# Guidance for the Identification of Specific Learning Disabilities

## Portland Public Schools
## Committee for Specific Learning Disabilities
## Using Pattern of Strengths and Weaknesses
## Methodology and Research

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# ELIGIBILITY FOR PSW SPECIFIC LEARNING DISABILITY
# OVERVIEW
# SEPTEMBER, 2015

The purposes of a comprehensive evaluation are to:

Review instructional interventions,
Develop a clear statement of student present levels of academic achievement and functional performance,
Determine why a student is not making adequate academic progress,
Determine if a student meets eligibility criteria for a specific learning disability and/or other educational disabilities,
Generate an appropriate and effective plan to meet student educational needs.

All tests that are administered for the PSW model-whether assessing psychological processes and academic achievement or social emotional status-must meet reliability and validity standards. For initial PSW evaluations, teams must complete standardized, norm-referenced achievement tests, tests of basic psychological processes, and other assessment of basic psychological processes.

On individually administered, standardized, norm-referenced tests of basic psychological processes, a “strength” is considered a standard score of 90 or above and/or a percentile rank of at or above the 25th percentile. A “weakness” is considered a standard score of 8**0**or below and/or a percentile rank at or below the **9**th percentile. Professional judgment is needed to classify psychological process scores of 81-89. Depending on the student’s individual testing profile, scores of 85-89 may be classified as a strength, a weakness, or as neither a strength or a weakness. Depending on the student’s individual profile, scores of 81-85 may be classified as a weakness or as neither a strength or a weakness.

If a psychological process test cluster score is not cohesive, due to a significant difference that is unusual in the testing population between subtest scores that comprise the cluster, an additional subtest will be administered and the X-BASS software (Flanagan, Ortiz, Alfonso, 2015) will be used to calculate a psychological process composite score. The X-BASS composite score is calculated using the subtest scores and median cross battery inter-correlations and reliabilities. The software will determine if a score is an outlier and will not use this score in the calculation of the composite score.

On Achievement testing, a “strength” is considered a standard score of 90 or above and/or a percentile rank of at or above the 25th percentile. A “weakness” is considered a standard score of 85 or below and/or a percentile rank at or below the 16th **percentile. A**n **achievement** weakness may also be established by an RPI score of 67/90**.** On current year state testing and standards-based report **cards, “meets” is** a strength, “does not meet” is a weakness, and “conditionally meets” is neither a strength nor a weakness. On state tes**t**ing for prior years, a strength is considered a score at or above the 25**th**%ile and a weakness is considered a score of at or below the 16**th**%ile. On progress monitoring, a strength is considered a score at or above the 25**th** **percentile** or “core” and a weakness is considered below the 16**th** **percentile** or “intensive”. Standard scores between 86 and 89 and/or percentiles between the 17th and 24th **percentile** are considered neither a strength nor a weakness**.**

**Student Intervention Team (SIT) Referral Process** (see **PSW Evaluation of Culturally and Linguistically Diverse (CLD) Students below for SIT procedures for CLD students).**

**Implement** and progress monitor Tier II and Tier III academic interventions in all areas of academic concern

**Complete** the "Academic Exclusionary Factors Worksheet" for students who are not making comparable academic progress to similar peers in response to Tier II and Tier III interventions to determine if there are barriers to learning that would indicate that the learning difficulties are primarily due to factors other than a Specific Learning Disability including visual, hearing, motor, sensory or behavioral concerns, lack of appropriate instruction, lack of English language proficiency, cultural factors, or economic disadvantage

**Generate** a working hypothesis of academic and cognitive strengths and weaknesses using the "Development of Working Hypothesis Statement" to formulate a hypothesis about the nature of the difficulty and develop an intervention and progress monitoring plan across all tiers of support and assist in determining if a learning disability is suspected. The Development of a Working Hypothesis Statements include a selection of research based indicators of Specific Learning Disabilities; the indicators included are not exhaustive (for additional indicators see the Resources and Research Section of the manual).

**Evaluation Planning Components**

**Review** with the parents and other members of the IEP team current evaluation data and progress summarized on the "Development of a Working Hypothesis Statement" as well as additional information provided by parents and current classroom assessment(s) and observations.

**Determine** if there is sufficient evidence to suspect the student has an educational disability.

**Utilize** the "Development of Working Hypothesis Statement" to determine needed evaluation components based on suspected weaknesses in psychological processing and achievement areas

**Develop** an individualized evaluation plan to assess the specific disability(s) and areas of educational need.

**Elicit** parent concerns regarding the evaluation plan; and

**Provide** copies of the written Parent Notification and the Notice of Procedural Safeguards (Parent Rights for Special Education) and obtain written consent in the parents' native language as specified under IDEA 2004.

**Comprehensive Assessment Elements include:**

- **An assessment of the child's academic achievement toward grade-level standards**. Examine scores on the student's state testing scores or if applicable, state testing equivalency measures such as scored reading work samples. If the student has not yet taken state assessments or for additional information use standards-based report cards.

- **An observation of the child's academic performance and behavior in a regular classroom setting or age-appropriate environment.** The observer must be qualified member of the evaluation team but not the student's general education teacher.

- **Progress monitoring data.** Provide data that demonstrates qualified personnel provided the student with appropriate instruction in regular education settings. This data includes information on school history, discipline, attendance, curricula used, and progress assessment methods and results. General education teachers must provide data based documentation in area(s) of suspected disability.

- **Developmental history.** For initial assessments, teams must obtain a developmental and family history and report on any relevant environmental or personal factors that affect student participation and learning (e.g., racial or historical trauma, cultural expectations, family or personal history, rural/urban setting, language and acculturation status, etc.). Vision, hearing, and motor status information must be included.

- **Medical statement.** If a student has a medical condition that affects educational performance, the team must obtain a physician's statement to document the condition. The evaluation report must contain a statement of how any medical condition affects student body function and structure (including psychological functions) and how this relates to the suspected disability.

- **Pattern of Strengths and Weaknesses (PSW) Assessments, Measures, and Processes.**

1. **Standardized, norm-referenced academic achievement test data** The evaluation team will conduct a standardized, norm-referenced test of academic achievement in the defined area(s) of concern:
    a. Basic reading skills
    b. Reading fluency
    c. Reading comprehension
    d. Math calculation
    e. Math problem solving
    f. Written expression
    g. Oral Expression
    h. Listening Comprehension

    Teams must report results from standardized achievement testing in a report format

2. Determine if the students Cognitive Abilities Facilitating Learning (CAFL) is consistent with a pattern of strengths and weakness that is relevant to the identification of a Specific Learning Disability:

    The criteria below is used to determine if a student's CAFL is consistent with a pattern of strengths and weakness that is relevant to the identification of a Specific Learning Disability :

    - Full Scale, GAI, Gf-Gc, MPI, or NVI ≥ SS 90
    - X-BASS software gValue ≥ .6 The gValue is calculated by the X-BASS software using the sum of the "g-weights" (values that indicate the relative

contribution of each ability to overall cognitive functioning) associated with each area of cognitive strength.

- Gf and/or Gc ≥ SS85 if there is a related cognitive processing weakness that is a least 10 points below the Gf or Gc score & there is confirmation of brain based Specific Learning Disability indicator data including confirmed "Development of Working Hypothesis Statements"

3. **Standardized, norm-referenced objective assessments of basic psychological processes.** Assessment of basic psychological processes is required to meet the federal definition of a learning disability. An objective norm referenced assessment must be administered in order to establish a processing weakness.

4. **Performance of basic psychological processes:** Results from cognitive testing must be confirmed by assessments that document the same psychological processing weakness or weaknesses in the general education classroom or other learning environment. This also includes subjective normative measures including rating scales.

5. **Other assessment(s) related to cognition, fine motor skills, perceptual motor skills, communication, social/emotional status, perception, or memory.**

Some students with learning disabilities also have sensory-motor concerns. If a student's sensory-motor skills, including their fine motor skills, appear to be impacting their educational progress, teams should consider including an occupational therapist as a part of the evaluation planning to determine if assessment in the area of sensory-motor is needed.

Twelve to twenty-four percent of students with dyslexia also have ADHD. If a student is suspected of having an Other Health Impairment, including students where ADHD is suspected due to deficits in one or more of the following psychological processing areas; attention, executive functions, processing speed, and working memory, an evaluation must include a medical statement.

If a student is suspected of having an intellectual disability, an evaluation must include an adaptive behavior rating scale and other necessary assessments.

If teams have reason to suspect that a student has social or emotional challenges, teams should conduct additional assessment for social/emotional needs, including functional behavioral assessment when appropriate, and then recommend subsequent behavioral instruction and/or counseling.

### Interpretation of Evaluation Data

- **Analyze** the data to determine if the student is not achieving adequately in four domains:
  1) Achievement relative to age;
  2) Performance relative to age;
  3) Achievement relative to state standards; and
  4) Performance relative to state standards

The student must have a documented "weakness" on a standardized, norm-referenced test of achievement (achievement relative to age); and this score must be corroborated by other academic data including:

1) Empirically-derived criterion assessments (e.g. easy CBM, DIBELS) including those used in the RTI process;
2) Results from the State Test and/or State Test equivalency measure;
3) Results from curriculum/grade leveled assessments and standards-based report cards
4) Anecdotal information such as work samples, tests from the curriculum used in the classroom; portfolio assessment, teacher observation, specialist observations, developmental history, "Development of a Working Hypothesis Statement" , and teacher report.

- **Examine** the "Development of a Working Hypothesis Statement" and results from measures of basic psychological processes in two domains:

  1) Achievement relative to intellectual development
  2) Performance relative to intellectual development.

The student must have a documented "weakness" in a basic psychological process (or processes) on a standardized, norm-referenced test of cognition, language or neuropsychology; this score must be corroborated by one additional point of evidence from any of the following four performance of basic psychological processing areas:

1) Standardized behavior rating scale,
2) Semi-structured observation or interview,
3) Classroom and testing observation, or
4) Confirmed psychological processing indicators on the "Development of a Working Hypothesis Statement"

- **Determine** if there is a relationship between the academic weakness and the cognitive weakness using the Cognitive to Achievement GRID . **If there is a relationship between the academic and cognitive weakness**,

- **Use the following method(s) to help determine if the student has a PSW.**

- **Examine** results from the "Development of a Working Hypothesis Statement" . Determine the relationship between the "Development of a Working Hypothesis Statement" and the results obtained from standardized academic measures, history, and observations. Confirm or disconfirm the working hypotheses for both academics and psychological processes. Consider if the student has a neurologically based learning disability based on this data taking into account both academic deficits and a related deficit (or deficits) in basic psychological processes.

- **Consider and integrate** results from observations, histories, medical, and social/emotional assessment;

- **Review** exclusionary factors when considering the student's performance;

- **Consult** with the PSW-assigned technical assistant and/or committee for students that do not fit the methods above but who may still require identification, instruction, and/or accommodations (e.g., Gifted SLD, SPED-ELL ), or to review hypotheses.

- **Report** all assessment findings in either a team or individual report format.

- **Link** assessment results to appropriate intervention and/or accommodations.

**Eligibility**

- **Provide** written Parental Notification in the parent's native language as specified under IDEIA 2004 and invite parents to attend the eligibility meeting -- i.e., IEP

- **Ensure** members of the team attend the eligibility determination meeting, including the parents, and two or more professionals, and all professionals who conducted an assessment component.

- **Review** the evaluation data to ensure the team has gathered information from all appropriate sources and, further, the evaluation information is documented, understood, and carefully considered.

- **Elicit** parent input regarding eligibility. Parents should receive verbal and written notification in their native language of their right to agree or disagree with eligibility decisions and to receive appropriate eligibility documentation.

- **Follow** the procedures in the Determination of Eligibility.

- **Determine** student eligibility by following District procedures and the applicable state Administrative Rules for Special Education.

- **Documen**t in IEP Meeting Notes and Prior Notice of Special Education Action all conclusions including a statement of eligibility for special education, any relevant discussion of inconsistencies in data or participant conclusions, and a record of the discussion regarding the significance of cultural, linguistic, socio-economic, environmental factors and the student behaviors and learning factors related to the assessment data.

- **Schedule** an Initial IEP and Placement meeting for students who meet eligibility requirements (in some cases, eligibility and IEP meetings do not need to be separate meetings, but may be done consecutively).

- **Use** information to draft standards-based Individual Education Programs. Use confirmed results from the "Development of a Working Hypothesis Statement" to target instruction in curricula used. Use information from assessment of cognitive and non-cognitive factors to draft standards-based IEPs including appropriate instruction and accommodations.

- **Refer** students who do not meet the Special Education eligibility requirements or who have learning difficulties that result from exclusionary factors, to the building's Student Intervention Team for appropriateTier II and Tier III instructional interventions and progress monitoring based on evaluation findings

**Three Year Re-Evaluations**

At three-year re-evaluations, IEP team members are directed to determine whether the student continues to need specialized instruction and document how the need for specialized instruction was established on the Prior Notice of Special Education Action. Teams must not be discouraged from completing additional assessments if they determine a need for the information. Teams should examine previous evaluations and note any concerns with the validity of the testing and previous teams' recommendations. Teams also may decide they do not have enough information from previous testing to establish that a pattern of strengths and weaknesses exists, and/or they have determined that this information has current relevance to academic needs.

**PSW Evaluation of Culturally and Linguistically Diverse (CLD) Students**

* Follow PPS special education pre-referral procedures for CLD students including reviewing the CLD Student Intervention Team Process packet and relevant ESL data (ADEPT, ELPA, IDEL, etc). For general guidelines for the evaluation of CLD students please refer to Section 19 of the Special Education Procedures Manual -LEP Parents and ELL Students in Special Education Process.

**Cognitive Test Selection**

Cognitive test selection for CLD students should be guided by the referral concern, the student's cultural and language background, and by the Culture-Language Test Classifications (X-BASS software, Ortiz, Flannagan, Olfonso, 2015). Evaluations should be comprehensive and measure all required related and suspected processing areas relevant to the referral concern. Nonverbal tests may be administered as a part of the assessment, but due to the limited processing areas measured by most nonverbal assessments, supplemental testing will also be needed. Nonverbal assessments administered should also be classified using the C-LTC as these tests are not culture free and are also mediated by language. Native language testing may also be administered, though it is important to note that the normative populations for these tests are not always reflective of most of our CLD student's backgrounds as some of the tests were normed on a monolingual population outside of the USA. Test score validity will also be impacted by the use of an interpreter/auxiliary examiner if this was not a part of the standardization of the test.

**Test Administration**

Tests should be administered in a manner necessary to ensure full comprehension including use of any modifications and alterations necessary to reduce barriers to performance, while documenting approach to tasks, errors in responding, and behavior during testing, and analyze scores both quantitatively and qualitatively to confirm and validate areas as true weaknesses.

**Test Interpretation**

The Culture-Language Interpretive Matrix (C-LIM) on the X-BASS software should be used to determine if the test results indicate a valid or invalid pattern and whether or not test results are subject to further interpretation. The first step in using the C-LIM software is to select the level of cultural and linguistic difference of the student you are assessing. There are three levels to choose from; slightly, moderately, and markedly, different and guiding descriptors for each level. To determine if scores are valid, the subtest scores are entered into the C-LIM and are classified based on the degree of cultural and language loading of the subtest. After entering in scores, three general declining patterns may emerge which would indicate that the results are primarily the result of culture and/or language and are therefore invalid and are not indicative of a disability:

1. Scores decline and fall within the shaded region on the Cultural and Linguistic Influences Graph
2. Scores decline and fall within the shaded region on the Linguistic Influences Graph
3. Scores decline and fall within the shaded region on the Cultural Influences Graph

If none of the above patterns are present, the C-LIM should be used to assist in determining CAFL and strengths and weaknesses for CLD students. The following patterns may emerge on the C-LIM which would indicate valid results and the possibility of a specific learning disability (Ortiz, 2014):

1. Overall pattern generally appears to decline and is within the shaded region on the Culture and Linguistic Influences, Linguistic Influences, or Cultural Influences Graphs, with one bar on the graph below the shaded region. If the above conditions are met, a related processing area weakness may indicate a valid processing weakness (except for Gc*).
2. Overall pattern does not appear to decline and all bars are within or above the shaded region on the Culture and Linguistic Influences, Linguistic Influences, or Cultural Influences Graphs. If the above conditions are met, a related processing area weakness may indicate a valid processing weakness (except for Gc*).
3. Overall pattern does not appear to decline and is within the shaded region on the Culture and Linguistic Influences, Linguistic Influences, or Cultural Influences Graphs, with one bar on the graph below the shaded region. If the above conditions are met, a related processing area weakness may indicate a valid processing weakness (except for Gc*).

*Gc should only be indicated as a potential area of weakness if the subtest results fall below the shaded range on the Culture and Linguistic Influences or Linguistic Influences graph and/or in context of other data and information.

Weakness must also be confirmed using performance data as indicated on the hypothesis statements, observations, and/or behavior checklists. Interpretation of performance assessment results should also take into account cultural and language factors.

## ACADEMIC EXCLUSIONARY FACTORS WORKSHEET

| **Exclusionary Factors/Additional Considerations: Please consider whether or not the academic difficulty is primarily due to any of the following. Provide additional information if needed.** | |
|---|---|
| Visual, Hearing, Motor, Sensory or Behavioral Concerns:<br><br>Most Recent Vision Screening:<br><br>Most Recent Hearing Screening: | Yes No |
| Lack of appropriate instruction (such as district recommended appropriately matched Tier II and Tier III interventions implemented with fidelity and attendance concerns): | Yes No |
| Lack of English language proficiency (For CLD students attach and review CLD SIT Process Packet): | Yes No |
| Cultural factors: | Yes No |
| Environmental factors: | Yes No |
| Economic disadvantage:<br><br>‘ | Yes No |

If the answer to all the questions above are “no”, and the academic hypothesis statement suggests learning disability indicators and academic weaknesses across multiple measures that require Tier III supports, consider referring to an Evaluation Planning Meeting.

**Basic Reading Skills (BRS)**
**Development of Working Hypothesis**

Guiding Statement:
Basic reading skills deficits, also known as word-level reading disability or dyslexia, represents approximately 80% of the students with Specific Learning Disabilities. Dyslexia is defined by a weakness in decoding skills at the single word and phoneme level. Due to the cognitive demands created by poor decoding skills, multiple academic domains may be affected. It may occur in conjunction with difficulty in reading fluency and comprehension tasks, as well as spelling and written expression. Basic Reading Skills (dyslexia) deficits may be more phonologically based (phonological or dysphonetic dyslexia) or visually based (orthographic or surface dyslexia) (Feifer, 2007; Mather & Wendling, 2011). These categories relate most specifically to intervention. For example, for phonological processing weaknesses an explicit phonological and phonics program is recommended, whereas for orthographic weaknesses whole word or lexical level strategies are recommended. Some students have mixed phonological and orthographic deficits and these students require balanced literacy intervention including both phonological and phonics instruction and whole word and lexical level strategies. Other core basic psychological processes hypothesized to have a strong relationship with basic reading skills include language, working memory, long-term memory storage and retrieval, and rapid automatic naming. Students with a weakness in working memory would benefit from the use of a multi-sensory reading intervention program.

Purpose:
Formulate hypothesis about the nature of the difficulty and develop an intervention and progress monitoring plan across all tiers of support and assist in determining if a learning disability is suspected.

