## Outcome Domain:

Language and Communication

### Domain Description and Relevance in TBI:

“Deficits in language comprehension and expression and in speech articulation are common after TBI. Measures of language use in context (pragmatics) are particularly sensitive to TBI effects.” - McCauley et al. 2012

Table 1 CDE Classification by Type of TBI Study and Relevant Population for Recommended Language and Communication Outcome Measures.

| Outcome Measure Name | Relevant TBI Population | Acute Hospitalized | Moderate/ Severe Rehabilitation | Concussion/ Mild TBI | Epidemiology |
| --- | --- | --- | --- | --- | --- |
| Bedside Western Aphasia Battery - Revised | Adult  | Supplemental | Supplemental | Supplemental | Supplemental |
| Caregiver Unintelligible Speech Rating  | Pediatric  | Supplemental | Supplemental | Supplemental | Supplemental |
| Clinical Evaluation of Language Fundamentals (CELF-4)  | Pediatric  | Supplemental | Supplemental | Supplemental | Supplemental |
| Comprehensive Assessment of Spoken Language (CASL)  | Pediatric  | Supplemental | Supplemental | Supplemental | Supplemental |
| Goldman-Fristoe Test of Articulation  | Pediatric  | Supplemental | Supplemental | Supplemental | Supplemental |
| Language Sample  | Pediatric  | Supplemental | Supplemental | Supplemental | Supplemental |
| National Adult Reading Test | Adult TBI | Supplemental | Supplemental | Supplemental | Supplemental |
| Peabody Picture Vocabulary Test, 4th Edition (PPVT-4) | Pediatric  | Supplemental | Supplemental | Supplemental | Supplemental |
| Percentage of Consonants Correct-Revised (PCC) | Pediatric  | Supplemental | Supplemental | Supplemental | Supplemental |
| Test of Language Competence-Expanded (TLCE) | Pediatric  | Supplemental | Supplemental | Supplemental | Supplemental |
| Verbal Motor Production Assessment for Children (VMPAC) | Pediatric  | Supplemental | Supplemental | Supplemental | Supplemental |
| Wechsler Abbreviated Scale of Intelligence (WASI II) - Vocabulary subtest  | Pediatric  | Basic | Basic | Basic  | Supplemental |
| Wechsler Test of Adult Reading | Adult  | Supplemental | Supplemental | Supplemental | Supplemental |

## References

McCauley SR, Wilde EA, Anderson VA, Bedell G, Beers SR, Campbell TF, Chapman SB, Ewing-Cobbs L, Gerring JP, Gioia GA, Levin HS, Michaud LJ, Prasad MR, Swaine BR, Turkstra LS, Wade SL, Yeates KO. Recommendations for the Use of Common Outcome Measures in Pediatric Traumatic Brain Injury Research. J Neurotrauma. 2012 March; 29: 678-705. PubMed PMID: 21644810.

Bedside Western Aphasia Battery – Revised

### DESCRIPTION

This is a shortened version of the Western Aphasia Battery—Revised, designed to be administered at a patient’s bedside. The battery measures linguistics skills to assess for the presence of aphasia, and certain nonlinguistic skills, such as drawing, calculation, block design, and praxis. The results of the battery provide diagnostic information as to the types of aphasia the participant/subject may have.

### PERMISSIBLE VALUES

The test provides a number of criterion cut scores

### PROCEDURE

Trained examiners should administer. The battery can be administered in 15 minutes.

### COMMENTS

Ages 18 to 89 years.

### RATIONALE

A measure of basic language included in the CDE recommendations to test for the presence of aphasia. The results of such a test can help determine whether other outcome measures that rely on language tasks are valid and interpretable for the individual patient. Can be completed in 15 minutes.

### REFERENCES

Kertesz, A. (2006). Western aphasia battery revised. San Antonio, TX: Harcourt Assessment. Caregiver Unintelligible Speech Rating

### DESCRIPTION

This measure consists of 8 questions that assess a child’s speech intelligibility in spontaneous speech throughparent/caregiver rating.

### PERMISSIBLE VALUES

The parent/ caregiver is asked eight questions. Questions 1 – 6 are scored from 5 – 1 (5=Always – 1=Never); Question 7 is scored from 4 -1 (4=All or almost all – 1=Less than half); Question 8 is scored from 5 to 1 (5=Greatly Improved – 1=Not Improved).

