is the Baby Barbell. You can position the thumb over the handle and the thumb stays out of the palm. The baby can then bring the rattle up to his or her mouth for calming and oral stimulation. The barbell is much easier to clean than the Benik splint, so mouthing is no problem.

In one unusual case, I was working with an eight-month-old boy with severe



involvement and a diagnosis of hydrocephalus. When he was sitting supported in an infant carrier, he maintained his elbows in complete flexion with both hands fistled and with indwelling thumbs bilaterally. He was very irritable and disliked being handled. In an attempt to get him to relax, I placed a Baby Barbell in each hand. His mother, the early interventionist, and I watched in amazement as his arms relaxed and his elbows straightened as far as they could and he calmed. His mother reported it was the first time she had seen him let go and just relax like that. Sometimes a small thing can make a big difference.

Of course the most common way to use the Baby Barbell is *(continued on page 20)*

*(Ideal Toy continued from page 19)*

with infants from birth to walking age. I like to position a baby on my thighs with my knees bent and place a Baby Barbell in one hand. If the child has a hard time holding the rattle, support the wrist and gently shake the rattle. Once the child is holding it well, support at the elbow and assist the baby to get the rattle to his mouth. Once there, gently place it on his lips and wait for a reaction. In supported sidelying, place the rattle in the “top” hand and wait. Assist the baby to move the rattle if he or she has difficulty.

For tummy time, the rattle can be held, but it is awkward. I tend to use the rattle to get the baby to look up or track the rattle from side to side or up and down. The barbell works well as a distraction in tummy time, a reaching and grasping activity in sidelying, and in a great variety of ways in sitting and supported sitting. I like the way a baby’s little hands can wrap around the handle and the fact

that the rattle is lightweight makes maneuvering it easier than a conventional rattle.

As a therapist who sees many babies in the same day, being able to quickly clean a toy is very important. The Baby Barbell is easy to clean and can even be thrown in the top rack of the dishwasher at the end of the day.

*Vickie Dakin is a PT at Magical Innovations, Inc. in Tampa, Florida. She has been trained in the NDT/Bobath 8 Week Certificate Course in the Management and Treatment of Children with Cerebral Palsy and the NDT Advanced Baby Course.*

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