**Basic Reading Skills (BRS): Check box to the right if description applies.**

| **Hypothesized Academic Indicator descriptions – Phonological** | |
|---|---|
| Problems identifying the sound of a letter | |
| Problems segmenting and blending two or more sounds | |
| Difficulty identifying that two words rhyme | |
| Difficulty identifying phonemes (sounds) within words that slow down word recognition | |
| Spelling demonstrates pre-phonetic relationships or no phonetic relationship | |
| **Hypothesized Academic Indicator descriptions – Orthographic** | |
| PreK-2nd Difficulty learning letters, problems naming rapidly all the letters of the alphabet | |
| K-12 Consistently confuses similarly shaped letters (b/d, p/g, p/q, n/u, m/w) | |
| K-12 Frequent sight words are not automatically recognized but individual sounds are identified | |
| K-12 Sounds out every word, even irregular sight words (of, was, light) | |
| **Hypothesized Academic Indicator descriptions – General** | |
| Higher skill development in areas that are not dependent on reading | |
| Avoidance or behavior problems when asked to read | |
| Family history of learning disabilities | |

☐ Primarily Phonological
☐ Primarily Orthographic
☐ Combination of both types

| **Performance Relative to Intellectual development** | **Check if Description Applies:** | **Psychological Processing Area** |
|---|---|---|
| Difficulty finding the right word to say or slow, labored, or limited amount of speech. Difficulty comprehending language and learning vocabulary. | | Language |
| Frequently asks for directions to be repeated or gets lost in the middle of a problem or assignment. Tendency to lose track when working on sequential activities. Difficulty with multi-tasking. | | Working Memory |
| Does well on daily assignments but doesn't do well on formative assessment/end of week tests. Difficulty recalling facts and related concepts/ideas. Difficulty with memorization. Difficulty with word retrieval. | | Long Term Memory |
| Takes longer to complete tasks than others the same age. Slow reading speed. Need to reread for understanding. | | Processing Speed |
| Difficulty hearing words exactly; makes small mistakes in the sounds of words (e.g., "I thought you said,"), difficulty with rhymes and sound discrimination including blending and segmenting. | | Phonological Awareness |
| Difficulty naming learned numbers, letters, or names quickly, or substitutes the wrong name or word, has words on "the tip of the tongue" but can't remember, takes long pauses in speaking, uses the wrong word or "speaks around" a word or someone's name, has difficulty recalling known words from a particular category. | | Speed of Lexical Access |
| Spells irregular words phonetically rather than by their visual pattern (srkoll for circle). | | Orthographic |
| Difficulty figuring out what is needed for a task, getting started, or sticking to a plan of action, does not anticipate the time or sequence necessary for task completion. Mind appears to go blank, gets overwhelmed with difficult tasks, or can't pay attention for long, unusual or erratic patterns of error , easily distracted from relatively mundane tasks, inattentiveness to errors, problems when focusing on more than one thing at a time . | | Executive Functions and Attention |

| **Culturally and Linguistically Appropriate Instructional Intervention Implemented (Reading interventions that correspond to the purposed area of weakness should be implemented (i.e. phonological, orthographic, working memory).** | **Dates of Intervention** | **Is *progress* being made when compared to peers (for CLD students compare to CLD peers)?** |
|---|---|---|
| | | Yes No |
| | | Yes No |
| | | Yes No |

**Progress Monitoring Data** (At least one of the following repeated progress monitoring probes must be administered)**:**

| **PERFORMANCE relative to Grade Empirically-derived Criterion Assessments** | **Criteria for Academic Weakness** | **Administered (dates)** | **Data Indicates an Academic Weakness** |
|---|---|---|---|
| Repeated Phoneme Segmentation Probes (for students with a weakness in phonological processing). | 4 data probes ≤16th %ile, or indicating a need for Tier III Intervention (e.g. DIBELS "Intensive") | ☐ | Yes No |
| Repeated Letter/Word ID Probes (for students with a weakness in either phonological or orthographic processing). | 4 data probes ≤16th %ile, or indicating a need for Tier III Intervention (e.g. DIBELS "Intensive") | ☐ | Yes No |

**State Assessment**

| **ACHIEVEMENT relative to STATE STANDARDS Curriculum/Grade Leveled Assessments** | **Criteria for Academic Weakness** | **Administered (dates)** | **Data Indicates an Academic Weakness** |
|---|---|---|---|
| Oregon State Assessment – Reading | Not Met (current year)<br>≤16th %ile previous years | ☐ | Yes No |

**Report Cards/Classroom Assessment**

| **PERFORMANCE relative to STATE STANDARDS Curriculum/Grade Leveled Assessments** | **Criteria for Academic Weakness** | **Administered (dates)** | **Data Indicates an Academic Weakness** |
|---|---|---|---|
| Standards-based report card – Reading, L/A | Not yet, D, F | ☐ | Yes No |
| Teacher-scored reading assessment from curriculum | Not passing or <60% | ☐ | Yes No |
| Graded reading assignment from curriculum | Not passing or <60% | ☐ | Yes No |

## Reading Fluency (RF)
## Development of Working Hypothesis

Guiding Statement:
Reading fluency is the most recent addition to the classification model in the federal language around Specific Learning Disabilities. Although the measurement of reading fluency is relatively straightforward, it involves a number of processes that are highly correlated. Poor reading fluency may also be primarily caused by word-level reading and phonological deficits, although evidence for a fluency-only subtype of learning disability does exist. Basic psychological processes primarily involved in reading fluency include attention, language, memory and learning (working memory, long-term memory retrieval, rapid naming), metacognition, and speed of cognitive processing. For students who exhibit a weakness in the area of fluency and/or processing speed, a reading fluency intervention (e.g. Read Naturally) is recommended. If the student is exhibiting a weakness in their accuracy as well as their fluency, they should be provided with fluency level intervention at their 92-95% accuracy level along with basic reading skills instruction to increase accuracy. For students who exhibit a weakness in their working memory, a multi-sensory based reading intervention is recommended in addition to reading fluency interventions.

Purpose:
Formulate hypothesis about the nature of the difficulty and develop an intervention and progress monitoring plan across all tiers of support and assist in determining if a learning disability is suspected.

**Reading Fluency (RF): Check box to the right if description applies.**

| **Hypothesized Academic Indicator Descriptions – Accuracy** | |
|---|---|
| Problems accurately identifying individual letters | |
| Substitution of words | |
| Difficulty using context to correctly identify words | |
| Frequently guesses at words | |
| Makes careless errors | |
| Missing phonemes in the middle or end of words | |
| Problems with reading words in isolation | |
| **Hypothesized Academic Indicator Descriptions – Fluency** | |
| Problems quickly associating a letter with a sound | |
| Increased effort when naming letters | |
| Frequent pauses in between words in connected text | |
| Difficulty reading simple connecting or function words such as *that, an, in, the, etc.* | |
| Oral reading that is choppy or dysfluent | |
| Problems with reading words in isolation | |
| Inability to finish reading tasks or tests in a reasonable amount of time | |
| **General** | |
| Family history of learning disability | |

| **Performance Relative to Intellectual development** | **Check if Description Applies:** | **Psychological Processing Area** |
|---|---|---|
| Difficulty finding the right word to say or slow, labored, or limited amount of speech | | Language |
| Frequently asks for directions to be repeated or gets lost in the middle of a problem | | Working Memory |
| Does well on daily assignments but doesn't do well on formative assessment/end of week tests | | Long Term Memory |
| Takes longer to compete tasks than others the same age. Slow reading speed. Need to reread for understanding. | | Processing Speed |
| Difficulty naming learned numbers, letters or names quickly, or substitutes the wrong name or word, has words on "the tip of the tongue" but can't remember, takes long pauses in speaking, uses the wrong word or "speaks around" a word or someone's name, has difficulty recalling known words from a particular category. | | Speed of Lexical Access |
| Spells irregular words phonetically rather than by their visual pattern | | Orthographic |
| Mind appears to go blank, gets overwhelmed with difficult tasks, or can't pay attention for long, unusual or erratic patterns of error, easily distracted from relatively mundane tasks, inattentiveness to errors, problems when focusing on more than one thing at a time. Difficulty figuring out what is needed for a task, getting started, or sticking to a plan of action, does not anticipate the time or sequence necessary for task completion. | | Attention and Executive Functions |

| **Culturally and Linguistically Appropriate Instructional Intervention Implemented** | **Dates of Intervention** | **Is *progress* being made when compared to peers (for CLD students compare to CLD peers)?** |
|---|---|---|
| | | Yes<br>No |
| | | Yes<br>No |
| | | Yes<br>No |

**Progress Monitoring Data** (At least one of the following repeated progress monitoring probes must be administered)**:**

| **PERFORMANCE relative to Grade Empirically-derived Criterion Assessments** | **Criteria for Academic Weakness** | **Administered (dates)** | **Data Indicates an Academic Weakness** |
|---|---|---|---|
| Repeated Letter Naming Fluency or Repeated Oral Reading Fluency | 4 data probes ≤16th %ile or indicating a need for Tier III Intervention (e.g. DIBELS "Intensive") | ☐ | Yes<br>No |

**State Assessment**

| **ACHIEVEMENT relative to STATE STANDARDS Curriculum/Grade Leveled Assessments** | **Criteria for Academic Weakness** | **Administered (dates)** | **Data Indicates an Academic Weakness** |
|---|---|---|---|
| Oregon State Assessment – Reading | Not Met (current year)<br>≤16th %ile previous years | ☐ | Yes<br>No |

**Report Cards/Classroom Assessment**

| **PERFORMANCE relative to STATE STANDARDS Curriculum/Grade Leveled Assessments** | **Criteria for Academic Weakness** | **Administered (dates)** | **Data Indicates an Academic Weakness** |
|---|---|---|---|
| Standards-based report card – Reading, L/A | Not yet, D, F | ☐ | Yes<br>No |
| Reading Logs | Not passing or <60% | ☐ | Yes<br>No |

**Reading Comprehension (RC)**
**Development of Working Hypothesis**

Guiding Statement:
For the majority of students, reading comprehension problems are related fundamentally to decoding problems at the individual word level. For example, many students age six to eight, phonemic awareness deficits may impact basic reading skills and therefore affect reading comprehension. In later teen years, students with auditory processing problems may also experience difficulty with subject area vocabulary and reading comprehension. Nevertheless, there is evidence that a percentage of students demonstrate poor comprehension despite adequate decoding ability (Catts, 2003). Students with poor reading comprehension may lack not only poor decoding, but also comprehension in oral listening tasks and/or written language (Berninger, 2007). Poor fluency with reading tasks can also negatively impact overall comprehension. Therefore, it is unlikely that any single underlying source may be solely attributed to poor reading comprehension (Cain, 2006). Core basic psychological processes contributing to reading comprehension may include attention, language use (including listening comprehension and vocabulary development), memory and learning (e.g., working memory), metacognition, problem-solving/judgment (including making inferences and deductions), and processing speed. Students with a weakness in the area of language would benefit from systematic and explicit reading comprehension interventions that incorporate language including semantic, morphological, and syntactic awareness instruction. Student with a weakness in the area of working memory, attention, and executive functions would benefit from a multi-sensory reading comprehension intervention.

Purpose:
Formulate hypothesis about the nature of the difficulty and develop an intervention and progress monitoring plan across all tiers of support and assist in determining if a learning disability is suspected.

| **Hypothesized Indicator descriptions (check to right if description applies)** | **Check if description applies:** |
|---|---|
| Difficulty understanding oral directions at an age/grade appropriate level | |
| Uses imprecise vocabulary | |
| Trouble remembering what was read | |
| Difficulty retelling a story | |
| Problems defining vocabulary | |
| Trouble recalling relevant detail from a passage | |
| Difficulty retelling a sequence of consecutive actions | |
| Problems drawing an accurate picture from an age appropriate orally presented story | |
| Problems with cloze or maze reading tasks | |
| Difficulty providing possible outcomes in a given unfinished story | |
| Problems identifying inconsistencies in a contrived story | |
| Problems sorting and sequencing randomized sentences from the same story (story anagram) | |
| Difficulty with inference tasks (providing missing elements, elaboration on detail, etc.) | |
| Family history of learning disability | |

| **Performance Relative to Intellectual development** | **Check if Description Applies:** | **Psychological Processing Area** |
|---|---|---|
| Difficulty finding the right word to say or slow, labored, or limited amount of speech | | Language |
| Frequently asks for directions to be repeated or gets lost in the middle of a problem | | Working Memory |
| Does well on daily assignments but doesn't do well on formative assessment/end of week tests. Difficulty recalling facts and related concepts/ideas. Difficulty with memorization. Difficulty with word retrieval. | | Long Term Memory |
| Difficulty with conceptual thinking, understanding how ideas are interrelated and forming conclusions | | Fluid Reasoning |
| Mind appears to go blank, gets overwhelmed with difficult tasks, or can't pay attention for long, unusual or erratic patterns of error, easily distracted from relatively mundane tasks, inattentiveness to errors, problems when focusing on more than one thing at a time. Difficulty figuring out what is needed for a task, getting started, or sticking to a plan of action, does not anticipate the time or sequence necessary for task completion. | | Attention and Executive Functions |

| **Culturally and Linguistically Appropriate Instructional Intervention Implemented (Reading interventions that correspond to the purposed area of weakness should be implemented (Instructional intervention should correspond with suspected area of weakness (i.e. language based comprehension strategies, multi-sensory instructional strategies).** | **Dates of Intervention** | **Is *progress* being made when compared to peers (for CLD students compare to CLD peers)?** |
|---|---|---|
| | | **Yes**<br>**No** |
| | | **Yes**<br>**No** |
| | | **Yes**<br>**No** |

**Progress Monitoring Data** (At least one of the following repeated progress monitoring probes must be administered)**:**

| **PERFORMANCE relative to Grade**<br>**Empirically-derived Criterion Assessments** | **Criteria for Academic Weakness** | **Administered (dates)** | **Data Indicates an Academic Weakness** |
|---|---|---|---|
| Repeated Multiple Choice RC | 4 data probes ≤16th %ile or indicating a need for Tier III Intervention | ☐ | Yes<br>No |
| Repeated Reading Maze CBM | 4 data probes ≤16th %ile or indicating a need for Tier III Intervention | ☐ | Yes<br>No |

**State Assessment**

| **ACHIEVEMENT relative to STATE STANDARDS Curriculum/Grade Leveled Assessments** | **Criteria for Academic Weakness** | **Administered (dates)** | **Data Indicates an Academic Weakness** |
|---|---|---|---|
| Oregon State Assessment – Reading | Not Met (current year)<br>≤16th %ile previous years | ☐ | Yes<br>No |

**Report Cards/Classroom Assessment**

| **PERFORMANCE relative to STATE STANDARDS Curriculum/Grade Leveled Assessments** | **Criteria for Academic Weakness** | **Administered (dates)** | **Data Indicates an Academic Weakness** |
|---|---|---|---|
| Standards-based report card – Reading, L/A | Not yet, D, F | ☐ | Yes<br>No |
| Teacher-scored reading/vocab from curriculum | Not passing or <60% | ☐ | Yes<br>No |
| Graded reading comp activity from curriculum | Not passing or <60% | ☐ | Yes<br>No |

## Written Expression (WE)
## Development of Working Hypothesis

Guiding Statement:
Written language disabilities co-occur with reading disabilities about 75% of the time (Katusic et. al, 2009) but they may exist separately. Current research tends to group written language disorders into three brain-based categories. The first two categories are dysgraphia (poor handwriting related to impaired orthographic memory and processing) and dyslexia (see Basic Reading Skills) (Mather & Wendling, 2011). Dysgraphia and dyslexia can be caused by deficits in phonological, orthographic, or morphological memory. Both conditions affect basic writing skills (i.e., spelling and editing). They may also affect writing speed. The third category of written language disorders is Oral and Written Language Disorder (OWL-LD) (Berninger, 2011). Students with OWL LD are sometimes made eligible for special education services under the category of Communication Disordered (CD) because their disability may affect the primary areas of language: semantics, syntax, and morphology. OWL LD students may also have difficulty with basic writing skills. Teams should be aware that other disabilities in executive functions (e.g., ADHD, ASD) might also impair students' written expression achievement. Current federal guidelines require teams to examine only written expression as an eligibility category. However, teams are encouraged to be mindful of the components of brain-based written language categories because of their relevance to academic intervention. The basic psychological processes of written expression are language, working memory, fluid reasoning, processing speed, sensory motor, attention, and executive functions. Students with primarily dysgraphia/dyslexia indicators would benefit from explicit handwriting and spelling instruction. Phonics based instruction should be used to address phonetically inaccurate spelling errors and morphological strategies should be used to address spelling errors that are phonetically accurate. Students with an OWL SLD subtype would benefit from language based instructional strategies including semantic, morphological and syntactic awareness instruction.

Purpose:
Formulate hypothesis about the nature of the difficulty and develop an intervention and progress monitoring plan across all tiers of support and assist in determining if a learning disability is suspected.

**Written Expression (WE): Check box to the right if description applies.**

| **Hypothesized Indicator Descriptions; Dysgraphia, Dyslexia** | |
|---|---|
| Poor visual format (spacing, paragraphs, indentation, margins, etc.) | |
| Poor spelling (phonological, additional syllables, etc.) spells words how they sound rather than as they should look (srkoll for circle). | |
| Limited use of punctuation, incorrect punctuation | |
| Incorrect or missing capitalizations | |
| Poor decoding/reading skills | |
| Poor letter formation | |
| Consistently confuses similarly shaped letters (b/d, p/g, p/q, n/u, m/w) or order of letters (from vs. form) | |
| **Hypothesized Indicator Descriptions; OWL LD** | |
| Poor narrative (consistent style, point of view, etc.) | |
| Demonstrates poor grammatical structure (verb tense, subject verb agreement, etc.) | |
| Uses poor semantics (words with wrong meaning) | |
| Does not correct mistakes (revising for content, mechanics, etc.) | |
| Problems with vocabulary (age appropriate words, descriptive, imaginative) | |
| Poor descriptive quality | |
| Poor organization | |
| **General** | |
| Family history of learning disability | |

☐ Primarily handwriting and spelling (dysgraphia, dyslexia)
☐ Primarily written expression (OWL LD)
☐ Combination of both types

| **Performance Relative to Intellectual development** | **Check if Description Applies:** | **Psychological Processing Area** |
|---|---|---|
| Difficulty finding the right word to say or slow, labored, or limited amount of speech. Difficulty comprehending language and learning vocabulary. | | Language |
| Frequently asks for directions to be repeated or gets lost in the middle of a problem or assignment. Tendency to lose track when working on sequential activities. Difficulty with multi-tasking. | | Working Memory |
| Difficulty with conceptual thinking, understanding how ideas are interrelated and forming conclusions | | Fluid Reasoning |
| Takes longer to compete tasks than others the same age | | Processing Speed |
| Difficulty figuring out what is needed for a task, getting started, or sticking to a plan of action, does not anticipate the time or sequence necessary for task completion. Mind appears to go blank, gets overwhelmed with difficult tasks, or can't pay attention for long, unusual or erratic patterns of error , easily distracted from relatively mundane tasks, inattentiveness to errors, problems when focusing on more than one thing at a time | | Attention and Executive Functions |

| **Culturally and Linguistically Appropriate Instructional Intervention Implemented (Interventions should correspond to suspected area(s) of weakness (i.e. explicit handwriting and/or spelling instruction for students with Dyslexia/Dysgraphia subtype and language based strategies for students with an OWL LD subtype).** | **Dates of Intervention** | **Is *progress* being made when compared to peers (for CLD students compare to CLD peers)?** |
|---|---|---|
| | | Yes No |
| | | Yes No |
| | | Yes No |

**Progress Monitoring Data:**

| **PERFORMANCE relative to Grade Empirically-derived Criterion Assessments** | **Criteria for Academic Weakness** | **Administered (dates)** | **Data Indicates an Academic Weakness** |
|---|---|---|---|
| Repeated Written Expression CBM Probes | 4 data probes ≤ 16th %ile or indicating a need for Tier III Intervention | ☐ | Yes No |

**State Assessment**

| **ACHIEVEMENT relative to STATE STANDARDS Curriculum/Grade Leveled Assessments** | **Criteria for Academic Weakness** | **Administered (dates)** | **Data Indicates an Academic Weakness** |
|---|---|---|---|
| Oregon State Assessment – Writing | Not Met (current year)<br>≤16th %ile previous years | ☐ | Yes No |

**Report Cards/Classroom Assessment**

| **PERFORMANCE relative to STATE STANDARDS Curriculum/Grade Leveled Assessments** | **Criteria for Academic Weakness** | **Administered (dates)** | **Data Indicates an Academic Weakness** |
|---|---|---|---|
| State Writing Work Sample Rubric | Score of 3 or below in the majority of areas | ☐ | Yes No |
| Standards-based report card – Writing | Not yet, D, F | ☐ | Yes No |
| Graded Writing Samples from Curriculum | Not passing or <60% | ☐ | Yes No |

**Math Calculation (MC)**
**Development of Working Hypothesis**

Guiding Statement:
Math calculation skills have generally been conceptualized and evaluated as paper-and-pencil math computations. However, brain-based math calculation skill development is somewhat more complex. Researchers have examined developmental elements such as number sense (immediately apprehending exact quantities of small collections of objects and the approximate magnitudes of larger collections, estimation, and making small adjustments in numbers of items relatively automatically) and counting knowledge and strategies (1:1 correspondence, stable order, cardinality, abstraction, etc.). There are three subtypes of brain-based math disabilities: procedural, semantic, and visuospatial (Geary et al. 2011). Math calculation activities may be affected by any of these. These distinctions become important in both assessment and intervention for math calculation and math reasoning problems. Their characteristics are listed below. The type of math instruction in schools may also play a role in diagnosis and intervention. Nearly a decade of math instruction has emphasized conceptual problem solving which may have resulted in a reduced emphasis on instruction in basic number skills (Geary, 2004). Cognitive correlates of calculation skills have been centered on executive functions (particularly inhibiting irrelevant items), attention, memory and learning (working memory, long-term storage and retrieval, and rapid naming), meta-cognition (sequential reasoning), problem solving (particularly quantitative reasoning), and speed of cognitive processing.