### PROCEDURES

The child's parent/ caregiver answers 8 questions regarding the speech of their child.

### COMMENTS

This test is most appropriate for children under 60 months of age.

### RATIONALE

The test “has been shown to have high sensitivity and specificity for identifying children with speech delay/disorder.” – McCauley et al. 2012

**REFERENCES**

Campbell, T. (1998). Measurement of Functional Outcome in Preschool Children with Neurogenic Communication Disorder. Seminars in Speech and Language (19)3, 223- 233.

Coplan, J., and Gleason, J. (1988). Unclear speech: recognition and significance of unintelligible speech in preschool children. Pediatrics 82, 447-452.

Clinical Evaluation of Language Fundamentals (CELF-4)

### DESCRIPTION

The CELF-4 measures language performance both in school and at home. The CELF-4 is comprised of 19 subtests and includes composite scores for Core Language, Receptive Language, Expressive Language, Language Structure, Language Content, Language Memory and Working Memory. The CELF-4 assessment process model includes four levels:

* Level 1: Identify whether or not there is a language disorder
* Level 2: Describe the nature of the disorder
* Level 3: Evaluate underlying clinical behaviors
* Level 4: Evaluate language and communication in context

### PERMISSIBLE VALUES

The CELF-4 provides standardized scores for receptive language, expressive language, and total language (mean = 100, standard deviation = 15).

### PROCEDURES

Examiners should have training in administration, scoring, and interpretation of clinical instruments. Administration time is 30-60 minutes.

### COMMENTS

This test is for ages 5-21.

### RATIONALE

“As the CELF-4 is available in a Spanish translation, it was included as an alternative to the CASL when norms for Spanish-speaking children and adolescents are needed.” – McCauley et al. 2012

### REFERENCES

Semel, W., Wiig, E., and Secord, W. (2003). Clinical Evaluation of Language Fundamentals (Fourth ed.). Pearson Assessments: San Antonio, TX.

Hanten, G., Xiaoqi, L., Newsome, M., Swank, P., Chapman, S., Dennis, M., and al., e. (2009). Oral reading and expressive language after childhood traumatic brain injury: Trajectory and correlates of change over time. Top Lang Disord 29(3), 236-248.

PsychCorp/Pearson/Pearson Education, Inc. CELF-4 – Technical Report. Retrieved on July 10, 2012 from [Pearson Assessments Website Homepage](http://www.pearsonassessments.com/NR/.../CELF_4_Tech_Report.pdf)

Wiig, E., Secord, W., and Semel, W. (2005). Clinical Evaluation of Language Fundamentals (Spanish ed.). Pearson Assessments: San Antonio, TX.

Taylor, H., Swartwout, M., Yeates, K., Walz, N., Stancin, T., and Wade, S. (2008). Traumatic brain injury in young children: postacute effects on cognitive and school readiness skills. J Int Neuropsychol Soc 14(5), 734-745.

Comprehensive Assessment of Spoken Language (CASL)

### DESCRIPTION

The CASL provides an oral language assessment for individuals ages 3 through 21. The battery includes 15 tests to measure language processing skills (comprehension, expression and retrieval) in four language structure categories (Lexical/Semantic, Syntactic, Superlinguistic, and Pragmatic. Each test has been classified by the authors as either Core or Supplementary; the core tests provide a global language composite and the supplementary tests provide additional information and index scores. A verbal or non-verbal response is required; however, reading or writing ability is not needed to complete this measure.

### PERMISSIBLE VALUES

Age-based and grade-based standard scores are provided with mean = 100 and standard deviation = 15. Grade and test-age equivalents, percentiles, normal curve equivalents (NCEs), and stanines are also given.

### PROCEDURES

The test is individually administered. The core battery takes 30-45 minutes.

### COMMENTS

The appropriate population for use is children age 3 through young adults age 21. Scoring software is available.

### RATIONALE

“The CASL was selected as a comprehensive measure of language function and has been used in studies of pediatric TBI.” – McCauley et al. 2012

**REFERENCES**

Carrow-Woolfolk, E. (1999). Comprehensive Assessment of Spoken Language. American Guidance Service, Inc: Circle Pines, MN.

