# Traumatic Brain Injury (TBI) Common Data Element (CDE)

# Outcome Measure Recommendations

# Version 2.0

## Outcome Domain:

Academics

### Domain Description and Relevance in TBI:

“Children with TBI have been found to have significant academic difficulties characterized by school failure and deficits in academic achievement such as reading, math, and written language.” - McCauley et al. 2012

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

| Outcome Measure Name | Relevant TBI Population | Acute Hospitalized | Moderate/ Severe Rehabilitation | Concussion/ Mild TBI | Epidemiology |
| --- | --- | --- | --- | --- | --- |
| Child Behavior Checklist (CBCL), School Competence scale | Pediatric | Supplemental | Supplemental | Supplemental | Supplemental |
| Comprehensive Test of Phonological Processing (CTOPP) | Pediatric | Supplemental | Supplemental | Supplemental | Supplemental |
| Gray Oral Reading Test, 4th Edition (GORT-4) | Pediatric | Supplemental | Supplemental | Supplemental | Supplemental |
| KeyMath-3 Diagnostic Assessment | Pediatric | Supplemental | Supplemental | Supplemental | Supplemental |
| Test of Word Reading Efficiency (TOWRE) | Pediatric | Supplemental | Supplemental | Supplemental | Supplemental |
| Woodcock-Johnson, 3rd Edition (WJ-III); Achievement Tests | Pediatric | 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.

## Child Behavior Checklist (CBCL), School Competence Scale

### DESCRIPTION

The Child Behavior Checklist measures a child’s competencies by using their parent’s perception of their performance on three scales, which include activities, social and school. Separate forms for ages 1.5 to 5 years and 6 to 18 years, as well as separate forms to be filled out by the parent/caregiver or teacher, are available. Scores for three competence scales and a total competence score can be computed.

### PERMISSIBLE VALUES

Raw scores, *t* scores (M=50, SD=10), and percentiles are given based on test results. The value of *t* scores for each range varies depending on the scale; in some scales higher *t* scores are associated with normal functioning and on others lower *t* scores are associated with normal functioning.

### PROCEDURES

The CBCL can be completed independently by the caregiver or administered by a professional familiar with the CBCL manual. Test can be completed by paper/pencil, online, or on a scannable form. The entire test, which includes the school competence scale, lasts approximately 25-30 minutes. Skills commensurate with at least a Master’s degree level in psychology, social work, or special education are recommended for interpretation.

### COMMENTS

The CBCL has two sets of forms, for ages 1.5 to 5 and ages 6 to 18.

### RATIONALE

“The CBCL School Competence subscale asks parents to rate their child’s performance in several academic subjects from failing to above average, and children with TBI have been rated as having lower academic performance than typically developing children.” - McCauley et al. 2012

### REFERENCES

Achenbach, T. (1991). Manual for Child Behavior Checklist/ 4-18 and 1991 Profile. University of Vermont, Dept. of Psychiatry: Burlington, VT.

Ewing-Cobbs, L., Barnes, M., Fletcher, J., Levin, H., Swank, P., and Song, J. (2004). Modeling of longitudinal academic achievement scores after pediatric traumatic brain injury. Dev Neuropsychol 25(1-2), 107-133.

Fletcher, J., Ewing-Cobbs, L., Miner, M., Levin, H., and Eisenberg, H. (1990). Behavioral changes after closed head injury in children. J Consult Clin Psychol 58(1), 93-98.

Reynolds, CR., Fletcher-Janzen, E. (2007) *Encyclopedia of Special Education*. John Wiley & Sons: Inc. Hoboken, New Jersey.

## Comprehensive Test of Phonological Processing (CTOPP)

### DESCRIPTION

The CTOPP assesses phonological awareness, phonological memory, and rapid naming as a measure of reading ability. Two levels of the test are available: for ages 5-6 years, containing seven core subtests and one supplemental test, and ages 7-24 years, containing six core subtests and eight supplemental tests.