Purpose:
Formulate hypothesis about the nature of the difficulty and develop an intervention and progress monitoring plan across all tiers of support and assist in determining if a learning disability is suspected.

**Math Calculation (MC): Check box to the right if description applies.**

| **Hypothesized Symptom Descriptions : Semantic** | |
|---|---|
| When facts are retrieved, there is a high error rate | |
| Problems with rapid number identification | |
| Early delays in counting objects or object sets | |
| Errors are often “neighbors” of the numbers in the problem (e.g., 2 + 5 = 6) | |
| Require excessive repetition of math facts for learning | |
| Difficulty retrieving math facts such as answers to simple math problems | |
| Gets the same problem wrong after solving it correctly earlier | |
| Delayed response times on simple counting or computations | |
| **Hypothesized Symptom Descriptions : Procedural** | |
| Errors in regrouping process including column alignment, 0’s, decrementing | |
| Uses inefficient or ineffective strategies when solving simple problems | |
| Lack of understanding of concepts underlying use of certain procedures | |
| Uses less mature procedures for computations (finger counting, counting all) | |
| Problems with sequence or order in computations | |
| **Hypothesized Symptom Descriptions : Visual** | |
| Difficulty understanding geometric concepts and relationships | |
| Difficulty making charts or visuals from equations | |
| Difficulty with graphs, charts, and other visual math | |
| **General** | |
| Family history of learning disability | |

| **Performance Relative to Intellectual development** | **Check if Description Applies:** | **Psychological Processing Area** |
|---|---|---|
| Difficulty with mental math. Frequently asks for directions to be repeated or gets lost in the middle of a problem or assignment. Tendency to lose track when working on sequential activities. Difficulty with multi-tasking. | | Working Memory |
| Does well on daily assignments but doesn’t do well on formative assessment/end of week tests. Difficulty recalling facts and related concepts/ideas. Difficulty with memorization. Difficulty with word retrieval. | | Long Term Storage and Retrieval |
| Difficulty with conceptual understanding | | Fluid Reasoning |
| Takes longer to compete tasks than others the same age | | Processing Speed |
| Difficulty naming learned numbers, letters, or names quickly, or substitutes the wrong name or word, has words on “the tip of the tongue” but can’t remember, takes long pauses in speaking, uses the wrong word or “speaks around” a word or someone’s name, has difficulty recalling known words from a particular category | | Speed of Lexical Access |
| Difficulty with numeral and math symbols | | Orthographic Processing |
| Mind appears to go blank, gets overwhelmed with difficult tasks, or can’t pay attention for long, unusual or erratic patterns of error, easily distracted from relatively mundane tasks, inattentiveness to errors, problems when focusing on more than one thing at a time. Difficulty figuring out what is needed for a task, getting started, or sticking to a plan of action, does not anticipate the time or sequence necessary for task completion | | Executive Functions and Attention |

| **Culturally and Linguistically Appropriate Instructional Intervention Implemented** | **Dates of Intervention** | **Is *progress* being made when compared to peers (for CLD students compare to CLD peers)?** |
|---|---|---|
| | | Yes<br>No |
| | | Yes<br>No |
| | | Yes<br>No |

**Progress Monitoring Data** (At least one of the following repeated progress monitoring probes must be administered)**:**

| **PERFORMANCE relative to Grade Empirically-derived Criterion Assessments** | **Criteria for Academic Weakness** | **Administered (dates)** | **Data Indicates an Academic Weakness** |
|---|---|---|---|
| Repeated digits-correct computation probes | 4 data probes ≤16th %ile or indicating a need for Tier III Intervention | ☐ | Yes No |
| Repeated counting strategy probes | 4 data probes ≤16th %ile or indicating a need for Tier III Intervention | ☐ | Yes No |
| Repeated fluent number identification probes | 4 data probes ≤16th %ile or indicating a need for Tier III Intervention | ☐ | Yes No |
| Repeated numbers reversed working memory probes | 4 data probes ≤16th %ile or indicating a need for Tier III Intervention | ☐ | Yes No |

**State Assessment**

| **ACHIEVEMENT relative to STATE STANDARDS Curriculum/Grade Leveled Assessments** | **Criteria for Academic Weakness** | **Administered (dates)** | **Data Indicates an Academic Weakness** |
|---|---|---|---|
| Oregon State Assessment – Math | Not Met (current year)<br>≤16th %ile previous years | ☐ | Yes No |

**Report Cards/Classroom Assessment**

| **PERFORMANCE relative to STATE STANDARDS Curriculum/Grade Leveled Assessments** | **Criteria for Academic Weakness** | **Administered (dates)** | **Data Indicates an Academic Weakness** |
|---|---|---|---|
| Standards-based report card – Math | Not yet, D, F | ☐ | Yes No |
| Teacher-scored math computation worksheets | Not passing or <60% | ☐ | Yes No |
| Teacher-scored math computation worksheets | Not passing or <60% | ☐ | Yes No |

**Math Problems Solving (MPS)**
**Development of Working Hypothesis**

Guiding Statement:
Geary and his colleagues (2011) have identified three types of brain-based math disabilities: 1) procedural 2) semantic, and 3) visuospatial. All three types of disabilities may affect math reasoning skills because math story problems are varied enough to tax each brain system. However, the majority of students with semantic math disabilities will have math reasoning difficulties and also have reading problems. Language skills and their correlates are required as a first step to conceptualize math story problems and then as a second step in accurately and fluently retrieving math language and facts from long-term memory. Cognitive correlates of reasoning skills include executive functions (particularly inhibiting irrelevant items), attention, visual spatial, language use, memory and learning (working memory, long-term storage and retrieval), meta-cognition (sequential reasoning), problem solving (particularly quantitative reasoning), and speed of cognitive processing.

Purpose:
Formulate hypothesis about the nature of the difficulty and develop an intervention and progress monitoring plan across all tiers of support and assist in determining if a learning disability is suspected.

**Math Problem Solving (Math Problem Solving): Check box to the right if description applies.**

| **Hypothesized Symptom Descriptions: Semantic** | |
|---|---|
| When facts are retrieved, there is a high error rate | |
| Problems with rapid number identification | |
| Early delays in counting objects or object sets | |
| Errors are often "neighbors" of the numbers in the problem (e.g., 2 + 5 = 6) | |
| Require excessive repetition of math facts for learning | |
| Difficulty retrieving math facts such as answers to simple math problems | |
| Gets the same problem wrong after solving it correctly earlier | |
| Delayed response times on simple counting or computations | |
| **Hypothesized Symptom Descriptions: Procedural** | |
| Errors in regrouping process including column alignment, 0's, decrementing | |
| Uses inefficient or ineffective strategies when solving simple problems | |
| Lack of understanding of concepts underlying use of certain procedures | |
| Uses less mature procedures for computations (finger counting, counting all) | |
| Problems with sequence or order in computations | |
| Delayed response times on simple counting or computations | |
| **Hypothesized Symptom Descriptions: Visual** | |
| Difficulty with graphs, charts, and other visual math | |
| Difficulty making charts or visuals from equations | |
| Difficulty understanding geometric concepts and relationships | |
| **General** | |
| Family history of learning disability | |

| **Performance Relative to Intellectual development** | **Check if Description Applies:** | **Psychological Processing Area** |
|---|---|---|
| Difficulty with graphs, charts, and other visual representations | | Visual Spatial |
| Difficulty with math vocabulary | | Language |
| Frequently asks for directions to be repeated or gets lost in the middle of a problem or assignment. Tendency to lose track when working on sequential activities. Difficulty with multi-tasking. | | Working Memory |
| Difficulty with conceptual understanding | | Fluid Reasoning |
| Mind appears to go blank, gets overwhelmed with difficult tasks, or can't pay attention for long, unusual or erratic patterns of error, easily distracted from relatively mundane tasks, inattentiveness to errors, problems when focusing on more than one thing at a time. Difficulty figuring out what is needed for a task, getting started, or sticking to a plan of action, does not anticipate the time or sequence necessary for task completion. | | Attention and Executive Functions |

| Culturally and Linguistically Appropriate Instructional Intervention Implemented | Dates of Intervention | Is *progress* being made when compared to peers (for CLD students compare to CLD peers)? |
|---|---|---|
| | | Yes<br>No |
| | | Yes<br>No |
| | | Yes<br>No |

**Progress Monitoring Data** (At least one of the following repeated progress monitoring probes must be administered)**:**

| PERFORMANCE relative to Grade Empirically-derived Criterion Assessments | Criteria for Academic Weakness | Administered (dates) | Data Indicates an Academic Weakness |
|---|---|---|---|
| Repeated missing number probes | 4 data probes ≤16th %ile or indicating a need for Tier III Intervention | ☐ | Yes<br>No |
| Repeated magnitude comparison probes | 4 data probes ≤16th %ile or indicating a need for Tier III Intervention | ☐ | Yes<br>No |
| Repeated story problem probes | 4 data probes ≤16th %ile or indicating a need for Tier III Intervention | ☐ | Yes<br>No |

**State Assessment**

| ACHIEVEMENT relative to STATE STANDARDS Curriculum/Grade Leveled Assessments | Criteria for Academic Weakness | Administered (dates) | Data Indicates an Academic Weakness |
|---|---|---|---|
| Oregon State Assessment – Math | Not Met (current year)<br>≤16th %ile previous years | ☐ | Yes<br>No |

**Report Cards/Classroom Assessment**

| PERFORMANCE relative to STATE STANDARDS Curriculum/Grade Leveled Assessments | Criteria for Academic Weakness | Administered (dates) | Data Indicates an Academic Weakness |
|---|---|---|---|
| Standards-based report card – Math | Not yet, D, F | ☐ | Yes<br>No |
| Teacher-scored math story problems worksheets | Not passing or <60% | ☐ | Yes<br>No |
| Graded math assessments from curriculum | Not passing or <60% | ☐ | Yes<br>No |

## Cognitive to Achievement Grid

| Cognitive to Achievement Grid | Required Initial Assessments | | | | | | | Additional Assessments | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Visual-Spatial | Language | Working Memory | Long-Term Storage-Retrieval (Learning) | Fluid Reasoning | Processing Speed | Phonological Awareness | Attention and Executive Functions | Speed of Lexical Access | Orthographic Processing |
| Basic Reading Skills | | ♦ | ♦ | ♦ | | ♦ | ♦ | ♦ | ♦ | ♦ |
| Reading Fluency | | ♦ | ♦ | ♦ | | ♦ | | ♦ | ♦ | ♦ |
| Reading Comprehen-sion | | ♦ | ♦ | ♦ | ♦ | | | ♦ | | |
| Math Calculation | | | ♦ | ♦ | ♦ | ♦ | | ♦ | ♦ | ♦ |
| Math Problem Solving | ♦ | ♦ | ♦ | | ♦ | | | ♦ | | |
| Written Expression | | ♦ | ♦ | | ♦ | ♦ | | ♦ | | |

Directions: This grid is designed as an overview of the most likely basic psychological processes involved in each federally defined area of academic achievement skill. As with all basic psychological events, there is overlap between processes as well as across/among academic domains.

♦ = Relationship between cognitive process and academic achievement area.

## ACHIEVEMENT Relative to AGE
## Norm Referenced Assessments

**The following clusters and subtests can be used to assess Achievement Relative to Age.** These scores should be corroborated by progress monitoring data, state assessment data if available, and report cards and classroom assessments. **Cluster Scores** are in **bold type**. Subtest scores are in regular type.

***BASIC READING SKILLS***

| ***ACHIEVEMENT relative to AGE Norm Referenced Assessments*** | ***Criteria for an Academic Weakness*** |
|---|---|
| **KTEA-3 Decoding Composite** | ≤16th %ile; SS≤85 |
| **WJ-IV ACH Basic Reading Skills** | ≤16th %ile; SS≤85 |

***READING FLUENCY***

| ***ACHIEVEMENT relative to AGE Norm Referenced Assessments*** | ***Criteria for an Academic Weakness*** |
|---|---|
| **KTEA-3 Reading Fluency Composite** | ≤16th %ile; SS≤85 |
| **WJ-IV Reading Fluency** | ≤16th %ile; SS≤85 |

***READING COMPREHENSION***

| ***ACHIEVEMENT relative to AGE Norm Referenced Assessments*** | ***Criteria for an Academic Weakness*** |
|---|---|
| **KTEA-3 Reading Understanding Composite** | ≤16th %ile; SS≤85 |
| **WJ-IV ACH Reading Comprehension** | ≤16th %ile; SS≤85 |

***MATH CALCULATION***

| ***ACHIEVEMENT relative to AGE Norm Referenced Assessments*** | ***Criteria for an Academic Weakness*** |
|---|---|
| **KTEA-3 Math Composite** | ≤16th %ile; SS≤85 |
| KTEA-3 Math Computation | ≤16th %ile; SS≤85 |
| **WJ-IV Math Calculation Skills** | ≤16th %ile; SS≤85 |

***MATH REASONING***

| ***ACHIEVEMENT relative to AGE Norm Referenced Assessments*** | ***Criteria for an Academic Weakness*** |
|---|---|
| **KTEA-3 Math Composite** | ≤16th %ile; SS≤85 |
| KTEA-3 Math Concepts and Applications | ≤16th %ile; SS≤85 |
| WJ-IV Math Problem Solving | ≤16th %ile; SS≤85 |

***WRITTEN EXPRESSION***

| ***ACHIEVEMENT relative to AGE Norm Referenced Assessments*** | ***Criteria for an Academic Weakness*** |
|---|---|
| **KTEA-3 Written Language Composite** | ≤16th %ile; SS≤85 |
| KTEA-3 Written Expression | ≤16th %ile; SS≤85 |
| **WJ-IV ACH Written Language** | ≤16th %ile; SS≤85 |
| **WJ-IV ACH Written Expression** | ≤16th %ile; SS≤85 |

## Basic Psychological Processes

## Required Initial Assessments

### Visual-Spatial (Gv)

Visual-Spatial abilities help generate, perceive, analyze, synthesize, manipulate, transform and think with visual patterns and stimuli. These abilities should not be confused as measures of sight (vision), but rather as indicators of more complex cognitive activities after visual perception has occurred. “Narrow,” or specific, visual-spatial abilities include spatial relations, visual-perceptual organization and reasoning, visual memory, visualization, spatial scanning, and visual planning. Visual processing abilities are related to math problem solving.

### Language (Gc)

Language abilities involve using verbal information to define concepts and solve problems. They refer to the breadth and depth of a person’s acquired knowledge of a culture and the effective application of that knowledge. This ability is sensitive to cultural, linguistic, educational, and environmental factors; as is true of all assessment data, these factors should be taken into account when interpreting this psychological processing area. Language abilities are important for the development of reading and writing skills and math problem solving and increase in importance with age.

### Working Memory (MW)

Working memory is the capacity to hold information in mind for the purpose of 1) temporarily maintaining and 2) simultaneously processing information. Working memory is required to efficiently analyze, reconfigure, and encode information that must be stored into long-term memory. Working memory may be represented by auditory means (e.g., phonological loop) or by visual means (e.g., visual-spatial sketchpad). Teams may also consider other aspects of memory as basic psychological abilities. Working memory is important for the acquisition of skill mastery that leads to automatic reading, writing and math processes.

### Long-Term Memory Storage and Retrieval - Learning (Glr)

Long-term memory storage and retrieval is the ability to 1) store information in long-term memory and 2) quickly and accurately retrieve previously learned information from long-term memory. Long-term storage includes associative memory (also known as paired-associate learning or sound/symbol encoding). Long-term retrieval begins within a few minutes or hours of learning a task. Retrieval includes ideational fluency, word fluency (quickly producing words that have specific phonemic, structural, or orthographic characteristics), and rapid automatic naming. Long-Term Memory is important for the development of all reading skills and for math calculation.

### Fluid Reasoning (Gf)

Fluid reasoning refers to the mental operations used when faced with a novel task that cannot be performed automatically. These metal operations may include forming and recognizing concepts, perceiving relationships among patterns, drawing inferences, comprehending implications, using inductive reasoning, problem solving, and extrapolating. Fluid reasoning also includes general sequential reasoning: hypothesizing, planning, initiating, monitoring performance, and analyzing results. This psychological processing area is important for math, written expression, and reading comprehension.

### Processing Speed (Gs)

Processing speed is the ability to make fast and accurate decisions on relatively familiar tasks under timed conditions. Processing speed is important for basic reading skills, reading fluency, math calculation, and written expression.

**Phonological Awareness**

Phonological awareness includes; rhyming, phoneme segmentation, phoneme deletion, elision, phoneme isolation, phoneme blending, phoneme matching, and phoneme substitution. Phonological awareness is highly predictive of deficits in basic reading skills.

## Additional Assessments

Because of the extensive research literature regarding the following processes, teams may use them when determining PSW.

**Executive Functions and Attention**

Attention and executive functions are the ability to be alert and pay attention when working on problems in a systematic way. Executive functions include directive capacities that are responsible for a person's ability to engage in purposeful, organized, strategic, self-regulated, goal-directed behavior to accomplish a task. Types of attention include sustained attention (the ability to stay on task, often measured by tests of continuous performance), focused attention (focusing on only the right material and inhibiting wrong responses when necessary), shifting attention (refocusing on a new task and/or avoiding "getting stuck" on one task), and divided attention (responding to more than one task or type of information simultaneously by means of "rapid automatic switching"). Executive functions and attention affect all areas of academics.

**Speed of Lexical Access**

Speed of lexical access includes the ability to rapidly and fluently retrieve words. This processing area also includes rapid automatic naming (RAN) or the ability to rapidly produce names when presented with a pictorial or verbal cue. Speed of lexical access is related to fluid retrieval from long-term memory and to processing speed. Speed of lexical access is important for basic reading skills, reading fluency, and math calculation.

**Orthographic Processing**

Orthographic processing is the rapid and accurate recognition of alphabet letters and numbers, letter and number groups, or whole words. Orthographic processing includes the rapid and accurate formation of word images in memory. "Individuals with orthographic dyslexia often have difficulty recalling sight words and, subsequently, are slow to develop fluency and automaticity…in decoding (reading) or encoding (spelling) skills…One common characteristic of individuals with orthographic dyslexia is that they have difficulty storing mental representations of phonetically irregular words or gestalts. As a result, they rely primarily on phonic principles for reading and produce misspellings that have good phonetic resemblance to target words." Roberts, R. & Mather, N. (1997). Orthographic dyslexia: The neglected subtype. *Learning Disabilities Research & Practice, 12,* 236-250. Orthographic processing is important for basic reading skills, reading fluency, and math calculation skills.

## ACHIEVEMENT RELATIVE TO INTELLECTUAL DEVELOPMENT-REQUIRED ASSESSMENTS

**Composite Scores** are in **bold type**. Subtest scores are in regular type. Scores used to determine a PSW in basic psychological process must either be a composite score or a score comprised of two or more subtests from within one process (within a column).