Taylor, H., Swartwout, M., Yeates, K., Walz, N., Stancin, T., and Wade, S. (2008). Traumatic brain injury in young children: postacute effects on cognitive and school readiness skills. J Int Neuropsychol Soc 14(5), 734-745.

Turkstra, L., Williams, W., Tonks, J., and Frampton, I. (2008). Measuring social cognition in adolescents: Implications for students with TBI returning to school. NeuroRehabilitation 23(6), 501-509.

PsychCorp/Pearson/Pearson Education, Inc. Comprehensive Assessment of Spoken Language. Retrieved on July 10, 2012, from [Comprehensive Assessment of Spoken Language Instrument Link](http://psychcorp.pearsonassessments.com/HAIWEB/Cultures/en-us/Productdetail.htm?Pid=PAa3580)

Goldman-Fristoe Test of Articulation

### DESCRIPTION

The GFTA-2 provides information on an individual’s articulation ability by asking a child to make 39 spontaneous or imitative sounds in words, sentences, and conversation. There are three sections of the measure: Sounds-in-Words, Sounds-in-Sentences and Stimulability Section.

### PERMISSIBLE VALUES

Raw scores fall between 0-77 and can be converted into standard scores and percentiles.

### PROCEDURE

Examiners must have training in phonetics and articulation disorders. Test administration is 15-30 minutes long.

### COMMENTS

The test is appropriate for use with individuals ages 2-21. Scoring software is available and includes normative data.

### RATIONALE

“The GFTA-2 was selected as a supplemental test to provide more specific information on the speech articulation errors of children who failed the … Caregiver Unintelligible Speech Rating measure.” – McCauley et al. 2012

### REFERENCES

Goldman, R., and Fristoe, M. (2000). Goldman-Fristoe Test of Articulation (Second ed.). Pearson Assessments: San Antonio, TX.

PsychCorp/Pearson/Pearson Education, Inc. Goldman-Fristoe Test of Articulation 2 (GFTA-2). Retrieved on July 10, 2012, from [Goldman Fristoe Test of Articulation Instrument Link](http://www.pearsonassessments.com/haiweb/cultures/en-us/productdetail.htm?pid=PAa11750&Community=CA_Ed_AI_Speech)

Language Sample Analysis

### DESCRIPTION

Language Sample Analysis is a method of evaluating language production in children. Language samples can be collected regularly to monitor progress and may be taken in different settings (e.g. school, home, clinic). Transcription software programs such as Systematic Analysis of Language Transcripts (SALT) or Child Language Data Exchange System (CHAT) may be used.

### PERMISSIBLE VALUES

Language sample can be analyzed by dependency analysis, which includes measures for dysfluency (the ratio of false starts, internal corrections, and additional dysfluencies to the total number of explicit propositions) and listener burden (number of implicit propositions divided by number of explicit propositions).

### PROCEDURES

In order to elicit a good language sample, the examiner should have experience talking with children. Conversations are recorded and transcribed. Samples can be analyzed by a software program and scored and interpreted by qualified personnel. Administration time is approximately 1 hour.

### COMMENTS

Language sampling is most commonly used in children of preschool age but can be used through high school.

### RATIONALE

“Language sample analysis has been found to discriminate between children and adolescents with versus without TBI in several studies. Content validity is high, as samples are taken with relevant partners (e.g., parents). Language samples often are more sensitive to group differences than are standard language measures.” – McCauley et al. 2012

### REFERENCES

Miller, J., and Chapman, J. (2004). The SALT Guide (Standard Version 8 ed.). Language Analysis Laboratory, Waisman Center, University of Wisconsin: Madison, WI.

MacWhinney, B. (2000). The CHILDES Project: Tools for Analyzing Talk. Lawrence Erlbaum Associates: Mahwah, NJ.

Biddle, K., McCabe, A., and Bliss, L. (1996). Narrative skills following traumatic brain injury in children and adults. J Commun Disord 29, 447-469.

Brookshire, B., Levin, H., Song, J., and Zhang, L. (2004). Components of executive function in typically developing and head-injured children. Dev Neuropsychol 25(1-2), 61-83.

Campbell, T., and Dollaghan, C. (1990). Expressive language recovery in severely brain-injured children and adolescents. J Speech Hear Disord 55, 567-581.