### PERMISSIBLE VALUES

The composite standard scores for Phonological Awareness Quotient (PAQ), Phonological Memory Quotient (PMQ), and Rapid Naming Quotient (RNQ) have a mean of 100 and a standard deviation of 15. Subtest standard scores have a mean of 10 and a standard deviation of 3. Percentiles and standard scores as well as age and grade equivalents are provided with the examiner’s manual.

### PROCEDURES

Both versions are individually administered, with the core subtests taking approximately 30 minutes total. Supplemental tests may also be administered. The test should be administered by trained examiners.

### COMMENTS

The test is appropriate for ages 5 through 24.

### RATIONALE

“To date, one subtest of this task has been used in at least one study on outcome from childhood TBI.” - McCauley et al. 2012

### REFERENCES

Wagner, R., Torgesen, J., and Rashotte, C. (1999). Comprehensive Test of Phonological Processing. Examiner's Manual. Pearson Assessments: San Antonio, TX.

Ewing-Cobbs, L., Prasad, M., Swank, P., Kramar, L., Cox, C., Fletcher, J., Barnes, M., and Zhang, X. (2008). Arrested development and disrupted callosal microstructure following pediatric traumatic brain injury: relation to neurobehavioral outcomes. Neuroimage 42(4), 1305-1315.

Pro-ed, an international publisher. CTOPP: Comprehensive Test of Phonological Processing. Retrieved July 9, 2012, from [Pro-ed Customer Product Review Link](http://www.proedinc.com/customer/productview.aspx?id=1615).

## Gray Oral Reading Test, 4th edition (GORT-4)

### DESCRIPTION

The GORT-4 assesses a subject’s oral reading, including strengths and weaknesses. The individual receives five scores which provide information in the domains of rate, accuracy, fluency, comprehension and overall reading ability.

### PERMISSIBLE VALUES

In addition to standard scores (M=10, SD=3), percentile ranks, grade equivalents, and age equivalents are provided.

### PROCEDURES

The test consists of two forms, each containing 14 reading passages with corresponding comprehension questions following each passage. The test is individually administered and takes from 20 to 30 minutes to complete. Skills commensurate with at least a Master’s degree level in psychology, education, or related field are recommended for interpretation.

### COMMENTS

The instrument is appropriate for ages 6 through 18.

### RATIONALE

“This measure has strong psychometric properties, and has been found to be sensitive to reading difficulties in children with TBI.” - McCauley et al. 2012

### REFERENCES

Wiederholt, J., and Bryant, B. (2001). Gray Oral Reading Test (GORT-4). Manual (Fourth ed.). Pearson Assessments: San Antonio, TX.

Ewing-Cobbs, L., Prasad, M., Kramar, L., Cox, C., Baumgartner, J., Fletcher, J., Mendez, D., Barnes, M., Zhang, X., and Swank, P. (2006). Late-intellectual and academic outcomes following traumatic brain injury sustained during early childhood. J Neurosurg 105(Suppl 4), 287-296.

Ewing-Cobbs, L., Prasad, M., Swank, P., Kramar, L., Cox, C., Fletcher, J., Barnes, M., and Zhang, X. (2008). Arrested development and disrupted callosal microstructure following pediatric traumatic brain injury: relation to neurobehavioral outcomes. Neuroimage 42(4), 1305-1315.

Psych Corp/ Pearson Assessments/ Pearson Education, Inc. Gray Oral Reading Test – Fourth Edition (GORT-4). Retrieved July 9, 2012, from [Gray Oral Reading Test 4th Edition Instrument Link](http://www.pearsonclinical.com/language/products/100000454/gray-oral-reading-test-fourth-edition-gort-4.html).