BRS: Basic Reading Skills — RF: Reading Fluency — RC: Reading Comprehension
MC: Math Calculation — MPS: Math Problem Solving — WE: Written Expression

| Proces | Visual-Spatial | Language | Working Memory | Long-Term Storage & Retrieval (Learning) | Fluid Reasoning | Processing Speed | Phonological Awareness |
|---|---|---|---|---|---|---|---|
| Area | | **BRS, RF, RC** | **BRS, RF, RC** | **BRS, RF, RC** | **RC** | **BRS, RF** | **BRS** |
| | **MPS** | **MPS** | **MC, MPS** | **MC** | **MC, MPS** | **MC, MPS** | |
| | | **WE** | **WE** | | **WE** | **WE** | |
| WJ-IV | ***WJ IV COG Visual Processing*** | ***WJ-IV COG Verbal Comp***<br>***WJ-IV Oral Oral Language*** | ***WJ-IV COG Short Term Working Memory***<br>*Object Number Sequencing* | ***WJ IV COG Long-Term Memory Storage and Retrieval*** | ***WJ IV COG Fluid Reasoning***<br>*Analysis Synthesis* | ***WJ-IV COG Processing Speed***<br>***WJ-IV COG Perceptual Speed*** | **WJ IV Oral Phonetic Coding,**<br>Sound Awareness<br>WJ-IV COG Phonological Processing |
| WISC-V | ***WISC-V Visual Spatial*** | ***WISC-V Verbal Comprehension***<br>*Information*<br>*Comprehension* | ***WISC-V Working Memory*** | ***WISC-V Symbol Translation and/or Storage and Retrieval*** | ***WISC-V Fluid Reasoning***<br>*Picture Concepts*<br>*Arithmetic* | ***WISC-V Processing Speed***<br>*Cancellation* | |
| KABC-II, | ***KABC-II Simultaneous*** | ***KABC-II Knowledge***<br>*KTEA-3 Listening Comprehension*<br>*Oral Expression* | ***KABC-II Sequential*** | ***KABC-II Learning*** | ***KABC-II Planning*** | | *KTEA-3 Phonological Processing* |
| DAS II | ***DAS-II Spatial*** | ***DAS-II Verbal*** | ***DAS-II Working Memory*** | | ***DAS-II Nonverbal Reasoning*** | ***DAS-II Processing Speed*** | *DAS-II Phonological Processing* |
| CELF-V | | ***CELF-V Expressive Language*** | ***CELF-V Working Memory*** | | | | |
| CTOPP-2 | | | ***CTOPP -2 Phonological Memory*** | | | | ***CTOPP-2 Phonological Awareness***<br>Blending Non Words<br>Segmenting Non Words |
| SB5 | ***SB5 Visual-Spatial Processing*** | ***SB5 Verbal and Non-Verbal Knowledge*** | ***SB5 Working Memory*** | | ***SB5 Fluid Reasoning*** | | |
| Other | ***NEPSY-II Visuospatial Processing Tests***<br>*PAL-II Spatial WM*<br>*Leiter-3 Form Completion.*<br>*Figure Ground* | | *NEPSY-II Auditory Attention and Response Set, Inhibition*<br>***PAL-II Working Memory***<br>*Leiter-3 Attention Divided*<br>*Leiter-3 Reverse Memory* | *NEPSY-II Narrative Memory, Memory for Designs Delayed, Memory for Faces Delayed, Memory for Names/Delayed*<br>*PAL-II Numeric Coding* | *NEPSY-II Animal Sorting*<br>*Leiter-3 Sequential Order and Visual Patterns* | ***PAL-II Numeral Writing***<br>*Leiter-3 Attention Sustained Nonverbal Stroop* | *NEPSY-II Phonological*<br>***PAL-II Phonological*** |

## ACHIEVEMENT RELATIVE TO INTELLECTUAL DEVELOPMENT-ADDITIONAL ASSESSMENTS

**Composite Scores** are in **bold type**. Subtest scores are in regular type. Scores used to determine a PSW in basic psychological process must either be a composite score or a score comprised of two or more subtests from within one process (within one column).

BRS: Basic Reading Skills
RF: Reading Fluency
RC: Reading Comprehension
MC: Math Calculation
MPS: Math Problem Solving
WE: Written Expression

| **Process** | **Attention and Executive Functions** | **Speed of Lexical Access** | **Orthographic Processing** |
|---|---|---|---|
| **Area** | **BRS, RF, RC** | **BRS, RF** | **BRS, RF** |
| | **MC, MPS** | **MC** | **MC** |
| | **WE** | | |
| **WJ-IV** | *WJ-IV COG Verbal Attention*<br>*WJ-IV COG Pair Cancellation* | **WJ-IV Oral Speed of Lexical Access** | ***WJ-IV COG Perceptual Speed***<br>*Spelling of Sounds* |
| **WIISC-V** | | ***WISC-V Naming Speed*** | |
| **KABC-II, KTEA-3** | | ***KTEA-3*** *Associational Fluency**,** Letter Naming Facility* | ***KTEA-3 Orthographic Processing*** |
| **CTOPP-2** | | ***CTOPP-2 Rapid Symbolic Naming*** | |
| **NEPSY-II** | ***NEPSY-II Attention and Executive Functions Tests*** | *NEPSY-II Speeded Naming, Word Generation* | |
| **PAL-II** | | ***PAL-II RAN/RAS, RAN Digits and Double Digits*** | ***PAL-II Orthographic Coding****, Orthographic Spelling* |
| **Test of Orthographic Competence** | | | ***Orthographic Ability , Spelling Accuracy, Spelling Fluency*** |

# PERFORMANCE RELATIVE TO INTELLECTUAL DEVELOPMENT

Below is a list of assessments that can be used to assess performance relative to intellectual development. Scores from standardized rating scales are considered strong measures. Scores from non-standardized measures, observations, or task analysis are considered moderate measures. Teams must use professional judgment to determine if there is a corresponding deficit in the "performance relative to intellectual development" domain.

- Confirmed psychological processing indicators on the hypothesis statement
- Classroom and test observations
- Non- standardized semi-structured interviews and observations (e.g. Executive Function Student Observation Form, Executive Function Structured Interview, Thinking Skills Inventory, Ziggurat Checklists)
- Standardized behavior rating scales.

**Standardized Behavior Rating Scales**

**Composite Scores** are in **bold type**. Subtest scores are in regular type. Scores are used to determine corroboration of cognitive test results.

BRS: Basic Reading Skills
RF: Reading Fluency
RC: Reading Comprehension
MC: Math Calculation
MPS: Math Problem Solving
WE: Written Expression

| Process | **Working Memory** | **Attention and Executive Functions** |
|---|---|---|
| Areas | **BRS, RF, RC**<br>**MC, MPS**<br>**WE** | **BRS, RF, RC**<br>**MC, MPS**<br>**WE** |
| BASC-2 | | BASC-2 Attention Problems |
| BRIEF | BRIEF Working Memory | **BRIEF Metacognition Scale** |
| CEFI | CEFI Working Memory | **CEFI Full Scale**<br>Attention |
| Conners-3 | Conners-3 Learning/ Executive | Connors 3-T Inattention |

**Decision Tree for Determining a Pattern of Strengths and Weaknesses for Specific Learning Disability**

Analyze psychological processing results that have been determined to be relevant to the identification of a Specific Learning Disability (*Language, Visual Spatial Thinking, Processing Speed, Phonological Awareness, Long Term Storage and Retrieval, Fluid Reasoning, Working Memory, etc.)* and determine if the student's Cognitive Abilities Facilitating Learning (CAFL) is consistent with a pattern of strengths and weakness relevant to the identification of a Specific Learning Disability.

Is the student's CAFL (see CAFL Decision Tree) consistent with a pattern of strengths and weakness that is relevant to the identification of a Specific Learning Disability?

**YES** **NO**

Is at least one psychological processing area a weakness (see Psychological Processes Results Decision Tree)?

**YES** **NO**

Analyze academic information:

*Standardized achievement scores, progress monitoring data, state test scores, classroom assessments, report cards, hypothesis statements*

Is there at least one academic weakness that is substantiated by standardized achievement testing (≤ SS 85) and academic performance measures?

**YES** **NO**

Is the academic weakness related to the cognitive processing weakness?

**YES** **NO**

Consider whether or not the student's academic weakness is due to exclusionary factors or another disability category.

**NO** **YES**

The eligibility team determines whether or not the student exhibits a pattern of strengths and weakness that is relevant to the identification of a Specific Learning Disability.

**YES** **NO**

The student does not exhibit a pattern of strengths and weaknesses that is determined to be relevant to the identification of a specific learning disability. If indicated, determine if the student is eligible under other special education categories. If the student does not meet eligibility criteria under any special education categories, implement general education accommodations and Tier II and Tier III general education instructional supports based on evaluation findings.

# Psychological Processes Decision Tree

**Cognitive Abilities Facilitating Learning (CAFL) Composite***

The criteria below should be used to determine if the student's CAFL is consistent with a pattern of strengths and weaknesses that is relevant to the identification of a Specific Learning Disability. **You must consider all of the criteria below before determining the student's CAFL is not indicative of a Specific Learning Disability (see CAFL Decision Tree for further guidance**).

- Full Scale, GAI, Gf-Gc, MPI, NVI ≥ SS 90
- X-Bass gValue ≥ .6
- Gf and/or Gc ≥SS85 if there is a related cognitive processing weakness that is a least 10 points below the Gf or Gc score **& there is confirmation of brain based data including confirmed Hypothesis Statements**

*The C-LIM is used to determine CAFL and strengths and weaknesses for CLD students

**Weakness**

Cognitive Cluster or Cross Battery Composite processing score ≤ SS 80

**Strength**

Cognitive Cluster or Cross Battery Composite processing score ≥ SS 90

**Professional Judgment Recommendations**

Cognitive Cluster or Cross Battery Composite processing score SS 81-89

**Weakness**

Cognitive Cluster or Cross Battery Composite processing score SS81-89 that is at least 10 points below the CAFL composite

**Neither**

Cognitive Cluster or Cross Battery Composite processing score SS81-89 that is not at least 10 below the CAFL composite

**Strength**

Cognitive Cluster or Cross Battery Composite processing score SS85-89 that is at least 10 points higher than the related cognitive weakness

**Professional Judgement Scenario Examples**

**Weakness Scenario –** Student has a GAI score of 105, a Phonological Processing score of 85 and a Basic Reading score of 80. Student qualifies with GAI CAFL and related Phonological Processing weakness.

**Strength Scenario** – Student has a Gc score of 89, a Gf score of 89, confirmed brain based hypothesis statement indicators, a phonological processing score of 65 and a basic reading score of 60. Student qualifies with Gc and Gf CAFL "strengths", and phonological processing related weakness.

**Neither Scenario** – Student's Full Scale IQ score is SS85, their highest cognitive score is Gv SS88 and lowest score is Gc SS81. Student does not qualify as all scores fall within the "neither range" and the student does not exhibit a pattern of strengths and weaknesses that are relevant to the identification of a specific learning disability.

**Cognitive Abilities Facilitating Learning (CAFL) Decision Tree**

For all students is there significant variability among cluster scores comprising the Full Scale IQ score?
No — Yes

(No →)
For *CLD students is the Gc score at or above other processing scores? (For Non-CLD students proceed to box below.)
Yes — No

(Yes →)
Consider using **Full Scale IQ.** Is the Full Scale score below SS90?
**Yes**

(Yes →)
1. For Non-CLD students is the student's Gc score near or above other processing areas?
2. For CLD* students, does Gc fall within or above the shaded range on the C-LIM graph?
Yes — No

(Yes →)
1. For all students consider using **X-BASS gValue, GAI, or Gf-Gc** score (if using gValue input SS85-89 as strengths if 10 points above the related weakness, all other SS81-89 should be recorded as weakness for gValue only and may be classified as "neither" in your report.)
2. For CLD* students, if Gc falls within or above the shaded range on the C-LIM graph, record Gc as a strength and Gc SS90, or actual score if above SS90, should be inputted into the X-BASS software
Is the gValue ≥ .6 or is the GAI or Gf-Gc score ≥ SS 90
No

(No →)
Consider using **MPI or NVI**
**Is the MPI or NVI ≥** SS 90
No

(No →)
Is the Gc or Gf score ≥ SS85, at least 10 points above a related cognitive weakness, **AND standardized and performance assessment data both confirm psychological and academic brain based indicators that are consistent with SLD including but not limited to confirmed hypothesis statement indicators?**
No

(No →)
Student does not exhibit a pattern of strengths and weaknesses that is determined to be relevant to the identification of a specific learning disability. Approximately 20% of the school age population falls within this range. Many students falling within this range will require Tier II and Tier III general education interventions. It is recommended that the student receive Tier II and/or Tier III general education interventions at their instructional level in order to maximize their academic achievement.

**Interpretive Statements:**

* C-LIM interpretive statements should be used for CLD students.

The Cognitive Abilities Facilitating Learning (CAFL) composite is comprised of abilities known to be strongly correlated with facilitating academic achievement.

The **(Full Scale IQ)** score was chosen to represent student's CAFL as the student does not exhibit significant variation in their cognitive profile and the Full Scale score was deemed the most reliable and valid score to represent student's overall abilities.

The **(GAI, Gf-Gc, or g-Value)** score was chosen to represent the student's CAFL as there was significant variation in their processing profile and this score is not attenuated by the student's related processing weakness(es).

The **(MPI or NVI)** score was chosen to represent student's CAFL as this score is less impacted by cultural, environmental, educational, and linguistic factors.

The **(Gc or Gf)** score was chosen to represent the student's CAFL as there was significant variation in the student's psychological processing profile *(add for Gf only) and this score is less impacted by cultural, environmental, educational, and linguistic factors.* Though student's overall cognitive ability may be a contributory factor to the student's learning difficulties, this student also exhibits academic and psychological brain based indicators consistent with a Specific Learning Disability.

# PSW Evaluation Results Worksheet

**PPS Strengths/Weaknesses Chart** (PPS thanks Eugene 4J School District for their permission to adapt its form.)

| | Basic Reading | Reading Fluency | Reading Comp. | Math Calculation | Math Problem Solving | Written Expression | Oral Expression | Listening Comp. |
|---|---|---|---|---|---|---|---|---|
| **Norm-referenced academic assessments** | | | | | | | | |
| | S W N | S W N | S W N | S W N | S W N | S W N | S W N | S W N |
| **Empirically-derived criterion assessments/ CBM** | | | | | | | | |
| | S W N | S W N | S W N | S W N | S W N | S W N | S W N | S W N |
| **State Assessment** | | | | | | | | |
| | S W N | S W N | S W N | S W N | S W N | S W N | S W N | S W N |
| **Report Cards Classroom Assessment** | | | | | | | | |
| | S W N | S W N | S W N | S W N | S W N | S W N | S W N | S W N |

| **Psychological Processes** | Standardized Assessments | Strengths: | Weaknesses: | Neither: |
|---|---|---|---|---|
| Visual Spatial<br>Language<br>Working Memory<br>Long-Term Memory<br>Fluid Reasoning<br>Processing Speed<br>Phonological Awareness<br>Attention and Executive Functions<br>Speed of Lexical Access<br>Orthographic Processing | Rating scales | Strengths: | Weaknesses: | Neither: |
| | Semi-Structured Observations or Interviews | Strengths: | Weaknesses: | Neither: |
| | Hypothesis Statement Psychological Processing Indicators | Strengths: | Weaknesses: | Neither: |

| | | |
|---|---|---|
| | **Exclusionary Factors:** | |
| | Lack of appropriate instruction | Yes No |
| | Lack of English language proficiency (See CLD SIT Process document) | Yes No |
| | Cultural factors | Yes No |
| | Environmental factors | Yes No |
| | Economic disadvantage | Yes No |

# RESOURCES AND RESEARCH REFERENCES

**RESOURCES**
**International Dyslexia Association (IDA)**
Dyslexia Indicators
http://www.dyslexia-rmbida.org/whatisdyslexia.html
Dysgraphia Indicators
http://www.wrightslaw.com/info/read.dysgraphia.facts.htm

**RESEARCH REFERENCES**

**Dyslexia, Dysgraphia, and Oral Written Language Disabilities**

Berninger, K. (2009). Differential Diagnosis and Treatment for Dysgraphia, Dyslexia, OWL LD and Dyscalculia Treatment. Retrieved May 19, 2015, from http://www.iapsych.com/chccogachmeta/The.Gvmystery.andtentative.speculativeCH.html
**https://view.officeapps.live.com/op/view.aspx?src=http%3A%2F%2Fwww.nasponline.org%2Fconventions%2Fhandouts%2Funstated%2FDifferential%2520Diagnosis%2520and%2520Treatment%2520Dysgraphia%2520Dyslexia%2520OWL%2520LD%2520NASP%2520upload.ppt**

**Cross Battery Assessment**

Flanagan, D.P., Ortiz, S.O., & Alfonso, V.C. (2013). *Essentials of Cross Battery Assessment, Third Edition.* New York: John Wiley & Sons, Inc.

**CHC Broad and Narrow Abilities in General**

McGrew, K.S. “CHC Cognitive and achievement relations research synthesis: What we’ve learned from 20 years of research.” PowerPoint Presentation. 27 Feb 2009. Retrieved September 17, 2011, from http://www.slideshare.net/iapsych.chcsignbrs-presentation.

# Visual-Spatial

**Visual-Spatial Abilities and Reading**

“It is possible that those Gv abilities related to academic learning simply are missing from the current collection of intelligence batteries used in school achievement research. The types of Gv tests in current intelligence batteries (e.g., block design, spatial relations; memory for designs or pictures; etc.) may not measure the Gv abilities important for reading and math. For example, the visual aspects of orthographic processing or awareness (the ability to rapidly map graphemes to phonemes; rapid processing of visual symbols; etc) have been reported as important for reading (e.g., Barker, Torgesen, & Wagner, 1992; Berninger, 1990; Berninger et al., 2006; Flanagan et al., 2006; Hale & Fiorello, 2004; Urso, 2008;) and are absent from intelligence batteries. Additionally, more complex visual-spatial processing (not measured by current intelligence tests) may be important for school learning, such as Gv tasks that measure complex visual- spatial working memory (e.g., see Holmes, Adams & Hamilton, 2008; Maehara & Saito, 2007; Mammarella, Pazzaglia & Cornoldi, 2008). Like breathing, basic Gv processes may function as a *threshold ability*—you need a minimal amount to read and perform math, but beyond the minimal threshold level “more Gv”does not improve performance.”

McGrew, K. (2009). The "Gv mystery" and tentative/speculative CHC COG-ACH findings. Retrieved September 17, 2011, from http://www.iapsych.com/chccogachmeta/The.Gvmystery.andtentative.speculativeCH.html

Two narrow Gv abilities were identified as *tentative/speculative* in the current review. Visual memory (Gv-MV) was so classified at ages 14-19 for Reading Comprehension (RC), possibly related to the positive effect of visual imagery on reading comprehension (e.g., Gambrell & Jawitz, 1993). Spatial scanning (Gv-SS) was similarly classified at ages 6-8 for Basic Math Skills (BMS). Both of these isolated and tentative findings, which were based on single test indicators in a handful of studies, should be viewed with caution and warrant additional investigation.”

McGrew, K. (2009). The "Gv mystery" and tentative/speculative CHC COG-ACH findings. Retrieved September 17, 2011, from http://www.iapsych.com/chccogachmeta/The.Gvmystery.andtentative.speculativeCH.html

**Visual-Spatial Abilities and Math**

“Assel and colleagues (2003) showed that visuospatial ability related to later executive function but not vice versa, pointing to a developmental trajectory in which spatial skills develop prior to and underlie executive functions but in which both cognitive abilities have separate specific effects on math skills. Other studies also support the existence of spatial and executive function components in math achievement, although this support is evident only after a critical examination of the tests that were utilized."

Osmon, D.C., Smerz, J.M., Braun, M.M., & Plamback, E. (2006). Processing abilities associated with math skills in adult learning disability. *Journal of Clinical and Experimental Neuropsychology*, 23, pp. 84-95.

"Cognitive studies combined with research on arithmetical difficulties associated with brain injury (i.e., dyscalculia) and with behavioral genetic studies of individual differences in mathematical abilities provided clues as to possible sources of the problem-solving characteristics of children with Arithmetic Disorder (AD). The integration of these literatures resulted in a taxonomy of three general subtypes of MD, procedural, semantic memory, and visuospatial…Visuospatial subtype cognitive and performance features (include) difficulties in spatially representing numerical and other forms of mathematical information and relationships (and) frequent misinterpretation or misunderstanding of spatially represented materials. Neuropsychological features appear to be associated with right-hemispheric dysfunction…(However,) the relation between visuospatial competencies and AD has not been fully explored. In theory, visuospatial deficits should affect performance in some mathematical domains, such as certain areas of geometry and the solving of complex word problems, but not other domains, such as fact retrieval or knowledge of geometric theorems."

Geary, D.C. (2003). Learning disabilities in arithmetic: Problem-solving differences and cognitive deficits. In H. Swanson, K. Harris, & S. Graham, (Eds), *Handbook of Learning Disabilities* (pp. 199-212). New York: The Guilford Press.

"The third subtype of MD, the visual-spatial subtype, has been researched and described extensively by Byron Rourke at the University of Windsor….Rourke (1994) has provided convincing evidence that children with this subtype of MD have poor visual-spatial organization, psychomotor, tactile-perceptual, and concept formation skills, but adequate rote, automatic verbal skills…They also show semantic problems when verbal information is complex or novel. (p. 214)

Hale, J.B. & Fiorello, C.A. (2004). *School Neuropsychology: A Practitioner's Handbook.* New York: The Guilford Press.