Campbell, T., and Dollaghan, C. (1994). Phonological and speech production characteristics of children following TBI: Principles underlying asessment and treatment. Thieme: St Loius, MO.

Campbell, T., and Dollaghan, C. (1995). Speaking rate, articulatory speed, and linguistic processing in children and adolescents with severe traumatic brain injury. J Speech Hear Res 38, 864

Campbell, T., Dollaghan, C., and Janosky, J. (2009). Understanding speech-sound change in young children following severe traumatic brain injury. Plural Publishing: San Diego.

Chapman, S., Culhane, K., Levin, H., Harward, H., Mendelsohn, D., Ewing-Cobbs, L., and al., e.(1992). Narrative discourse after closed head injury in children and adolescents. Brain Lang 43, 42-65.

Chapman, S., Gamino, J., Cook, L., Hanten, G., Li, X., and Levin, H. (2006). Impaired discourse gist and working memory in children after brain injury. Brain Lang 97(2), 178-188.

Chapman, S., Levin, H., Wanek, A., Weyauch, J., and Kufera, J. (1998). Discourse after closed head injury in young children. Brain Lang 61(3), 395-419.

Chapman, S., Sparks, G., Levin, H., Dennis, M., Roncadin, C., Zhang, L., and al., e. (2004). Discourse macrolevel processing after severe pediatric traumatic brain injury. Dev Neuropsychol 25(1-2), 37-60.

Chapman, S., Watkins, R., Gustafson, C., Moore, S., Levin, H., and Kufera, J. (1997). Narrative discourse in children with closed head injury, children with language impairment, and typically developing children. Am J Speech Lang Pathol 6(2), 66-69.

Coelho, C., Ylvisaker, M., and Turkstra, L. (2005). Nonstandardized assessment approaches for individuals with traumatic brain injuries. Semin Speech Lang 26(4), 223-241.

Dennis, M., Jacennik, B., and Barnes, M. (1994). The content of narrative discourse in children and adolescents after early-onset hydrocephalus and in normally developing age peers. Brain Lang 46, 129-165.

Ewing-Cobbs, L., and Barnes, M. (2002). Linguistic outcomes following traumatic brain injury in children. Sem Ped Neurol 9(3), 209-217.

Ewing-Cobbs, L., Brookshire, B., Scott, M., and Fletcher, J. (1998). Children's narratives following traumatic brain injury: linguistic structure, cohesion and thematic recall. Brain Lang 61(3), 395-419.

Wilson, B., and Proctor, A. (2002). Written discourse of adolescents with closed head injury. Brain Inj 16(11), 1011-1024.

Youse, K., and Coelho, C. (2005). Working memory and discourse production abilities following closed-head injury. Brain Inj 9(12), 1001-1009.

National Adult Reading Test

### DESCRIPTION

The National Adult Reading Test (NART) assesses verbal neurocognitive function and can be used as a proxy for estimating premorbid intelligence, as it is somewhat resistant to the effects of injury. It includes 50 irregularly pronounced words, which the test-taker must pronounce.

### PERMISSIBLE VALUES

Norms for age and various groups are available

### PROCEDURE

Fifty words are presented to the subject to be read out loud

### COMMENTS

Adults

### RATIONALE

The NART is included as a measure of basic language to test whether a patient may have an acquired language impairment.

### REFERENCES

Nelson, H. E. (1982). National Adult Reading Test. Windsor, UK: NFER-Nelson.

Uttl, B. (2002). North American Adult Reading Test: Age norms, reliability, and validity. Journal of Clinical and Experimental Neuropsychology, 24, 1123–1137.

Peabody Picture Vocabulary Test, 4th edition (PPVT-4)

### DESCRIPTION

The PPVT-4 measures receptive vocabulary skills that does not require any reading or writing on the part of the subject. There are 228 test items separated into 19 sets of 12 items each. The PPVT-4 has two parallel forms which are used to monitor progress. The test can also be used to screen patients according to their level of verbal ability.

### PERMISSIBLE VALUES

Age- and grade-based standard scores are given, with mean = 100 and standard deviation= 15. Percentiles, normal curve equivalents (NCEs), stanines, age and grade equivalents, and Growth Scale Value (GSV) are also provided.

### PROCEDURES

Administration time is approximately 10-15 minutes and is completed via pencil and paper. No special training is required, although practice in administering the test is recommended.