## KeyMath-3 Diagnostic Assessment

### DESCRIPTION

The KeyMath-3 is used to assess a subject’s ability to understand and apply mathematical concepts. Five subtests assess basic concepts (Numeration, Algebra, Geometry, Measurement, Data Analysis and Probability); three subtests test operations (Mental Computation and Estimation, Written Computation: Addition and Subtraction, Written Computation: Multiplication and Division); and two subtests are devoted to applying concepts (Foundations of Problem Solving and Applied Problem Solving).

### PERMISSIBLE VALUES

Standard scores (M=100, SD=15), scale scores, percentiles, and grade/age equivalents are given for the Total Test, 3 areas, and 10 subtests.

### PROCEDURE

The KeyMath-3 is individually administered and ranges from 30 to 90 minutes for the entire battery of tests, depending on the student's grade level. Select subtests may be administered if a professional is interested in a particular area of the student’s ability. This assessment has two versions that can be administered (by alternating versions) every three months. Examiner should have formal training in mathematics and test interpretation.

### COMMENTS

KeyMath-3 should be used with students from pre-kindergarten through 12th grade. Age norms range from 4 years through 21 years. To date, there are no published studies on this task with children with TBI.

### RATIONALE

“This measure has good psychometric properties and has potential to elucidate mathematical skills in children with TBI.” - McCauley et al. 2012

### REFERENCES

Wagner, R., Torgesen, J., and Rashotte, C. (1999). Comprehensive Test of Phonological Processing. Examiner's Manual. Pearson Assessments: San Antonio, TX.

Ewing-Cobbs, L., Prasad, M., Swank, P., Kramar, L., Cox, C., Fletcher, J., Barnes, M., and Zhang, X. (2008). Arrested development and disrupted callosal microstructure following pediatric traumatic brain injury: relation to neurobehavioral outcomes. Neuroimage 42(4), 1305-1315.

Psych Corp/ Pearson Assessments/ Pearson Education, Inc. KeyMath 3 Diagnostic Assessment. Retrieved July 10, 2012, from http://www.pearsonschool.com/index.cfm?locator=PSZ3E2

## Test of Word Reading Efficiency (TOWRE)

### DESCRIPTION

The TOWRE assesses reading development with two subtests that present the subject either with familiar words or unfamiliar nonsense words. The subject is scored on the ability to pronounce the words accurately. Each of the subtests has two alternate forms.

### PERMISSIBLE VALUES

Raw scores are the number of real words that are read correctly in 45 seconds and the number of non-words pronounced correctly in 45 seconds. Subtest standard scores have a mean of 100 and a standard deviation of 15. The TOWRE scoring software includes percentiles, standard scores, and age and grade equivalents.

### PROCEDURES

The test is comprised of two subtests, lasting 45 seconds each. The test can be administered by trained research assistants with formal training in administration, scoring, and interpretation of clinical assessments.

### COMMENTS

The TOWRE is appropriate for ages 6 through 24.

### RATIONALE

The measure is nationally normed on a sample of over 1500 and has potential for use with TBI.

### REFERENCES

Wagner, R., Torgesen, J., and Rashotte, C. (1999). Comprehensive Test of Phonological Processing. Examiner's Manual. Pearson Assessments: San Antonio, TX.

Ewing-Cobbs, L., Prasad, M., Swank, P., Kramar, L., Cox, C., Fletcher, J., Barnes, M., and Zhang, X. (2008). Arrested development and disrupted callosal microstructure following pediatric traumatic brain injury: relation to neurobehavioral outcomes. Neuroimage 42(4), 1305-1315.

Torgesen, J., Wagner, R., and Rashotte, C. (1999). Test of Word Reading Efficiency. Pro-Ed: Austin, TX.