*For a more extensive review of visual spatial and other abilities on math disabilities, including Geary (2003), Wilson & Dehaene (2007), and Hale, Fiorello, & Miller (2008), please see Maricle, D.E., Psimas-Fraser, L, Muenke, R.C., & Miller, D.C. (2010). Assessing and intervening with children with math disorders. In Miller, D.C. (Ed.). Best Practices in School Neuropsychology: Guidelines for Effective Practice, Assessment, and Evidence-Based Intervention. New York: John Wiley & Sons.*

**Visual-Spatial Abilities and Written Expression**

"Although visual processing abilities may contribute to the earliest stages of spelling acquisition, this study indicates primarily negligible effects of Visual-Spatial Thinking on writing achievement throughout the period of analysis. These results replicate the findings from McGrew and Knopik (1993). It is likely that orthographic coding skills, which were not targeted in this study, account for the expected relations between visual processing abilities and writing skills (Berninger, 1994)."

Floyd, R.G., McGrew, K.S., & Evans, J.J. (2008). The relative contributions of the CHC cognitive abilities in explaining writing achievement during childhood and adolescence. *Psychology in the Schools, 45(2*), 132-144. (WJ III ACH and COG only)

See also: "Orthographic Processing"

# Language

**Language in General**

"Language Processing includes measures of syntax, semantics/vocabulary, discourse, listening comprehension, and oral expression."

Podhajski, Blanche. " "Robust Oral Language Assessment for Literacy Learning." PowerPoint presentation. International Dyslexia Association Conference, Phoenix, AZ. 27 Oct 2010.

"A rather unique aspect of Gc (Language Abilities) not seen in the other broad abilities is that it appears to be both a store of acquired knowledge (e.g., lexical knowledge, general information, information about culture) as well as a collection of processing abilities (e.g., oral production and fluency, listening ability)…Although research is needed to discern the nature of acquired knowledge versus processing abilities within the Gc domain, assessment of Gc should pay close attention to the nature of the narrow abilities that define this broad domain." (pp. 280-281).

Flanagan, D.P., Ortiz, S.O., & Alfonso, V.C. (2007). *Essentials of Cross Battery Assessment, Second Edition.* New York: John Wiley & Sons, Inc.

**Language and Reading**

“It is not surprising that Gc has strong Basic Reading Skills (BRS) relations as ample evidence exists that general language and vocabulary development, aspects of Gc, are necessary for acquiring reading skills (Cooper, 2006; Shaywitz, Morris, & Shaywitz, 2008; Torgesen, 2002; Velluntino, Tunmer, Jaccard, & Chen, 2007). General Information (Gc-KO) was consistently related to BRS at all ages, with a trend toward increased importance with increasing age. This finding is consistent with the importance of prior background knowledge, knowledge integration, and a general fund of knowledge in reading (Cooper, 2006; Kintsch & Rawson, 2005). Listening ability (Gc-LS) was classified as medium at the youngest age group (6-8 years), a finding consistent with research that has implicated the ability to comprehend spoken language (i.e., listening comprehension) in reading development (Hoover & Gouch, 1990; Johi & Aaron, 200).”

McGrew, K. (2009). CHC cognitive-achievement relations: What we have learned from the past 20 years of research. Retrieved September 17, 2011, from http://www.iapsych.com/chccogachmeta/PrimaryCHCCOG-ACHfindings.html

“The relationship between early language development and reading has been well documented. Catts, Fey, Tomblin, and Zhang (2002) determined that approximately 50 percent of students identified in kindergarten with SLI (Speech and Language Impairment) met criterion for a reading disability in second and fourth grades as opposed to roughly 8 percent of the non-impaired control group…(Termine et al. 2007) found that many students may have intact phonological skills, but delayed receptive and/or expressive language development puts them at greater risk for later (reading) difficulties.” (p. 559).

Quinn, M.T. (2011). Assessing and intervening with children with speech and language disorders. In Miller, D.C. (Ed.). *Best Practices in School Neuropsychology: Guidelines for Effective Practice, Assessment, and Evidence-Based Intervention.* New York: John Wiley & Sons.

“The Comprehension/Knowledge (Gc) cluster was generally the strongest predictor of Basic Reading Skills and Reading Comprehension in this analysis. The relations between reading achievement and the breadth and depth of a person’s knowledge are logical. It is clear that the link between Gc and reading achievement is robust and increasing as a function of age. This link may reflect a bidirectional relationship, whereas vocabulary and general knowledge contribute to reading abilities and vice versa (Stanovich, 1986). This hypothesis may explain the notable increase in the predictive power of Gc abilities after age 8.”

Evans, J.J., Floyd, R.G., McGrew, K.S., & Leforgee M. H. (2001). The relations between measures of Cattell-Horn-Carroll (CHC) cognitive abilities and reaching achievement during childhood and adolescence. *School Psychology Review, 31(2),* 246-262.

**Language and Math**

“Initially, young children learn verbal labels for numbers in a standard sequence (i.e., rote counting) without engaging the visual system for objects. True counting begins when those verbal labels are associated with the objects in the physical world with one-to-one correspondence (one number word to one object). True counting requires crosstalk among the quantitative, visual, and oral language systems.” (p. 196) “The principles of one-on-one correspondence, stable order, and cardinality define the initial ‘how to count’ rules, which provide the potentially inherent skeletal structure for children’s emerging counting knowledge.” (p. 50). “The newly constructed components of this brain system are…(listed) and a specialized math lexicon. This lexicon of single words and phrases is specialized for quantitative concepts (e.g., greater than or less than), visual-spatial concepts (e.g., above, between, diagonal, circumference) and arithmetic operations (e.g., How much altogether? How much more? How many will each have?)” (p.205-207).

Berninger, V.W. & Richards, T. L. (2002). *Brain Literacy for Educators and Psychologists*. San Diego, CA: Academic Press, and Geary, D.C., Hoard, M.K., & Bailey, D.H. (2011). How SLD Manifests in Mathematics. In Flanagan, D.P. & Alfonso, V.C. (Eds.) *Essentials of Specific Learning Disability Identification.* New York: John Wiley & Sons, Inc.

“Current understanding of math conceptual development suggests that children first learn about numbers as words. It is logical to suspect that children with SLIs often have difficulty mastering a sense of number. fMRI studies of children with developmental dyscalculia (DD) suggest that two-thirds have other conditions, such as language disorders. ” (p. 559).

Quinn, M.T. (2011). Assessing and intervening with children with speech and language disorders. In Miller, D.C. (Ed.). *Best Practices in School Neuropsychology: Guidelines for Effective Practice, Assessment, and Evidence-Based Intervention.* New York: John Wiley & Sons.

“Broad Gc is moderately consistent at ages 9-19 years for Basic Math Skills/Math Calculation (BMS). The lack of a relationships between Language Development (LD)/Lexical Knowledge (VL) and BMS at ages 6-8 years in McGrew and Wendling (2010) is surprising, as elementary math contains several language concepts (e.g., less than, greater than, sum, in all, together). This finding is likely related to the nature of the math tasks used in the studies reviewed.”

Flanagan, D.P., Alfonso, V.C. & Mascolo, J.T. (2011). A CHC based operational definition of SLD: Integrating multiple data gathering methods. In Flanagan, D.P. & Alfonso, V.C. (Eds.) *Essentials of Specific Learning Disability Identification.* New York: John Wiley & Sons, Inc.

“Broad GC is consistent at ages 6-8 years, moderately consistent at ages 9-13, and highly consistent at ages 14-19 years for Math Reasoning (Math Problem Solving).”

Flanagan, D.P., Alfonso, V.C. & Mascolo, J.T. (2011). A CHC based operational definition of SLD: Integrating multiple data gathering methods. In Flanagan, D.P. & Alfonso, V.C. (Eds.) *Essentials of Specific Learning Disability Identification.* New York: John Wiley & Sons, Inc.

“The ability to solve word problems is also related to reading ability and nonverbal reasoning ability above and beyond the influence of working memory (Lee et al., 2004)…Hembree’s (1992) meta-analysis revealed that for ninth-graders, the best predictors of the ability to solve word problems were computational sills (r = .51) and knowledge of mathematical concepts (r = .56). Other predictors were intelligence (r = .44), reading ability (r = .44) and vocabulary (r = .26)…Translation of word problems, especially relational information, onto appropriate algebraic expression and the discrimination of relevant and irrelevant information are consistent sources of student difficulty.”

Geary, D.C., Boykin, A.W. Embertson, S., Reyna, V., Siegler, R., Berch, D.B., & Graban, J. (2008). *Report on the task group on learning processes.* In National Mathematics Advisory Panel, Reports of the task groups and subcommittees (pp 4-i-4-221). Washington DC: United States Department of Education.

**Language and Written Expression**

“Cognitive, language, and executive functions play the major roles in building the functional writing system…The Writing Brain is, however, fundamentally a language system. As such, the Writing Brain probably drawn on all language sources available to it through listening, talking, reading and writing. “ (p. 186-187).

Berninger, V.W. & Richards, T. L. (2002). *Brain Literacy for Educators and Psychologists*. San Diego, CA: Academic Press.

“Many studies have shown that all levels of language (word, sentence syntax, discourse, schema/text organization) contribute to writing in children with and without writing disorders (Berninger & Richards, 2002)…The Oral and Written Language Specific Learning Disability (OWL-LD) is an oral as well as written language disorder. Hallmark deficits of OWL LD are in morphological and syntactic awareness as well as in word retrieval. As a result, affected individuals have problems that include but are not restricted to work reading and spelling. They also have significant difficulty in reading comprehension and written expression of ideas (particularly in the syntax of the sentence construction) (Scott, 2002). See Berninger (2008b) and Berninger, O’Donnel, et al. (2008).” (p. 508, 513).

Berninger, V. W. (2010). Assessing and intervening with children with written language disorders. In Miller, D.C. (Ed.). *Best Practices in School Neuropsychology: Guidelines for Effective Practice, Assessment, and Evidence-Based Intervention.* New York: John Wiley & Sons.

“Consistent with prior research guided by CHC theory that focused on writing and similar research targeting reading and mathematics, it was not surprising that Comprehension-Knowledge was often the strongest and most consistent predictor of writing achievement across childhood and adolescence and that its strongest effects began as children enter upper elementary school (about age 10 years). It is logical that vocabulary knowledge and word knowledge would be highly related to knowledge of spelling, punctuation, and capitalization rules, as reflected in the basic writing skills analysis. In addition, these finding are consistent with research demonstrating a strong link between verbal ability, verbal reasoning, or oral language skills and compositional quality (e.g., Abbott & Berninger, 1993), as reflected in the written expression analysis. Consistent with some theoretical models of the writing process (e.g., Berninger, 1999; Hayes & Flower, 1980), vocabulary knowledge and knowledge of the domain on which writing is focused form the foundation of writing itself.”

Floyd, R.G., McGrew, K.S., & Evans, J.J. (2008). The relative contributions of the CHC cognitive abilities in explaining writing achievement during childhood and adolescence. *Psychology in the Schools, 45(2*), 132-144. (WJ III ACH and COG only)

# Working Memory

**Working Memory and Reading**

"Working memory…contributed more robustly to comparisons of decoding fluency and reading fluency groups versus adequate responders."

> Fletcher, J.M., Stuebing, K.K., Barth, A.E., Denton, C.A., Cirino, P.T., Francis, D.J., & Vaugh, S. (2011). Cognitive correlates of inadequate response to reading intervention. *School Psychology Review, 40 (1),* pp. 3-22.

"Auditory memory contributed strongly to the prediction of four reading skills (i.e., letter-word calling, reading comprehension, decoding, and spelling)."

> Bell, S.M., McCallum, R.S., & Cox, E. A. (2003) Toward a research-based assessment of dyslexia: Using cognitive measures to identify reading disabilities. *Journal of Learning Disabilities, 36,* 505-516. Cited in McCallum, R. S., Bell, S.M., Wood, M.S., Below, J.L., Choate, S. M., & McCane, S.J. (2006). What is the role of working memory in reading relative to the big three processing variables (orthography, phonology, and rapid naming)? *Journal of Psycho-educational Assessment, 24*, 243-259.

"Deficits in working memory can certainly disrupt a student's ability to make appropriate linkages among information in the text and, therefore, hinder reading comprehension skills…Brosnan et al., (2002) suggested that deficits in working memory can also hinder a child's ability to recall the sequential order of events in a story and prevent the child from organizing contextual information in a cohesive manner." (p. 494).

> Feifer, S. G. (2010). Assessing and intervening with children with reading disorders. In Miller, D.C. (Ed.). *Best Practices in School Neuropsychology: Guidelines for Effective Practice, Assessment, and Evidence-Based Intervention.* New York: John Wiley & Sons.

**<u>Working Memory and Math</u>**

"Phonological and visuospatial working memory contributed to more specific math cognition deficits, as did speed of processing. The children in the Mathematics Learning Disability (MLD) group scored a full standard deviation below their Low Math Achievement (LA) peers-the average child with MLD was at the 16th percentile-on measures of each of the working memory systems, and showed a deficit of about the same magnitude on the speed of processing measure, consistent with Swanson and colleagues' findings of pervasive working memory deficits in children with MLD (Swanson, 1993; Swanson & Sach-Lee, 2001)…Neither of these LA groups has working memory deficits as assessed by standard central executive, phonological loop, or visuospatial sketchpad tests…Most of the preceding described mathematical cognition deficits are found in children with MLD, independent of *(full scale)* IQ."

> Geary, D.C., Hoard, M.K., & Bailey, D.H. (2011). How SLD Manifests in Mathematics. In Flanagan, D.P. & Alfonso, V.C. (Eds.) *Essentials of Specific Learning Disability Identification.* New York: John Wiley & Sons, Inc.

"Empirical research has consistently implicated working memory as a central deficit in children with math disabilities. Hutton and Towse (2001) cited a correlation of .45 between digit span tasks and performance on mathematical tests, and Swanson and Beebe-Frankenberger (2004) noted a correlation of .54 between working memory tasks and mathematical problem solving. Furthermore, a study conducted by Hitch and McAuley (1991) concluded that children with math disorders have difficulty holding information in working memory while attending to more than one mathematics task. In a study conducted by Geary, Hoard, and Hamson (1999), the researchers found a significant difference between how individuals with a math disorder performed on digits backward tasks, but not how they performed on digits forward when they were compared to normally functioning children. These results support the idea that children with a math disorder are able to store and retrieve information but that they have difficulty holding information in mind while manipulating that information."

> Maricle, D.E., Psimas-Fraser, L, Muenke, R.C., & Miller, D.C. (2010). Assessing and intervening with children with math disorders. In Miller, D.C. (Ed.). *Best Practices in School Neuropsychology: Guidelines for Effective Practice, Assessment, and Evidence-Based Intervention.* New York: John Wiley & Sons.

**<u>Working Memory and Written Expression</u>**

"Compared to reading and mathematics, there have been fewer scientific inquiries into the relationship between working memory and written language…Despite the limited research, there can be little doubt that written language production depends heavily on working memory and all aspects of verbal and executive working memory are fully involved, even in proficient writers…Written language is not a lock-step sequence; writing is a parallel and iterative process requiring constant shifting among the procedures. In addition to reliance on the executive, the planning phase draws on the visuospatial component, as many writers visualize images, and the translating phase imposes demands on the verbal component (Kellogg, 1996; Olive, 2004). All of these steps place very heavy demands on working memory…Furthermore, even with well-developed written language skills, written expression will always place extensive demands on working memory because processes such as construction ideas can never become fully automatized." (pp. 120-121).

> Dehn, M.J. (2008). Working memory and academic learning: Assessment and intervention. New York: John Wiley & Sons, Inc.

"Memory Span (MS) is important to writing, especially spelling skills, whereas Working Memory (MW) has shown relations with advanced writing skills (e.g., written expression). (p.40).

Flanagan, D.P., Ortiz, S.O., & Alfonso, V.C. (2007). *Essentials of Cross Battery Assessment, Second Edition.* New York: John Wiley & Sons, Inc.

# Long-Term Memory Storage and Retrieval (Learning)

**Long-Term Memory Storage and Retrieval (Learning) in General**

"Reading decoding, reading comprehension, mathematic, spelling, basic writing skills, written expression, and all academic subjects, such as science and social studies, all require effective encoding, storage and retrieval of vast amounts of information…Thus, all long-term memory systems, including the subconscious implicit memory system play a role in academic learning and performance. " (p. 4).

Dean, M.J. (2010). *Long-term memory problems in children and adolescents: Assessment, intervention, and effective instruction.* New York: John Wiley & Sons, Inc.

"Attempts to isolate retrieval can be worthwhile when there is a desire to identify specific underlying memory impairments. When retrieval is impaired, the desired information may still be stored in memory; it just can't be quickly accessed on demand. The most direct measures of retrieval efficiency are tasks that measure associational fluency, such as when the examinee must quickly name items from a well-known semantic category. Another activity to include in assessment of retrieval fluency is rapid automatic naming (RAN)." (p. 137).

Dean, M.J. (2010). *Long-term memory problems in children and adolescents: Assessment, intervention, and effective instruction.* New York: John Wiley & Sons, Inc.

**Long-Term Memory Storage and Retrieval and Reading**

"Visual-auditory learning is a measurement paradigm that involves learning the association between a visual stimulus and its verbal label across several trials with corrective feedback…Performance on visual-auditory learning tasks is highly related with the development of early language and also the development of early reading skills." (p.175)

Dean, M.J. (2010). *Long-term memory problems in children and adolescents: Assessment, intervention, and effective instruction.* New York: John Wiley & Sons, Inc.

"As noted in Chapter 2, the left angular gyrus has been implicated in reading disorders, as this multimodal convergence zone serves to connect visual (occipital) and auditory (superior temporal gyrus) language processes (Horwitz et al., 1998; Poldrack, 2001). It is not surprising that children with this type of reading disability *(phonological, working memory)* show decreased functional magnetic resonance imaging (fMRI) or positron emission tomography (PET) activation in response to phonological tasks in the left temporal and parietal regions (Demb, Poldarack, & Gabrieli, 1999)." (p. 188).

Hale, J.B. & Fiorello, C.A. (2004). *School Neuropsychology: A Practitioner's Handbook.* New York: The Guilford Press.

"Individuals with reading comprehension difficulties often display problems with verbal fluency, word retrieval, naming facility (rapid automatic naming), or speed and quality of lexical access (e.g., Kintsch & Rosson, 2005; Nation, Marshall, & Snowling, 2001; Shaywitz et al., 2008) which is consistent with the findings presented here."

McGrew (2009). CHC cognitive-achievement relations: What we have learned from the past 20 years of research. Retrieved September 17, 2011, from http://www.iapsych.com/chccogachmeta/PrimaryCHCCOG-ACHfindings.html

**Long-Term Memory Storage and Retrieval and Math**

"Learning math facts is a paired- associate learning task requiring associative memory (Geary, 2007; Osman et al., 2006). Additionally, verbal counting, an aspect of naming facility (Glr-NA), has been mentioned as a precursor to early math achievement (Mazzocco & Thompson, 2005; Passolunghi, Vercelloni, & Schadee, 2007)."

McGrew, K. (2009). The "Gv mystery" and tentative/speculative CHC COG-ACH findings. Retrieved September 17, 2011, from http://www.iapsych.com/chccogachmeta/The.Gvmystery.andtentative.speculativeCH.html

"The use of counting results in the development of memory representations of basic facts (Siegler & Shrager, 1984). Once formed, these long-term memory representations support the use of memory-based processes…Children with math learning disabilities and a subset of children with low math achievement have difficulties learning basic arithmetic facts or retrieving them from long-term semantic memory once they are learned (Barrouillet, Fayol, & Lathuliere, 1997; Geary, 1990, Geary, Hamson, & Hoard, 2000; Jordan, Hanich & Kaplan, 2003a).

Geary, D.C., Hoard, M.K., & Bailey, D.H. (2011). How SLD Manifests in Mathematics. In Flanagan, D.P. & Alfonso, V.C. (Eds.) *Essentials of Specific Learning Disability Identification.* New York: John Wiley & Sons, Inc.

"The ability to fluently retrieve math facts from memory, a Glr function, is the most consistent Basic Math Skills/Math Calculation (BMS) deficit associated with Math Disabilities (MD) (e.g., Garnett, Frank, & Fleishcner, 1983; Geary, 1990, 1993; Geary, Hamson, & Hord, 200); Goldman, Pellegrino, & Mertz, 1988).

McGrew (2009). CHC cognitive-achievement relations: What we have learned from the past 20 years of research. Retrieved September 17, 2011, from http://www.iapsych.com/chccogachmeta/PrimaryCHCCOG-ACHfindings.html

"Naming facility (Glr-NA) was predictive of *Basic Math Skills/Math Calculation* (BMS) at all ages and associative memory (Glr-MA) and meaningful memory (Glr-MM) were predictive of BMS and *Math Reasoning* (MR) at one or more age levels. The importance for all three narrow Glr abilities is consistent with the finding that *Math Disability* (MD) students often have difficulty forming and later retrieving or accessing long-term memory representations of math facts (Geary, 1993, 2007)."