### COMMENTS

Appropriate for ages 2.5 to 90 years.

### RATIONALE

“It includes normative data for children and adults ages 2.6 to 90 years. It was standardized on a sample of 3500 subjects that matched the United States Census for gender, race/ethnicity, region, socioeconomic status, and clinical diagnosis for special education placement.” – McCauley et al. 2012

### REFERENCES

Dunn, L., and Dunn, D. (2007). Peabody Picture Vocabulary Test. Examiner's Manual (Fourth ed.). Pearson Assessments: San Antonio, TX.

Dunn, L., Lugo, D., Padilla, E., and Dunn, L. (1986). Test de Vocabulario en Imágenes Peabody. Pearson Assessments: San Antonio, TX.

Percentage of Consonants Correct-Revised (PCC)

### DESCRIPTION

The PCC is derived from a conversational speech sample and represents the percentage of consonant sounds correctly pronounced. Speech-sound omissions, substitutions, and distortions are all considered as incorrect consonants.

### PERMISSIBLE VALUES

Scores are given as percentages and correlate with severity of the speech delay or disorder. The severity is graded from Normal Development to Severe disorder.

### PROCEDURES

Test is administered as a 5 – 10 minute conversation with the child. Additional time is required to transcribe and compute the metric.

### COMMENTS

PCC normative data are available for individuals from age 18 months to 21 years.

### RATIONALE

“The PCC was selected as a supplemental measure to provide more detailed information about a child’s consonant production skills in an extended conversational context. The measure has been used to investigate the longitudinal speech outcomes of children with moderate to severe TBI.” – McCauley et al. 2012

### REFERENCES

Shriberg, L., Austin, D., Lewis, B., McSweeney, J., and Wilson, D. (1997). The percentage of consonants correct (PCC)metric. Extension and reliability data. J Speech Lang Hear Res 40, 708-722

Campbell, T., and Dollaghan, C. (1994). Phonological and speech production characteristics of children following TBI: Principles underlying asessment and treatment. Thieme: St Loius, MO.

Campbell, T., Dollaghan, C., and Janosky, J. (2009). Understanding speech-sound change in young children following severe traumatic brain injury. Plural Publishing: San Diego.

Campbell, T., Dollaghan, C., and Janosky, J. (2009). Understanding speech-sound change in young children following severe traumatic brain injury. Plural Publishing: San Diego.

Campbell, T., Dollaghan, C., Janosky, J., and Adelson, P. (2007). A performance curve for assessing change in percentage of consonants correct-revised (PCC-R). J Speech Lang Hear Res 50, 1110-1119.

Test of Language Competence – Expanded (TLC-E)

### DESCRIPTION

The TLC-E is used as a test of pragmatic language use and also a screening composite. The test is used to assess an individual’s ability to perceive, interpret and respond to the demands of a conversation. Sub-tests include the following: Ambiguous sentences, listening comprehension, making inferences, oral expression, recreating speech acts, figurative language and memory (supplemental test).

### PERMISSIBLE VALUES

Standard scores for subtests (M= 10; SD = 3) and the composite (M = 100; SD = 15), raw scores, age equivalent scores and percentile ranks are given.

### PROCEDURES

Administration time is up to one hour. Individuals who are qualified to interpret this test would either be certified by a professional organization in the relevant area of assessment; have a master’s degree in psychology, education, or a related field with training in assessment; have a degree or license in healthcare; or have formal supervised training in the appropriate subject matter and the use of standardized assessments.

### COMMENTS

Appropriate for children 5-18 years of age. Level 1 of the measure is for ages 5 - 9 and level 2 of is appropriate for ages 9 – 18.

### RATIONALE

“Although some of the idioms are no longer in current usage, the TLC-E has shown discriminant validity for children adolescents with TBI in previous research.” – McCauley et al. 2012

### REFERENCES

Wiig, E., and Secord, W. (1989). Test of Language Competence (Expanded ed.). Psychological Corporation: San Antonio, TX.

Dennis, M., and Barnes, M. (1990). Knowing the meaning, getting the point, bridging the gap, and carrying the message: Aspects of discourse following closed head injury in childhood and adolescence. Brain Lang 39, 428-446.

Hallett, T. (1997). Linguistic competence in paediatric closed head injury. Pediatr Rehabil 1(4), 219-228.