Western Psychological Services. Test of Word Reading Efficiency (TOWRE). Retrieved on July 12, 2012, from [Test of Word Reading Efficiency Instrument Link](http://www.wpspublish.com/store/p/3061/test-of-word-reading-efficiency-second-edition-towre-2) **Woodcock-Johnson, 3rd edition (WJ-III); Achievement Tests**

### DESCRIPTION

The WJ-III assesses academic abilities and is made up of a standard battery and extended battery. The standard battery can be administered without the extended battery but not vice versa. The recommended Achievement Tests include letter-word identification, reading fluency, passage comprehension, word attack, calculation, math fluency, applied problems, spelling, writing fluency, and writing samples.

### PERMISSIBLE VALUES

Scores between 0 and 200 are provided, as well as percentile rankings.

### PROCEDURES

Test should be administered by someone with thorough knowledge of the exact administration and scoring procedures. Administration time varies but comes to around 5 minutes per test for each battery. Completing the entire standard battery takes approximately 55-65 minutes. Scores should be interpreted by someone with graduate-level training in education assessment.

**COMMENTS**

The test is appropriate for persons age 2 through 90+ (grades kindergarten through graduate school).

### RATIONALE

“The WJ-III is extensively normed and has strong psychometric properties. … The earlier version of this measure was used in several outcome studies. Subtests of the current revision of this measure have been used in pediatric TBI outcome studies.” - McCauley et al. 2012

### REFERENCES

Woodcock, R., McGrew, K., and Mather, N. (2001). Woodcock-Johnson Tests of Achievement, 3rd edition, manual (Third ed.). Riverside Publishing: Itasca, IL.

Schrank, F., McGrew, K., Ruef, M., Alvarado, C., Muñoz-Sandoval, A., and Woodcock, R. (2005). Batería III Woodcock-Muñoz Assessment Service Bulletin Number 1: Overview and Technical Supplement. Itasca, IL: Riverside Publishing.

Woodcock, R., McGrew, K., and Mather, N. (1989). Woodcock-Johnson Tests of Achievement-- revised. Manual. Riverside Publishing: Itasca, IL.

Fay, T., Yeates, K., Wade, S., Drotar, D., Stancin, T., and Taylor, E. (2009). Predicting longitudinal patterns of functional deficits in children with traumatic brain injury. Neuropsychology 23(3), 271-282.

Taylor, H., Yeates, K., Wade, S., Drotar, D., Klein, S., and Stancin, T. (1999). Influences on first-year recovery from traumatic brain injury in children. Neuropsychology 13, 76-89.

Nelson Education. WJ III Tests of Achievement, Form B with Normative Update. Retrieved July 10, 2012, from [Nelson Education Woodcock Johnson Tests of Achievement Training Materials](http://www.assess.nelson.com/test-ind/wj-3-ach.html)

Taylor, H., Yeates, K., Wade, S., Drotar, D., Stancin, T., and Minich, N. (2002). A prospective study of short- and long-term outcomes after traumatic brain injury in children: behavior and achievement. Neuropsychology 16, 15-27.

Yeates, K., and Taylor, H. (1997). Predicting premorbid neuropsychological functioning following pediatric traumatic brain injury. J Clin Exp Neuropsychol 19, 825-837.

Ewing-Cobbs, L., Prasad, M., Swank, P., Kramar, L., Cox, C., Fletcher, J., Barnes, M., and Zhang, X. (2008). Arrested development and disrupted callosal microstructure following pediatric traumatic brain injury: relation to neurobehavioral outcomes. Neuroimage 42(4), 1305-1315.

Ewing-Cobbs, L., Prasad, M., Kramar, L., Cox, C., Baumgartner, J., Fletcher, J., Mendez, D., Barnes, M., Zhang, X., and Swank, P. (2006). Late-intellectual and academic outcomes following traumatic brain injury sustained during early childhood. J Neurosurg 105(Suppl 4), 287-296.

Ewing-Cobbs, L., Hasan, K., Prasad, M., Kramar, L., and Bachevalier, J. (2006). Relation of corpus callosum diffusion anisotropy and neuropsychological outcomes in twins disconcordant for traumatic brain injury. Am J Neuroradiol 27, 879-881.

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.