McGrew, K. (2009). The "Gv mystery" and tentative/speculative CHC COG-ACH findings. Retrieved September 17, 2011, from http://www.iapsych.com/chccogachmeta/The.Gvmystery.andtentative.speculativeCH.html

**Long-Term Memory Storage and Retrieval and Written Expression**

"Automatic letter writing has been identified as the best predictor of composition length and quality for both elementary and high school students (Connelly, Campbell, MacLean, & Barnes, 2006; Jones, 2004)…Using contemporary CHC theory, the cognitive abilities related to written expression include the broad abilities of auditory processing, long-term retrieval, processing speed, crystallized intelligence, short-term memory, and fluid reasoning (Floyd, McGrew, & Evans, 2008)." (p. 74)

Mather, N. & Wendling, B.J. (2011). How SLD manifests in writing. In Flanagan, D.P. & Alfonso, V.C. (Eds.) *Essentials of Specific Learning Disability Identification.* New York: John Wiley & Sons, Inc.

"Although previous research organized according to CHC theory did not indicate the relative importance of Long-Term Retrieval to writing (McGrew & Knopik, 1993), this ability demonstrated strong to moderate effects on basic writing skills and moderate effects on written expression during only the early elementary grades…consistent with theoretical models of writing (e.g., Berninger, 1999), the early development of writing requires fluent retrieval of knowledge of spelling, punctuation, and capitalization rules as well as writing strategies, from long-term memory stores. Such theoretical models also explain why the memory retrieval processes decline in relative importance with accumulating writing experience, whereas vocabulary knowledge and work knowledge increase in relative importance." *(Note: this research was done using Woodcock Johnson assessments only.)*

Floyd, R.G., McGrew, K.S., & Evans, J.J. (2008). The relative contributions of the CHC cognitive abilities in explaining writing achievement during childhood and adolescence. *Psychology in the Schools, 45(2*), 132-144.

# Fluid Reasoning

**Fluid Reasoning and Reading**

"While the left hemisphere analyzes the text for syntactic structure and details, the right hemisphere explores multiple semantic relationships between words and phrases (Beeman & Chiarello, 1998). This comparing and contrasting of information can only be carried out by the brain's manager, the prefrontal cortex, with the right hemisphere developing predictive inferences and the left making connective inferences. Given our understanding of the importance of executive and novel problem-solving abilities, we are not surprised that ambiguous lexical-semantic relationships and syntactic complexity result in higher right-hemisphere and frontal activity." (p.200)

Hale, J.B. & Fiorello, C.A. (2004). *School Neuropsychology: A Practitioner's Handbook.* New York: The Guilford Press.

"Inductive and General Sequential Reasoning abilities play a moderate role in reading comprehension. The lack of a consistent relationship between Gf abilities and reading in the McGrew and Wendling (2010) summary may be related to the nature of the dependent measures. For example, reading comprehension was represented by the Woodcock Johnson III Passage Comprehension and Reading Vocabulary tests, both of which draw minimally on reasoning (e.g., the do not require an individual to draw inferences or make predictions).”

Flanagan, D.P., Alfonso, V.C. & Mascolo, J.T. (2011). A CHC based operational definition of SLD: Integrating multiple data gathering methods. In Flanagan, D.P. & Alfonso, V.C. (Eds.) *Essentials of Specific Learning Disability Identification.* New York: John Wiley & Sons, Inc.

**Fluid Reasoning and Math**

“An up-to-date summary of the linkages between CHC abilities and reading and math achievement is provided by Floyd, Shaver, and McGrew (2003)…The most significant and consistent predictors of math reasoning are Gc, Gf, and Gq (specifically Quantitative Reasoning), Gsm, and in the early grades, Gs.”

Fiorello, C. A., & Primerano, D. (2005). Research into practice: Catell-Horn-Carroll cognitive assessment in practice: Eligibility and program development issues. *Psychology in the Schools, 42*, 525-537.

“The finding of a significant direct effect of Fluid Reasoning on mathematics achievement was not unexpected. The robust effect of Fluid Reasoning was consistent with earlier CHC-based studies that investigated relations between measures of Fluid Reasoning and mathematics achievement (e.g., Floyd, Evans, and McGrew, 2003; Keith, 1999; McGrew et al., 1997; McGrew Y Hessler, 1995; Proctor, Floyd, & Shaver, 2005; Williams, McCallum, & Reed, 1996) as well as other research (Fuchs et al., 2005, 2006; Rourke, 1993; Swanson & Beebe-Frankenberger, 2004). Fluid Reasoning seems to account for some of the prominent problem-solving constructs and strategies implicated in mathematics performance.”

Taub, G.E., Floyd, R.G., Keith, T.Z., & McGrew, K.S. Effects of General and Broad Cognitive Abilities on Mathematics Achievement. *School Psychology Quarterly, 23,* pp. 187-198.

“On the WISC-IV and WIAT-3, Hale, Fiorello, Miller, et al. (2008) found that average functioning in numerical operations, lower average math reasoning, and generally average performance in other cognitive areas exemplified the Fluid/Quantitative Reasoning subtype. This proposed subtype shows the most difficutly with the following WISC-IV subtests: Matrix Reasoning, Picture Concepts, and Arithmetic. Math difficulties in fluid and quantitative reasoning appear to be the result of deficits in the left dorsolateral prefrontal cortex.” (p. 531).

Maricle, D.E., Psimas-Fraser, L, Muenke, R.C., & Miller, D.C. (2010). Assessing and intervening with children with math disorders. In Miller, D.C. (Ed.). *Best Practices in School Neuropsychology: Guidelines for Effective Practice, Assessment, and Evidence-Based Intervention.* New York: John Wiley & Sons.

**Fluid Reasoning and Written Expression**

“Inductive and General Sequential Reasoning abilities are related to basic writing skills primarily during the elementary school years (e.g., ages, 6 to 13) and consistently related to written expression at all ages.” (p. 40).

Flanagan, D.P., Ortiz, S.O., & Alfonso, V.C. (2007). *Essentials of Cross Battery Assessment, Second Edition.* New York: John Wiley & Sons, Inc.

“Fluid reasoning demonstrated moderate effects on both writing clusters (Basic Writing Skills, Written Expression) only during some of the oldest age levels.”

Floyd, R.G., McGrew, K.S., & Evans, J.J. (2008). The relative contributions of the CHC cognitive abilities in explaining writing achievement during childhood and adolescence. *Psychology in the Schools, 45(2*), 132-144.

“The four cognitive ability clusters (Gc [Language], Gs [Speed], Ga [Auditory], Gf [Fluid]) that demonstrated at least moderate relations with measure of writing achievement across the lifespan can be associated with several of these primary and secondary writing requirements…with the primary being prerequisites for the secondary…For example, Gc can be associated with receptive and expressive language skills and syntactical knowledge; Gs can be associated with automatization and fluent motor skills; Ga can be associated with the encoding of sounds as symbols; and Gf can be associated with concepts of planning, organization, and flow. The specific finding that Ga and Gs were predominantly influential during the primary and intermediate grades supports evidence that writing difficulties in the elementary grades are often a result of primary requirements such as handwriting, spelling, and orthographic coding (e.g., Berninger, 1998). Likewise, the specific finding that Gf and Gc were primarily significant in later life supports evidence that older students typically have more difficulty with the higher-order cognitive processing, both language generation and planning and organization (Berninger, 1998).

Fiorello, C. A., & Primerano, D. (2005). Research into practice: Cattell-Horn-Carroll cognitive assessment in practice: Eligibility and program development issues. *Psychology in the Schools, 42*, 525-537.

# Processing Speed

**Processing Speed in General**

"Miskin and colleagues (Mishkin & Appenzeller 1987) made a major discovery that unites the cognitive and behavioral research traditions and that may explain how lower-level automaticity and higher-order reflection need to learn to work together in functional language systems. On the one hand, there is a cognitive pathway. This pathway supports representations of the relationships among items in a cognitive schema but also has important connections with the amygdala, which is rich in opiate neurotransmitters and serves as a gatekeeper that allows information about bodily state emotions transmitted from the hypothalamus to influence what is perceived and learned. This pathway is ideally suited for processing emotionally charged events that are salient in learning and for processing sets of items in which the interrelationships among the items are important. On the other hand, there is a behavioral pathway that supports representations for habits or over-learned responses, with relatively direct stimulus-response links. The striatum is an ideal candidate for this pathway because it receives projections from many areas of cortex and sends fibers to globus pallidus and substantia nigra and thus is a funnel to motor and pre-motor cortex for controlling movement needed to act on the environment. Recent brain imaging studies with humans suggest that cerebellum also plays a role in automatization (Nicholson et al. 1999; Raichle et al. 1994). Mishkin had the insight that most kinds of learning draw on both the cognitive and behavioral pathways. Learning is based on cognitive mechanisms that guide knowledge and expectation and draw on information with emotional significance but also on non-cognitive, automatic stimulus-response associations. In Part III we draw on Miskin's insight in discussing effective pedagogy for teaching literacy." (p.129).

Berninger, V.W. & Richards, T. L. (2002). *Brain Literacy for Educators and Psychologists*. San Diego, CA: Academic Press.

**Processing Speed and Reading**

"Speed of information processing separates fluent from non-fluent readers (Semrud-Cklikeman, Guy, & Griffin, 2000)."

Semrud-Clikeman, M. (2005). Neuropsychological aspects for evaluating learning disabilities. *Journal of Learning Disabilities, 38(6),* 563-568.

"Processing speed (Gs) was moderately associated with both Basic Reading Skills and Reading Comprehension from approximately ages 6 to 10 years. This finding is consistent with prior CHC-organized reading research (Flanagan, 200; McGrew et al, 1997; Williams et al., 1996) and with a wide array of research that indicates that Gs is an important ingredient in the early stages of acquiring most cognitive or academic skills (Fry & Hale, 2001; Kail, 1991; Kail, Hall & Caskey, 19999; Necka, 1999; Rasinski, 2000; Rindermann & Neubauer, 200; Weiler et al., 2000). In general, it is hypothesized that the more rapidly and efficiently an individual can automatize basic academic or cognitive operations, the more attention and working memory resources can be allocated to higher level aspects of task performance. The previously described developmental cascade hypothesis explains that processing speed increases with maturation and exerts a direct and positive effect on working memory capacity. This greater capacity, in turn, mediates more efficient controlled functioning on complex cognitive and academic tasks, such as reading comprehension (Fry & Hale, 2001; Kail & Hall, 2001).

Evans, J.J., Floyd, R.G., McGrew, K.S., & Leforgee M. H. (2001). The relations between measures of Cattell-Horn-Carroll (CHC) cognitive abilities and reaching achievement during childhood and adolescence. *School Psychology Review, 31(2),* 246-262.

"Perceptual Speed (P) is important (for all reading skills) during all school years, particularly the elementary school years. Flanagan et al.'s (2011) summary shows a stronger relation between Processing Speed (Gs) and reading than McGrew and Wendling's (2010) summary. Nevertheless, the findings of both investigations show that Gs and P in particular, are important for reading." (p. 255).

Flanagan, D.P., Alfonso, V.C. & Mascolo, J.T. (2011). A CHC based operational definition of SLD: Integrating multiple data gathering methods. In Flanagan, D.P. & Alfonso, V.C. (Eds.) *Essentials of Specific Learning Disability Identification.* New York: John Wiley & Sons, Inc.

"Broad abilities not consistently significant *(for reading comprehension)* at any of the three ages groups include processing speed (Gs), fluid reasoning (Gf), and visual processing (Gv). However, processing speed (Gs) was classified as tentative/speculative at the younger ages (ages 6-13), which is consistent with Keith's (1999) research."

McGrew (2009). CHC cognitive-achievement relations: What we have learned from the past 20 years of research. Retrieved September 17, 2011, from http://www.iapsych.com/chccogachmeta/PrimaryCHCCOG-ACHfindings.html

**Processing Speed and Math**

“Hale, Fiorello, Miller, et al. (2008) performed commonality analysis on WISC-IV (Wechsler, 2003) predictors for the Numerical Operations and Math Reasoning subtests from the WIAT-3 (Wechsler, 2001) using a group of typical children (n=846) and a group of children with specific learning disabilities in math (n=63). Hale and colleagues using a forced entry discriminant analysis, identified five math subtypes in children that closely approximate the developmental dyscalculia deficit areas proposed by Wilson and Dehaene (2007). “ *(Note: Below average Processing Speed was an indicator for three of the five Hale subtypes: Numeric-Quantitative Knowledge, Dyscalculia-Gerstmann Syndrome, and Right-Hemisphere SLD (e.g., NVLD). Processing speed was not an indicator for two of the five subtypes: Mild Executive/Working Memory and Fluid/Quantitative Reasoning.)*

> Maricle, D.E., Psimas-Fraser, L, Muenke, R.C., & Miller, D.C. (2010). Assessing and intervening with children with math disorders. In Miller, D.C. (Ed.). *Best Practices in School Neuropsychology: Guidelines for Effective Practice, Assessment, and Evidence-Based Intervention.* New York: John Wiley & Sons.

“The following CHC broad cognitive ability factors demonstrated statistically significant direct effects on the mathematics achievement variables (math calculation, math reasoning): Fluid Reasoning, Crystallized Intelligence, and Processing Speed…Processing Speed was significantly related to Quantitative Knowledge at the earliest age level and for ages 9 to 13. These cross-age effects corroborate the findings of a number of studies focusing on CHC theory (e.g., Floyd et al, 1003; Keith, 1999; McGrew et al., 1997; McGrew & Hessler, 1995), as well as other studies (Bull & Johnson, 1997; Fuchs et al., 2006; Kirby & Becker, 1988) that suggest that the ability to process and make decisions quickly about visual stimuli (without verbalization) is related to the ability to complete mathematics computations and other early academic tasks (Fry & Hale, 2001).

> Taub, G.E., Floyd, R.G., Keith, T.Z., & McGrew, K.S. Effects of General and Broad Cognitive Abilities on Mathematics Achievement. *School Psychology Quarterly, 23,* 187-198.

“Processing speed can also affect mathematics performance. If automaticity of retrieval is an issue for the child, one would expect the child to perform better on tasks that are untimed and perform more poorly on tasks where there are pressures of time and speed. Issues of processing speed are likely to broadly affect the child’s performance, not just specifically in mathematics.”

> Maricle, D.E., Psimas-Fraser, L, Muenke, R.C., & Miller, D.C. (2010). Assessing and intervening with children with math disorders. In Miller, D.C. (Ed.). *Best Practices in School Neuropsychology: Guidelines for Effective Practice, Assessment, and Evidence-Based Intervention.* New York: John Wiley & Sons.

**Processing Speed and Written Expression**

“Processing Speed demonstrated moderate effects on Basic Writing Skills and moderate to strong effect on Written Expression…Its effects were moderate at age 7 years and at ages 15 through 18 years, but from age 8 through 14 years, its effects were strong.”

> Floyd, R.G., McGrew, K.S., & Evans, J.J. (2008). The relative contributions of the CHC cognitive abilities in explaining writing achievement during childhood and adolescence. *Psychology in the Schools, 45(2*), 132-144. (WJ III ACH and COG only)

“Perceptual Speed (P) is important during all school years for basic writing, and is related to all ages for written expression.”

> Flanagan, D.P., Alfonso, V.C. & Mascolo, J.T. (2011). A CHC based operational definition of SLD: Integrating multiple data gathering methods. In Flanagan, D.P. & Alfonso, V.C. (Eds.) *Essentials of Specific Learning Disability Identification.* New York: John Wiley & Sons, Inc.

“The four cognitive ability clusters (Gc [Language], Gs [Speed], Ga [Auditory], Gf [Fluid]) that demonstrated at least moderate relations with measure of writing achievement across the lifespan can be associated with several of these primary and secondary writing requirements…with the primary being prerequisites for the secondary…For example, Gc can be associated with receptive and expressive language skills and syntactical knowledge; Gs can be associated with automatization and fluent motor skills; Ga can be associated with the encoding of sounds as symbols; and Gf can be associated with concepts of planning, organization, and flow. The specific finding that Ga and Gs were predominantly influential during the primary and intermediate grades supports evidence that writing difficulties in the elementary grades are often a result of primary requirements such as handwriting, spelling, and orthographic coding (e.g., Berninger, 1998). Likewise, the specific finding that Gf and Gc were primarily significant in later life supports evidence that older students typically have more difficulty with the higher-order cognitive processing, both language generation and planning and organization (Berninger, 1998).

> Fiorello, C. A., & Primerano, D. (2005). Research into practice: Cattell-Horn-Carroll cognitive assessment in practice: Eligibility and program development issues. *Psychology in the Schools, 42*, 525-537.

# Phonological Awareness

**Phonological Awareness and Reading**

"Evidence began accumulating more than two decades ago that the core difficulty in dyslexia was getting to the sound structure of the spoken word…Phonemic awareness is necessary for reading, and reading, in turn, improves phonemic awareness still further…In the 1980s…Lynette Bradley and Peter Bryan found that a preschooler's phonological aptitude predicts his reading three years later. They and other investigators also found that training a young child to attend to the sounds in spoken words before he goes to school significantly improves his success in learning to read later on. In the 1990s, we and other research groups demonstrated that phonologic difficulties are the most significant and consistent markers of dyslexia in childhood…This finding converges with other evidence to suggest that while the phonological component of the language system is impaired in dyslexia, the higher-level components *(e.g., fluid reasoning, verbal abilities)* remain intact." (55-56).

> Shaywitz, S. (2003) *Overcoming dyslexia: A new and complete science-based program for reading problems at any level.* New York: Alfred A. Knopf.

"In the first University of Washington LDC phenotyping study (Berninger et al., 2001), 102 probands and 122 affected adults (dyslexics) were given a half-day battery of reading, writing, and math achievement measures and related processing measures. Results showed that they were not only discrepant from their Verbal IQ on the target reading and spelling skills but also had associated impairments in the following processes: orthographic, phonological, and RAN. The more of these processing measures that were impaired, the more severe was the reading and spelling impairment. Structural equation modeling showed that the orthographic coding factor uniquely predicted accuracy and rate for all reading and writing outcomes except reading comprehension, that phonological coding predicted accuracy of reading and writing outcomes, and RAN predicted rate of reading and writing outcomes."

> Berninger, V.W., O'Donnell, L.O., & Holdnack, J. (2008). Research-supported differential diagnosis of specific learning disabilities and implications for instruction and response to instruction. In Prifitera, A., Saklofske, D.H., & Weiss, L.G. (Eds.) *WISC-IV Clinical Assessment and Intervention, Second Edition. New* York: Academic Press.

"Most surprising may be that Ga did not meet the criteria for low, medium, or high significance at any of the ages (for Basic Reading Skills, or BRS). The reason for the lack of broad Ga significance is apparent when one examines the results of the research at the narrow ability level. Phonetic Coding (Ga-PC) was classified at medium at all three age levels, a finding supporting the importance of phonemic awareness in BRS, despite the lack of significant for a broad Ga/BRS relationship. This finding is consistent with research (Berninger et al, 2006; Cooper, 2006: Shaywitz et al., 2008; Torgesen, 2002) indicating that awareness of sounds is a prerequisite skill for mastering the alphabetic principle in reading (e.g., Adams, 1990; Ehri, 1998) and that a phonological core deficit exists in many individuals with dyslexia (e.g., Morris et al., 1998; Stonovich & Siegel, 1994)."

> McGrew, K. (2009). CHC cognitive-achievement relations: What we have learned from the past 20 years of research. Retrieved September 17, 2011, from http://www.iapsych.com/chccogachmeta/PrimaryCHCCOG-ACHfindings.html

"As Nation et al. (2004) noted, there is no support for the view that children with poor reading comprehension at the secondary level have residual phonological processing deficits. Instead, students with poor reading comprehension skills are less successful due to language-based deficits including semantic processing, morph-syntax, and higher-level aspects of linguistic reasoning skills."

> Feifer, S. G. (2010). Assessing and intervening with children with reading disorders. In Miller, D.C. (Ed.). *Best Practices in School Neuropsychology: Guidelines for Effective Practice, Assessment, and Evidence-Based Intervention.* New York: John Wiley & Sons.