Towne, R., and Entwisle, L. (1993). Metaphoric comprehension in adolescents with traumatic brain injury and in adolescents with language learning disability. Lang Speech Hear Serv Sch 24, 100-107.

PsychCorp/Pearson/Pearson Education, Inc. Test of Language Competence – Expanded Edition (TLC – E). Retrieved on July 11, 2012, from [Test of Language Competence-Expanded Edition Instrument Link](http://www.pearsonpsychcorp.com.au/productdetails/203)

Verbal Motor Production Assessment for Children (VMPAC)

### DESCRIPTION

The VMPAC measure assesses three major areas of motor speech: global motor control, focal oromotor control, sequencing of speech sounds. There are also two additional areas that may be tested: connected speech and language control and speech characteristics.

### PERMISSIBLE VALUES

A 3-point scale is used to assess the neuromotor integrity of the motor speech system (0= incorrect; 1 = partially correct; 2 = Correct). Percentage scores are calculated as the raw score divided by the sum of the area's item scores. An overall score is calculated as the mean percentage score of all areas.

### PROCEDURES

The administration for the text is approximately 30 minutes. Individuals who are qualified to interpret this test would either be certified by a professional organization in the relevant area of assessment or have a Master’s degree in psychology, education, or a related field with training in assessment.

### COMMENTS

The measure is appropriate for ages 3 to 12 years.

### RATIONALE

“The VMPAC was selected to identify children who have speech motor control deficits that affect the recovery and development of normal speech production. It has been used to examine the speech outcomes of children with various neurological deficits, including TBI. ” – McCauley et al. 2012

### REFERENCES

Hayden, D., and Square, P. (1999). Verbal Motor Assessment of Children (VMPAC). Pearson: San Antonio, TX.

Chen, CL., Lin, KC., Chen, CH., Chen, CC., et al. Factors Associated with Motor Speech Control in Children with Spastic Cerebral Palsy. (2010). Chang Gung Med J 33, 415-23.

Wechsler Abbreviated Scale of Intelligence (WASI II) - Vocabulary subtest

### DESCRIPTION

The WASI-II is an update of the WASI, and provides a brief estimate of general intelligence and cognitive ability for persons aged 6 to 89 years.

### PERMISSIBLE VALUES

WASI subtest scores have mean=50 and standard deviation=10.

### PROCEDURE

The vocabulary subtest takes less than 15 minutes to administer.

### COMMENTS

The WASI - Vocabulary subtest is appropriate for persons aged 6-89 years.

### RATIONALE

“The Pediatric CDE Workgroup recommends using the Vocabulary subtest as a brief measure of language functioning. Although the WASI does not have specific sensitivity to mild injury severity, it has been shown to be sensitive to a range of neurologic conditions including moderate to severe TBI.” – McCauley et al. 2012

### REFERENCES

Wechsler, D. (1999). Weschler Abbreviated Scale of Intelligence. The Psychological Corporation: New York.

Gamino, J., Chapman, S., and Cook, L. (2009). Strategic learning in youth with traumatic brain injury: evidence for stall in higher-order cognition. Top Lang Disord 29(3), 224-235.

Catroppa, C., and Anderson, V. (2004). Recovery and predictors of language skills two years following pediatric traumatic brain injury. Brain Lang 88(1), 68-78.

Prigatano, G., and Gray, J. (2008a). Predictors of performance on three developmentally sensitive neuropsychological tests in children with and without traumatic brain injury.Brain Inj 22(6), 491-500.

Wechsler Test of Adult Reading™ (WTAR)

### DESCRIPTION

The WTAR is an adult reading test that can serve as a measure of premorbid verbal intelligence, as pre- and post-injury performance shows some degree of correlation. The test has been co-normed with the WAIS-III. The subject is presented with 50 words with atypical pronounciations.

### PERMISSIBLE VALUES

Total score is the number of words read correctly out of 50

### PROCEDURE

Completed in 5-10 minutes. Should be administered by trained aexaminers.

### COMMENTS

Ages 16-89 years

### RATIONALE

The WTAR is a measure of receptive vocabulary and has use as a proxy for pre-morbid vocabulary skills.

### REFERENCES

Wechsler D. Wechsler Test of Adult Reading (WTAR). San Antonio, TX: Harcourt Assessment, 2001.