**Phonological Awareness and Math**

"Phonetic Coding (Ga-PC) displayed a medium level of consistent significance *(with Basic Math Skills)* at ages 6-13 and was tentative/speculative at ages 14-19. Phonological processing has been reported to predict arithmetic achievement (e.g., Leather & Henry, 1994; Rasmussen & Bisanz, 2005) and is associated with MD and low math achieving children with fact fluency deficits (Chong & Siegel, 2008)…Phonetic coding was classified as medium in consistency of significance *(with math reasoning)* at ages 6-8 and low for ages 9-19. A number of studies have implicated the phonological system as underlying individual difference in math problem solving (e.g., Furts & Hitch, 2000; Gathercole & Pickering, 2000; Geary & Brown, 1991; Swanson & Sachse-Lee, 2001)."

> McGrew, K. (2009). CHC cognitive-achievement relations: What we have learned from the past 20 years of research. Retrieved September 17, 2011, from http://www.iapsych.com/chccogachmeta/PrimaryCHCCOG-ACHfindings.html

"Phonetic Coding (PC) is consistent at ages 6-13 for Basic Math Skills (BMS). PC is moderately consistent at ages 6-8 and consistent at ages 9-19 years for Math Reasoning. The relationship in this McGrew and Wendling study (2010) between PC and BMS reflects the use of Sound Blending as the PC indicator. Memory Span is necessary for optimal performance on Sound Blending, which may account for the presence of the relationship."

Flanagan, D.P., Alfonso, V.C. & Mascolo, J.T. (2011). A CHC based operational definition of SLD: Integrating multiple data gathering methods. In Flanagan, D.P. & Alfonso, V.C. (Eds.) *Essentials of Specific Learning Disability Identification.* New York: John Wiley & Sons, Inc.

**Phonological Awareness and Written Expression**

"Phonemic Awareness demonstrated mostly negligible effects *(on written expression)* in the additional regression analyses. However, its effects were moderate at age 7 and again in late adolescence (ages 15 to 17 years). For these analyses, squared multiple correlation coefficients again ranged from .28 to .61 (Mdn = .54)."

Floyd, R.G., McGrew, K.S., & Evans, J.J. (2008). The relative contributions of the CHC cognitive abilities in explaining writing achievement during childhood and adolescence. *Psychology in the Schools, 45(2*), 132-144.

"Even spelling problems in high school students and young adults reflect specific deficits in the phonological aspects of language (Bruck, 1993; Moats, 1995). The most important phonological awareness ability for spelling is segmentation, the ability to break apart the speech sounds (Ehri, 2006; Smith, 1997). This ability allows an individual to place the graphemes representing the phonemes in correct order…In addition, an individual's ability to spell nonsense words conforming to English spelling patterns can help reveal his or her knowledge of phoneme-grapheme connections."(p.77).

Mather, N. & Wendling, B.J. (2011). How SLD manifests in writing. In Flanagan, D.P. & Alfonso, V.C. (Eds.) *Essentials of Specific Learning Disability Identification.* New York: John Wiley & Sons, Inc.

# Sensory-Motor Functions

**Sensory-Motor Functions in General**

"Contemporary research has indicated measures of basic sensory-motor skills are correlated with measures of intellectual functioning…and academic success…(*studies are listed*). This includes conditions such as learning disabilities and ADHD.

Decker, S.L. & Davis, A. (2010). Assessing and intervening with children with sensory motor impairment. In Miller, D.C. (Ed.). *Best Practices in School Neuropsychology: Guidelines for Effective Practice, Assessment, and Evidence-Based Intervention.* New York: John Wiley & Sons.

"(IDEA, 2004) excludes sensory-motor impairments by definition…These guidelines are provided to essentially isolate the cause of a learning disability to the higher-order cognitive processing component of the central nervous system…Determining where sensory processes stop and higher level information processing mechanism start is difficult, particularly when one considers the integral involvement of the sensory system in higher order processing…Additionally, sensory and motor difficulties could conceivably exacerbate a subclinical learning problem to a diagnostic level…Failure to assess or account for sensory motor deficits in children with SLD could lead to the subclinical SLD receiving an inappropriate (lessened) level of intervention.

Decker, S.L. & Davis, A. (2010). Assessing and intervening with children with sensory motor impairment.. In Miller, D.C. (Ed.). *Best Practices in School Neuropsychology: Guidelines for Effective Practice, Assessment, and Evidence-Based Intervention.* New York: John Wiley & Sons.

"The presence of mild sensory and motor skill impairment may exacerbate learning and attention problems and, without detection, may lead to (academic) interventions that are not targeting the correct construct…*(e.g., reading fluency, written expression instead of visual-motor skills and/or handwriting)* Subtle, or hidden, deficits may not have required attention from an occupational or physical therapist…This magnifies the importance of assessing sensory-motor deficits in children with suspected cognitive and/or academic problems."

Decker, S.L. & Davis, A. (2010). Assessing and intervening with children with sensory motor impairment. In Miller, D.C. (Ed.). *Best Practices in School Neuropsychology: Guidelines for Effective Practice, Assessment, and Evidence-Based Intervention.* New York: John Wiley & Sons.

**Sensory-Motor Functions and Reading**

"An oral-motor system that regulates mouth movements is the most relevant to learning to read and is discussed here. The grapho-motor system that regulates finger and hand movement is the most relevant to writing and computing skills, and thus will be discussed in Chapters 6 and 7, respectively…Oral motor planning may influence performance during oral reading, a major instructional component of beginning reading programs…The child will appear to struggle in automatic word recognition…Children who are generally accurate in oral reading of single words, but frequently exhibit oral reading dysfluencies in test, should be referred to speech language clinicians…Caution is in order, however, in that an oral motor planning problem is only one of many different kinds of problems that can interfere with children learning to name written words automatically." (pp. 116-117).

Berninger, V.W. & Richards, T. L. (2002). *Brain Literacy for Educators and Psychologists*. San Diego, CA: Academic Press.

**Sensory-Motor Functions and Math**

"A longitudinal study showed that neuropsychological measures of hand function predict children's arithmetic skills early in formal schooling. This relationship makes sense given that the hand plays an important role in this external representation system for producing visual notation of number concepts. Accordingly, the hand plays a major role in learning basic arithmetic facts and operations, which are often expressed in writing." (p.200).

Berninger, V.W. & Richards, T. L. (2002). *Brain Literacy for Educators and Psychologists*. San Diego, CA: Academic Press.

"A significant difference was found in performance on the VMI and Visual Perception and Motor Coordination subtests…and math achievement ($p = 0.01$). The VMI standard score was significantly correlated with Stanford total math standard score ($p = 0.001$)…Multiple linear regressions controlling for performance on the VMI and each subtest, as well as age and verbal cognitive ability, showed a significant relation between the Visual Perception subtest score and math achievement."

Sorter, J.M., Kulp, & Taylor, M. (2003) Are the results of the Beery-Buktenica Developmental Test of Visual-Motor Integration and its subtests related to achievement test scores? *Optometry & Vision Science (80)11,* 2003.

**Sensory-Motor Functions and Written Expression**

"Written spelling is by definition a visual-motor integration task…Children with Spelling Disorders (SD) tend to show poorer letter formation, spacing, and size, and their overall spelling and written language output *(writing fluency, written expression)* is lower than that of their same age peers." (p. 227)

Hale, J.B. & Fiorello, C.A. (2004). *School Neuropsychology: A Practitioner's Handbook.* New York: The Guilford Press.

"Under the guidelines of both the DSM-IV-TR and IDEA, poor handwriting or spelling alone is insufficient for a diagnosis of a written expression disorder. The writing difficulties must interfere with the ability to express oneself in writing. Many times, however, lower-level skills such as handwriting and spelling are the reasons for an individual's difficulty with written expression. Early identification of writing problems requires that attention be given to children who are struggling with the development of handwriting and spelling, as these are the foundational skills of writing in the primary grades."

Mather, N. & Wendling, B.J. (2011). How SLD manifests in writing. In Flanagan, D.P. & Alfonso, V.C. (Eds.) *Essentials of Specific Learning Disability Identification.* New York: John Wiley & Sons, Inc.

# Attention

**Attention in General**

"In addition to sensory-motor functions, attentional processes also serve as a baseline for all of the higher-order processes (e.g., visual-spatial processing, language skills, memory and learning.) p. 132.

Miller, D., (2007) *Essentials of School Neuropsychological Assessment.* New York: John Wiley & Sons, Inc.

"Despite the extremely close connection between working memory and attention, they are best regarded as separable processes and functions, with attention tasked with selecting relevant information and working memory responsible for processing and remembering information." (p. 86)

Dehn, M. (2008). *Working Memory and Academic Learning: Assessment and Intervention.* New York: John Wiley& Sons, Inc.

"To learn, an organism needs to be responsive to changes in the environment but also selective as to what is responded to among the vast array of potential stimuli...For example, children who habituate too easily may crave novelty and engage in novelty seeking behaviors more than is normal in the instructional environment. As a result they cannot maintain attentional focus long enough to attend to instruction, to practice skills sufficiently to automatize them, and to create precise representations of specific words in long-term memory. Thus, an attentional problem may underlie their problems in learning written language." (pp. 90-91)

Berninger, V.W. & Richards, T. L. (2002). *Brain Literacy for Educators and Psychologists*. San Diego, CA: Academic Press.

"We hypothesize that the crucial component of the central executive as it applies to LD is controlled attention…Executive processing constraints for participants with LD is inferred from three outcomes: (1) poor performance on complex divided attention tasks, (2) weak monitoring ability, as exhibited in the failure to suppress (inhibit) irrelevant information, and (3) depressed performance across verbal and visual-spatial tasks that require concurrent storage and processing." *(Note: Research summarized next to support hypothesis.)*

Swanson, H.L., & Saez, L. (2003). Memory difficulties in children and adults with learning disabilities. In Swanson, H.L., Harris, K.R., & Graham, S. (Eds.), *Handbook of Learning Disabilities* (pp182-198). New York: The Guilford Press.

# Rapid Automatic Naming (RAN)

**Rapid Automatic Naming (RAN) and Reading**

"In a series of regression analyses designed to evaluate the contributions to responder (RTI) status *(Note: of first grade students on reading decoding and fluency measures)* to cognitive skills independently of variability in reading skills, only the model for rapid letter naming achieved statistical significance."

Fletcher, J.M., Stuebing, K.K., Barth, A.E., Denton, C.A., Cirino, P.T., Francis, D.J., & Vaugh, S. (2011). Cognitive correlates of inadequate response to reading intervention. *School Psychology Review, 40 (1),* pp. 3-22.

"Measures of fluency within the language domain generally refer to the speed of lexical access or rapid automatic naming (RAN). RAN has been shown to be a significant predictor of early reading skills (Torgeson, Wagner, Rashotte, Burgess, & Hecht, 1977)…*(This)* cognitive fluency appears to place greater emphasis on completion speed for complex tasks than do general processing speed measures (Shrank & Flanagan, 2003)." (p. 263-264).

Miller, D., (2007) *Essentials of School Neuropsychological Assessment.* New York: John Wiley & Sons, Inc.

"The double-deficit hypothesis of dyslexia is currently receiving considerable attention in the neuropsychological literature. According to Wolf and Bowers (1999), the double-deficit hypothesis of dyslexia posits "phonological deficits and processes underlying naming speed represent two separable sources for reading dysfunction" (p. 415), such that there are separate types of reading disabilities characterized by single deficits in phonological processing or rapid naming as well as a more pervasive and severe form of dyslexia characterized by deficits in both."

Miller, C.J., Sanchez, J, and Hynd., G.W. (2003). Neurological correlates of reading disabilities. In H. Swanson, K. Harris, & S. Graham, (Eds.), *Handbook of Learning Disabilities* (pp. 345-363). New York: The Guilford Press.

"Wolf and Bowers (1999) have highlighted the importance of early rapid naming skills with the subsequent development of reading fluency…Recent studies conducted by Mirsa, Katzir, Wolf, and Poldrack (2004) have suggested that not all rapid naming tasks were created equal. For instance, rapid and automatic letter naming tasks were more predictive of word level reading skills than tasks involving the rapid and automatic naming of familiar objects. Therefore, school neuropsychologists who generally use tests of rapid naming such as the CTOPP or the PAL-II should differentiate between the ability to rapidly name letters and phonemes versus rapidly naming objects. School psychologists may want to explore the DIBELS as a more viable measure of rapid naming skills as they pertain specifically to reading."

Feifer, S. G. (2010). Assessing and intervening with children with reading disorders. In Miller, D.C. (Ed.). *Best Practices in School Neuropsychology: Guidelines for Effective Practice, Assessment, and Evidence-Based Intervention.* New York: John Wiley & Sons.

"Children with reading disabilities are slower at naming words and non-words as well as at naming letters and numbers (Aaron et. al., 1999)."

Semrud-Clikeman, M. (2005). Neuropsychological aspects for evaluating learning disabilities. *Journal of Learning Disabilities, 38(6),* 563-568.

"This study examined the relationships between the cognitive processes of rapid naming and phonological processing and various literacy skills. Variables measured and used in this analysis were phonological processing, rapid naming, reading comprehension, isolated and nonsense word reading, and spelling. Data were collected from 65 second-to-fifth grade children referred for learning difficulties. Regression analysis was performed to determine which of the cognitive processes was the strongest predictor of the literacy skills measured. Rapid naming was found to be a stronger predictor of word reading, reading comprehension and spelling than was phonological processing. When a measure of decoding skills was included as a predictor, it was found to account for the most variance in word reading and spelling."

Christo, C. & Davis, J. (2008). "Rapid naming and phonological processing as predictors of reading and spelling." *The California School Psychologist.* Retrieved on 17 September 2011 from: http://findarticles.com/p/articles/mi_7479/is_200801/ai_n32281790/

**Rapid Automatic Naming (RAN) and Math**

"Although broad Glr was not significantly related to BMS or MR in the current research synthesis, a number of narrow Glr abilities were identified as *tentative or speculative*. Naming facility (Glr-NA) was predictive of BMS (Basic Math Skills/Math Calculation) at all ages."

McGrew, K.S. (2009). The "Gv mystery" and tentative/speculative CHC COG-ACH findings. Retrieved September 17, 2011, from http://www.iapsych.com/chccogachmeta/The.Gvmystery.andtentative.speculativeCH.html

**Rapid Automatic Naming (RAN) and Written Expression**

"Naming Facility (NA), or rapid automatic naming, has demonstrated relations with written expression, primarily the fluency aspect of writing."

Flanagan, D.P., Alfonso, V.C. & Mascolo, J.T. (2011). A CHC based operational definition of SLD: Integrating multiple data gathering methods. In Flanagan, D.P. & Alfonso, V.C. (Eds.) *Essentials of Specific Learning Disability Identification.* New York: John Wiley & Sons, Inc.

# Orthographic Processing

**Orthographic Processing in General**

"The types of visual-spatial (Gv) tests in current intelligence batteries (e.g., block design, spatial relations, memory for designs or pictures, etc.) may not measure the Gv abilities important for reading and math. For example, the visual aspects of orthographic processing or awareness (the ability to rapidly map graphemes to phonemes, rapid processing of visual symbols, etc.) have been reported as important for reading (e.g., Barker, Torgesen, Y Wagner, 1992; Berninger, 2990; Berninger et al., 2006; Flanagan et al., 2006; Hale & Fiorello, 2004; Urso, 2008) and are absent from intelligence batteries. Additionally, more complex visual-spatial processing (not measured by current intelligence tests) may be important for school learning, such as Gv tasks that measure complex visual-spatial working memory (e.g., Holmes, Adams, & Hamilton, 2008; Maehara & Saito, 2007; Pazaglia & Cornoldi, 2008). It is also possible that the Gv mystery may be a dependent variable (DV) or criterion variable problem. The math achievement DV measured used in the extant CHC COG-ACH research may not tap the higher level mathematics (e.g., geometry, trigonometry, calculus) that draw heavily on Gv abilities."

McGrew, K.S. (2009). The "Gv mystery" and tentative/speculative CHC COG-ACH findings. Retrieved September 17, 2011, from http://www.iapsych.com/chccogachmeta/The.Gvmystery.andtentative.speculativeCH.html

"Orthographic structure of a written language includes the probability of where certain letters appear within words (spatial redundancy), which letter sequences are permissible (Sequential redundancy), and information about he pronounceability of words (phonemic-graphemic constraints) (Corcos & Willos, 1993). Coding of orthographic information is defined as the 'ability to represent the unique array of letters that defines a printed word, as well as general attributes of the writing system such as sequential dependencies, structural redundancies, letter position frequencies, and so for' (Velluntino, Scanlon & Tanzman, 1994, p. 314). The development of orthographic coding thus is based on the formation of visual long-term memory representations of letters, letter patterns, and sequences of letters that serve to map spatially the temporal sequence of phonemes within words (Ehri, 1992; 2005). Thus, orthographic knowledge is intimately connected to the other critical components necessary for fluent word recognition and comprehension. It is postulated that faster letter recognition and attention to letter sequences allows for the buildup of orthographic patterns that are then associated with sound (Adam, 1981; Wolf, Bowers & Biddle, 2000). Thus, readers depend on orthography for phonology as well as phonology for recognizing orthographic clusters (Breznitz, 2006, p. 43). "

O'Brien, B.A., Wolf, M, Miller, L.T. Lovett, M.W. & Morris, R. (2011). Orthographic processing efficiency in developmental dyslexia: an investigation of age and treatment factors at the sublexical level. *Annals of Dyslexia (61)* 1 p. 112.

**<u>Orthographic Processing and Reading</u>**

"Presently, learning to process orthographic information is held to play a critical role in the development of automatic word recognition that supports fluency by setting up and cueing the other systems of phonology, morphology, syntax, and semantics."

O'Brien, B.A., Wolf, M, Miller, L.T. Lovett, M.W. & Morris, R. (2011). Orthographic processing efficiency in developmental dyslexia: an investigation of age and treatment factors at the sublexical level. *Annals of Dyslexia (61)* 1 p. 112.

"Badian (2001) demonstrated a significant relationship between early orthographic matching skills weaknesses in 96 first graders and later poor comprehension skills in these students as seventh graders. In fact, a measure of early orthographic skills correctly predicted classification of 60% of poor and 80% of good readers several years later. A more recent study (Badian, 2005) found that children with a visual-orthographic deficit (29% of the sample of 207 children yielded significantly lower scores on all reading variables and specifically noted the negative impact of orthographic memory problems…Our findings offer support for the influence of visual (orthographic) processing, particularly speeded measures of visual processing. "

McCallum, R. S., Bell, S.M., Wood, M.S., Below, J.L., Choate, S. M., & McCane, S.J. (2006). What is the role of working memory in reading relative to the big three processing variables (orthography, phonology, and rapid naming)? *Journal of Psycho-educational Assessment, 24*, 243-259.

"Orthographic processing is more closely related to the visual aspects of reading, described by Eden and others, than to the phonological components. Orthographic processing is the interpretation of abstract representations (series of letters that form words) during the process of reading. Orthographic processing is most closely related to sight word reading where the individual does not sue decoding strategies to read words but, rather, know the entire word "on sight." Research on orthographic coding suggests that it contributes significantly to word-reading ability (Olson, Forsberg, & Wise, 1994). Furthermore, this contribution appears to be beyond that of the contributions of phonological processing to the reading processes (Cunningham, Perry, & Stanovich, 2001)."

Miller, C.J., Sanchez, J, and Hynd., G.W. (2003). Neurological correlates of reading disabilities. In H. Swanson, K. Harris, & S. Graham, (Eds.), *Handbook of Learning Disabilities* (pp. 345-363). New York: The Guilford Press.

"Another substantial difference between spelling and reading is that the former requires orthographic retrieval, whereas the latter requires only recognition of graphemes. There are only 26 letters in the alphabet, but over 500 spellings used in representing the 44 phonemes in the English language (Tompkins, 1998). To cover that much ground, we must think of unique ways to order the letters to produce the desired product. Add on top of this the irregular sight words-those words that do not follow standard orthographic-phonemic rules-and it is easy to see why so many children have difficulties with spelling that persist even after their reading decoding skills have been improved." (p. 227)

Hale, J.B. & Fiorello, C.A. (2004). *School Neuropsychology: A Practitioner's Handbook.* New York: The Guilford Press.

"Research has confirmed that orthographic skills are related to reading speed independently of phonological skills (Barker, Torgesen, & Wagner 1992), and that these skills are strong predictors of reading competency by the middle elementary grades (Torgesen, Wagner, Rashotte, Burgess, & Hecht, 1997). The RD subtype that involves difficulty with grapheme/morpheme problems due to impaired orthography is often called orthographic dyslexia. Children with orthographic dyslexia have little difficulty with words that make phonemic sense, but they often reading in a slow, laborious manner. These children tend to have problems with reading sight words; for instance, they can read the word 'grand' quite will, but have problems with 'right,' probably saying 'rig-hut.' (p.189)

Hale, J.B. & Fiorello, C.A. (2004). *School Neuropsychology: A Practitioner's Handbook.* New York: The Guilford Press.

**<u>Orthographic Processing and Math</u>**

"A model for working memory components (storage and processing of number, phonological and orthographic loops, and executive functions) may affect the acquisition of math calculation operations. Individuals may vary as to which of these components may be underdeveloped or functioning inefficiently, but if all components are not functionally efficient and in concert with one another, then fluency for reading or writing or performing math calculations is impaired."

Berninger, V.W., O'Donnell, L.O., & Holdnack, J. (2008). Research-supported differential diagnosis of specific learning disabilities and implications for instruction and response to instruction. In Prifitera, A., Saklofske, D.H., & Weiss, L.G. (Eds.) *WISC-IV Clinical Assessment and Intervention, Second Edition.* New York: Academic Press.

"Orthographic word form and orthographic loop are involved in writing visual symbols (numerals) for number concepts expressed as integers and decimals using the place value concept or as fractions."

Berninger, V. W. & Amtmann, D. (2011). Evidence-based differential diagnosis and treatment of reading disabilities with and without comorbidities in oral language, writing, and math. In Flanagan, D.P. & Alfonso, V.C. (Eds.) *Essentials of Specific Learning Disability Identification.* New York: John Wiley & Sons, Inc.

**Orthographic Processing and Written Expression**

"The initial hypothesis (Berning, Mizokawa, & Bragg, 1991) that the developmental origin of written expression problems lay in impaired low-level transcription skills in handwriting and spelling, which in turn were related to developmental variations in related neuropsychological process, was confirmed…The direct path from short-term orthographic coding to handwriting was significant, but the direct path from fine motor skills to handwriting was not significant (Abbot & Berninger, 1993)…Put another way, students with severe motor problems are likely to have handwriting problems, but children with motor development within the normal range may also have handwriting problems, which are more directly related to orthographic than motor processing skills."

Berninger, V.W. (2003). Preventing written expression disabilities through early and continuing assessment and intervention for handwriting and/or spelling problems: Research into practice. In H. Swanson, K. Harris, & S. Graham, (Eds.), *Handbook of Learning Disabilities* (pp. 345-363). New York: The Guilford Press.

"Affected individuals with dysgraphia almost always have handwriting problems with or without associated spelling problems and sometimes have only orthographic spelling problems related to fluent access to precise spellings in long-term memory (Fayol, Zorman, & Lete, 2009). As a result of these transcription problems related to handwriting and/or spelling, individuals with dysgraphia also have difficulties with written expression of ideas through composing (Berninger, Neilsen, et al., 2008b). Also see Berninger (2004, 2006) and Berninger, O'Donnell, and Holdnack (2008)…Early intervention research has shown that explicit instruction in transcription skills (handwriting and spelling) in the early grades can prevent composition problems in the upper grades (see Berninger & Amtmann, 2003, for review)." (pp. 508-510).

Berninger, V. W. (2010). Assessing and intervening with children with written language disorders. In Miller, D.C. (Ed.). *Best Practices in School Neuropsychology: Guidelines for Effective Practice, Assessment, and Evidence-Based Intervention.* New York: John Wiley & Sons.

# Executive Functions

**Executive Functions in General: Relations to Cognitive Abilities**

"Executive functions are seen only as directive processes. They give commands to engage in processing but do not carry out the commands themselves. Executive functions are not the capacities we use to perceive, feel, think and act. Instead, they are the processes that direct or cue the engagement and use of the capacities that we use to perceive, feel, think, and act. Rather than being conceived as a single, unitary construct, these executive functions are best viewed as a set of independent but coordinated processes, with amount and efficiency of coordination of efforts varying from person to person." (pp. 19-20).

McCloskey, G., Perkins, L.A., & VanDivner, B. (2009) *Assessment and intervention for executive function difficulties.* New York: Routledge, Taylor & Francis Group. McCloskey, G., Perkins, L.A., & VanDivner, B. (2009) *Assessment and intervention for executive function difficulties.* New York: Routledge, Taylor & Francis Group.

"It is also important to realize that overall average (or better) cognitive ability (as measured by most current intelligence tests) can be present in an individual who has executive functioning difficulties. In other words, an individual's executive control capacities are not assessed by traditional measures of intelligence and cognitive abilities. This is because the examiner serves as 'the executive control board' during the administration of norm-referenced, standardized tests of intelligence (Feifer & Della Tofallo, 2007, p.18). For example, the examiner tells the individual exactly what to do, motivates the individual, provides (and repeats) directions, monitors progress, and so forth, as dictated by standardized administration procedures. By contrast, on tests of executive functioning, the individual's performance processes are evaluated (i.e., the approach to task, problem solving and planning ability, organization, speed and efficiency, flexibility in shifting cognitive resources, etc.). Such, an individual may have high intelligence despite marked difficulties in executive functioning." (p. 264).

Flanagan, D.P., Alfonso, V.C. & Mascolo, J.T. (2011). A CHC based operational definition of SLD: Integrating multiple data gathering methods. In Flanagan, D.P. & Alfonso, V.C. (Eds.) *Essentials of Specific Learning Disability Identification.* New York: John Wiley & Sons, Inc.

"The operational definitions of intelligence that have been used to develop tests of intelligence have largely excluded executive control processes as a distinct content domain that contributes to an overall global estimate of intelligence. Therefore, these batteries have not intentionally targeted executive functions for assessment and have not attempted to assess the role of executive control as a part of test performance. As a result, intelligence test scores often do not accurately reflect a child's executive control capacities, nor do the directly provide insight into the extent to which executive function strengths or weaknesses are impacting test performance. The distinct differences between measures of intelligence and measures of executive functions are reflected in the low magnitude of relationship obtained when these measures are compared, typically producing correlations in the low .20s and .30s (Korkman, Kirk & Kemp, 1998; Perkins, 2009)…This means that it is possible to identify individuals who are strong in some executive function processes but are relatively weak in reasoning ability while at the same time identifying other individuals who are relatively strong in reasoning ability but are relatively weak in many executive function areas." (p.25).

McCloskey, G., Perkins, L.A., & VanDivner, B. (2009) *Assessment and intervention for executive function difficulties.* New York: Routledge, Taylor & Francis Group. McCloskey, G., Perkins, L.A., & VanDivner, B. (2009) *Assessment and intervention for executive function difficulties.* New York: Routledge, Taylor & Francis Group.

"While the collection of behaviors and processes known as the executive functions may be defined in a relatively straightforward manner, their precise assessment can be very challenging. A clear understanding of the differences between assessment of the "basic" domain-specific content areas of cognition (e.g., memory, language, visuospatial) and the domain general or "control" aspects of cognition and behavior is essential…Executive functions of self-awareness and control develop in parallel with the domain-specific content area or functional areas as described by Stuss and Benson (1986). For example, as basic memory skills (e.g., immediate memory span, encoding or retrieval) develop, the child develops concurrent 'meta-memory' knowledge about how to strategically use and control these memory abilities for particular tasks or situations (Brown, 1975). An important corollary is if the basic ability does not develop, then the associated 'meta' knowledge and control skills (i.e., the executive function) would not develop as fully. This point relates directly to the interest in meta-cognition in learning disabilities (Siegel and Ryan, 1991; Swanson, Cochran, and Ewers, 1991) Pressley and Levin, 1987; Wong, 1991) and the development of self-control strategies within the context of specific processes (e.g., reading disorder, writing process). Part of the assessment and intervention in learning disabilities, therefore, must include the control strategies (e.g., recognizing the critical 'problem' situation, planning and evaluating the use of specific learning strategies), in addition to the primary domain-specific content/processing disorder (e.g., decoding words, extracting meaning from sentences…The timing of manifestation of a child's executive difficulties is also important to assess. As Holmes (1987) describes in her discussion of the "Natural History of Learning Disabilities," the demand for executive functions are very limited until the upper elementary grades, and most notably, the middle school years. This is due to changes in environmental demands and expectations: as children make the adjustment from learning specific academic skills (e.g., reading, writing, and calculating) to applying these skills for learning content areas (e.g., literary analysis, report writing, algebra), the demand for the executive functions increases dramatically. Further, the organizational support and structure of elementary schools are reduced as children enter middle school, a context in which increasing executive problem-solving independence is expected of the child. Suddenly, children who had previously been good students without any academic problems become poor performers in school. This reflects the natural impact of an executive deficit in academics."

Gioia, G.A., Isquith, P.K., Y Guy, S.C. (2001). Assessment of executive function in children with neurological impairments. In R. Simeonsson & S. Rosenthal (Eds.). *Psychological and developmental assessment.* NY: The Guilford Press.

"General executive abilities should not be viewed as the equivalent of working memory. Certainly, working memory can vary independently of higher level executive functioning (Bayliss et. al, 2003). Nor should it be assumed that the relationship is hierarchical; it is most likely reciprocal." (p. 82).

Dehn, M.J. (2008). Working memory and academic learning: Assessment and intervention. New York: John Wiley & Sons, Inc.

**Executive Functions in General: Relation to Work Production and Achievement**

"To be judged an adequate learner, a child must produce specified amounts of work at specified levels of quality on any number of these tasks. The important word here is 'produce.' Students whose executive function development is lagging somewhat in one or more areas are much more likely to have difficulty consistently producing at levels that demonstrate what they have learned…Students with more extreme…executive function deficits are frequently unable to produce work that is judged adequate by established standards, although they have been able to acquire academic skills and learn new content. Martha Denkla (2007) has used the term "Producing Disabilities" rather than Learning Disabilities, to describe the condition of these students because their difficulties do not necessarily stem from problems with learning to communicate with language, read, quantify with number systems, or learn new information in a number of different ways…As Denckla (2007) has noted, the single most consistent finding across children who exhibit executive function difficulties of one type or another is the inconsistent nature of their behavior and/or academic production…What these individuals have difficulty with is complying with the demands for production that demonstrates what they have learned. This includes issues such as recording their thoughts in writing, responding effectively to oral and/or written test questions, completing projects that are done within specified timelines and that contain all required elements or follow the required rubric or remember to do and/or hand in homework assignments or lab reports. The number and severity of the executive function delays or deficits or these students put them at great risk of persistent failure in school, due to the lack of production." (p. 80, p. 249).

McCloskey, G., Perkins, L.A., & VanDivner, B. (2009) *Assessment and intervention for executive function difficulties.* New York: Routledge, Taylor & Francis Group. McCloskey, G., Perkins, L.A., & VanDivner, B. (2009) *Assessment and intervention for executive function difficulties.* New York: Routledge, Taylor & Francis Group.

"Many parents and teachers of children who demonstrate executive function difficulties are often baffled by the seeming paradox of the child who functions so effectively when engrossed in activities of their own choosing, yet who seem woefully inept when requested to perform the simples of household chores or classroom assignments…An important aspect of executive function development that is critical for understanding variations in everyday functioning related to the locus of intentionality for executive control. Executive control can stem from a person's own internal desires, dries, aspirations, plans and proclivities, namely by internal command. On the other hand, if summoned by sources outside of the person, executive control is being initially cued by external demand. Executive control that arises from internal command utilized specific neural networks routed through portions of the prefrontal lobes as well as other specific areas of the brain. These networks are distinct from, but not necessarily completely independent of, the neural networks of the frontal lobes and additional areas that must be activated when a person attempts to engage executive control in response to external demands (Barkley, 2005; Freeman, 2000). Executive control by internal command is generally much easier to engage because it flows naturally from the person's own internal states. Summoning executive control in situations of external demand, however, requires much more mental effort and much greater control capacity." (pp. 72-73).

McCloskey, G., Perkins, L.A., & VanDivner, B. (2009) *Assessment and intervention for executive function difficulties.* New York: Routledge, Taylor & Francis Group. McCloskey, G., Perkins, L.A., & VanDivner, B. (2009) *Assessment and intervention for executive function difficulties.* New York: Routledge, Taylor & Francis Group.

**Executive Functions in General: Relationship to Achievement**

"Executive Function difficulties can have a wide variety of negative effects on production in all academic areas. In the elementary grades, these effects are most prominent in the impact they have on the demonstration of written expression, reading, and mathematics skills. In the upper grades, executive function difficulties with basic skill production often persist and are joined by difficulties with organization and planning and completion of projects and homework as well as inadequate regulation of the use of study skills and/or test taking skills." (p.139).

McCloskey, G., Perkins, L.A., & VanDivner, B. (2009) *Assessment and intervention for executive function difficulties.* New York: Routledge, Taylor & Francis Group. McCloskey, G., Perkins, L.A., & VanDivner, B. (2009) *Assessment and intervention for executive function difficulties.* New York: Routledge, Taylor & Francis Group.

**Executive Functions and Reading**

"It is therefore apparent that the reading problems can result from, or be exacerbated by, disuse, or ineffective or inconsistent use, of the executive function capacities that direct all aspects of the reading process, specifically poor sight word recognition, poor word decoding, slowed reading rate, and/or poor comprehension." (pp. 141-142).

McCloskey, G., Perkins, L.A., & VanDivner, B. (2009) *Assessment and intervention for executive function difficulties.* New York: Routledge, Taylor & Francis Group. McCloskey, G., Perkins, L.A., & VanDivner, B. (2009) *Assessment and intervention for executive function difficulties.* New York: Routledge, Taylor & Francis Group.

"Constructing the Reading Brain requires considerable assistance from an executive system for governing the multiple components that sometimes work in harmony but sometimes come into conflict with each other. A single chief executive officer probably does not head this government. Rather, a group of executives appears to work together to manage the moment-to-moment activities of the Reading Brain…the frontal lobes that house the executive functions are still myelinating at the stage of development when brains are beginning to read. Therefore, wiring the brain to read may require considerable external executive coordination; that is, other-regulation in the form of guided assistance (scaffolding) from adults who provide explicit instructional cues." (p. 159-160, 227).

Berninger, V.W. & Richards, T. L. (2002). *Brain Literacy for Educators and Psychologists*. San Diego, CA: Academic Press.

"About 30 years ago, researchers began to investigate the nature of reading comprehension by analyzing the strategies used by proficient readers. Today…most strategy instruction involves a strong emphasis on meta-cognition; that is, instruction is geared toward an awareness of one's cognitive processes and how to deploy them (Swanson & Hoskyn, 1998). Students are directed to stop occasionally during their reading to monitor their understanding by asking themselves questions or by trying to summarize."

Williams, J.P., (2003). Teaching text structure to improve reading comprehension. In H. Swanson, K. Harris, & S. Graham, (Eds.), *Handbook of Learning Disabilities* (pp. 293-305). New York: The Guilford Press.

“It has been suggested that for reading comprehension, executive functions such as working memory and meta-cognitive skills are more likely to differentiate children with reading disabilities from controls than lower-level processes such as phonology and morphology, which are automatic in typical readers (Swanson & Alexander, 1997). As suggested in the previous discussion, comprehension deficits due to executive dysfunction appear to be independent of the phonological/articulatory functions subserving word recognition (Swanson & Ashbaker, 2000). In a direct comparison of prefrontal and posterior measures, Kelly and colleagues (1989) found that children with RDs had greater executive deficits, including problems with selective and sustained attention, inhibition, set maintenance, flexibility, and phonemic production.” (p.197).

Hale, J.B. & Fiorello, C.A. (2004). *School Neuropsychology: A Practitioner’s Handbook.* New York: The Guilford Press.

“Executive Functions, for example, are critical to reading comprehension and it is becoming just plain silly to evaluate a child for reading problems without examining how that child organizes, plans, and evaluates what he or she has just read! We could say that we are assessing a child’s organizing skills or we could say that we are assessing a child’s executive functions, and in general, the terms mean the same thing. The difference in this day and age, as opposed to what went before, is that when the school psychologist assesses executive functions, he or she is also seeing how those functions relate to working memory, short-term memory, and several forms of attention. Why would the school psychologist want to do that? Because differentiating memory, attention, and executive function skills will determine which evidence-based interventions will work with a certain child and which ones will not.”

Fletcher-Janzen, E. (2010) Foreword. In Miller, D.C. (Ed.). *Best Practices in School Neuropsychology: Guidelines for Effective Practice, Assessment, and Evidence-Based Intervention.* New York: John Wiley & Sons.

**Executive Functions and Math**

“As was the case with reading and writing, math problems (specifically poor basic fact automaticity, poor computation, poor problem solving, and/or poor practical applications), can result from, or be exacerbated by, disuse, or ineffective or inconsistent use, or the executive function capacities that direct all aspects of math processing.” (p. 163).

McCloskey, G., Perkins, L.A., & VanDivner, B. (2009) *Assessment and intervention for executive function difficulties.* New York: Routledge, Taylor & Francis Group. McCloskey, G., Perkins, L.A., & VanDivner, B. (2009) *Assessment and intervention for executive function difficulties.* New York: Routledge, Taylor & Francis Group.

“Compromised executive functioning, including poor attention and inhibitory control, has been associated with problems in the development of math computation skills and with individuals with Math Disability (Fuchs et al., 2006; Geary, 2007; Geary, Hoard, Byrd-Craven, Nugent, & Numtee, 2007; McLean & Hitch, 1999; Swanson, 1993; Swanson & Jerman, 2006; Swanson & Sachse-Lee, 2001).

McGrew, K.S. (2009). The "Gv mystery" and tentative/speculative CHC COG-ACH findings. Retrieved September 17, 2011, from http://www.iapsych.com/chccogachmeta/The.Gvmystery.andtentative.speculativeCH.html

“The Computing Brain keeps the executive/government system very busy. To begin with, the Computing Brain recruits the Reading Brain during written math word problem solving and the Writing Brain during written computation. During problem solving, the Computing Brain recruits the executive system to create goals and plans, coordinate multiple operations, monitor ongoing processes, and exert executive control over the working memory system. The executive system also reflects upon the math problem-solving process and develops meta-cognitive awareness of the math domain-these meta-cognitions become yet another knowledge source to draw upon in math problem solving…The executive governing, attentional, and memory systems work together.” (pp. 207-208).

Berninger, V.W. & Richards, T. L. (2002). *Brain Literacy for Educators and Psychologists*. San Diego, CA: Academic Press.

**Executive Functions and Writing**

“As was the case with reading, writing problems (specifically poor text formation, poor text production speed and automaticity, poor text generation, and/or poor text editing and revising), can result from, or be exacerbated by, disuse, or ineffective or inconsistent use, of the executive function capacities that direct all aspects of the writing process…Text generation and text editing/revising are the most complex of the writing skills. Use of these skills requires near continuous integration of (1) all of the subordinate writing skills (text formation, text production speed and automaticity, spelling) and their executive function cueing needs with (2) additional cognitive capacities (idea generation, reasoning, visuopatial and language abilities; word knowledge, grammar and syntax knowledge, and general knowledge lexicons) and the associated executive cues that guide their access and use, as well as with (3) an additional set of executive functions responsible for cueing sustained extension of the immediate time frame (i.e., the need for active working memory engagement) and (4) an additional set of executive functions responsible for coordination and multitasking needs created by the writer's attempt to generate text beyond simple production or transcription." (p.158-159).

McCloskey, G., Perkins, L.A., & VanDivner, B. (2009) *Assessment and intervention for executive function difficulties.* New York: Routledge, Taylor & Francis Group. McCloskey, G., Perkins, L.A., & VanDivner, B. (2009) *Assessment and intervention for executive function difficulties.* New York: Routledge, Taylor & Francis Group.

"Executive impairments may be at the core of many written language problems, as executive and working memory deficits have been associated with poor sentence coherence, output, efficiency, and lexical cohesion (Wilson & Proctor; 2000)…Attention, memory and executive functions play an important role in written language, with the frontal lobe playing an important role in all of these…As you can see, multiple areas of the brain are involved in written language. Written language is by far the most difficult academic subject, requiring virtually every part of the brain to work concertedly toward a final product. Obviously, many more cognitive processes are required for written language competency than for other academic skills. It requires brainstorming, planning, and organization skills; choosing appropriate words and phrases; putting together a coherent sequence of words and sentences; adherence to grammar and syntax conventions; handwriting and spelling; and monitoring, evaluating, and changing the written product. Determining where a child is having difficulty can help you understand how to help that child, so that he or she may effectively communicate ideas in both oral and written form." (pp. 235-237).

Hale, J.B. & Fiorello, C.A. (2004). *School Neuropsychology: A Practitioner's Handbook.* New York: The Guilford Press.