Divergent growth curves for human cognitive abilities is one form of evidence which supports the validity of tests designed to measure different ability constructs (Carroll, 1983, 1993). Growth curves have been presented for select WJ III cognitive and achievement tests and clusters in the WJ III Technical Manual (McGrew & Woodcock, 2001), as well as in the WJ III Diagnostic Supplement to the Tests of Cognitive Abilities Manual (Schrank, Mather, McGrew & Woodcock, 2003).

This brief descriptive report presents the growth curve plots for all individual WJ III cognitive and achievement tests. The remainder of this report presents, for each individual WJ III cognitive or achievement test, plots that include the average (median) Reference W-score for each test as well as the ± 1 SD W-score values for the test (see McGrew & Woodcock, 2001 for a description of the procedures used to calculate the smoothed Ref W-scores as well as the unique SD’s above and below the average score at each age). The curves presented in this report start at age six for each test.

With the exception of one test (Reading Fluency) which had a significantly larger range of scores than the other tests, all test curves are plotted on graphs with the same minimum and maximum y-axis (Ref W) values. This common scaling allows for the visual comparison of different curves. For each test two different plots were presented. The first plot presents the smoothed curves across an equal-interval x-axis. Given that equal-interval plots across such a wide age range (6 to 90+ years) make it difficult to discern the fine gradations of growth during the early years, a second plot with a log-transformed x-axis is also presented.

Measures that demonstrate an early asymptote, and less developmental change across the lifespan (when compared to other abilities), are considered to reflect performance based on abilities and cognitive processes that are less influenced by formal training and learning (process dominant abilities). These abilities are believed to develop more as a function of informal and indirect learning experiences. In contrast, growth curves with rapid growth and a later and

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1 Although the figures presented in this report are referred to as “growth curves”, a word of caution is in order. The reported curves are based on cross-sectional (not longitudinal) data. As a result, they portray the change in average (median) performance across age for the general population at the time the WJ III was normed. The figures do not reflect the progression of subjects across time.
higher asymptote are believed to be more influenced by past formal learning and education (product dominant abilities).

Forthcoming reports will present similar information for (a) the WJ III cluster curves\(^2\), (b) the complete age-range curve for each test that provides scores below age of 6, and (c) comparisons of test curves within the same broad domain (e.g., Gf) in a single figure.


\(^2\) Similar growth curve plots for eight cognitive and three achievement clusters have previously been reported in McGrew, Woodcock, & Ford (2002).
Description of WJ III tests and Broad and Narrow CHC Ability Classifications

<table>
<thead>
<tr>
<th>Cognitive Tests (in order in battery)</th>
<th>Broad and Narrow CHC Ability Classifications</th>
<th>Description of Test</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Test</strong></td>
<td><strong>Ga</strong></td>
<td>gc</td>
</tr>
<tr>
<td><strong>Verbal Comprehension</strong></td>
<td><strong>Language Development (LD)</strong></td>
<td>Measures knowledge of word meanings. In Picture Vocabulary, the subject must name familiar and unfamiliar pictured objects. In Oral Vocab: Synonyms, the subject must say a word similar in meaning to the word presented. In Oral Vocab: Antonyms, the subject must say a word that is opposite in meaning to the word presented. In Verbal Analogies the subject must complete phrases with words that indicate appropriate analogies.</td>
</tr>
<tr>
<td></td>
<td><strong>Lexical Knowledge (VL)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Visual-Auditory Learning</strong></td>
<td><strong>Associative Memory (MA)</strong></td>
<td>Measures the ability to associate new visual symbols (rebuses) with familiar words in oral language and to translate a series of symbols presented as a reading passage (a visual-auditory association task). This is a &quot;learning&quot; test where corrective feedback is provided to the subject.</td>
</tr>
<tr>
<td></td>
<td><strong>Meaningful Memory (MM)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Spatial Relations</strong></td>
<td><strong>Visualization (Vz)</strong></td>
<td>Measures the ability to visually match and combine shapes. The subject must select from a series of shapes, the component parts composing a given whole shape.</td>
</tr>
<tr>
<td></td>
<td><strong>Spatial Relations (SR)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Sound Blending</strong></td>
<td><strong>Phonetic Coding (PC) (synthesis)</strong></td>
<td>Measures the ability to perform auditory synthesis on segments of speech. After hearing recorded parts (syllables and/or phonemes) of a word the subject must “blend” the parts together to make a whole word (synthesis task).</td>
</tr>
<tr>
<td><strong>Concept Formation</strong></td>
<td><strong>Induction (I)</strong></td>
<td>Measures the ability to identify and state the rule for a concept about a set of colored geometric figures when shown instances and non-instances of the concept. This is a &quot;learning&quot; test with corrective feedback and reinforcement of correct answers provided to the subject.</td>
</tr>
<tr>
<td><strong>Visual Matching</strong></td>
<td><strong>Perceptual Speed (P)</strong></td>
<td>Measures the ability to quickly locate and circle the two identical numbers in a row of six numbers. The task proceeds in difficulty from single-digit numbers to triple-digit numbers and has a three-minute time limit. For younger subjects, a downward extension requires the subject to visually identify two identical pictures of assorted shapes and colors. The subject is only required to point to the two correct pictures. The test has a three-minute time limit.</td>
</tr>
<tr>
<td><strong>Numbers Reversed</strong></td>
<td><strong>Working Memory (MW)</strong></td>
<td>Measures the ability to repeat a series of random numbers backward. The number sequences are presented by audio tape.</td>
</tr>
<tr>
<td><strong>Incomplete Words</strong></td>
<td><strong>Phonetic Coding (PC) (analysis)</strong></td>
<td>Measures the ability to perform auditory closure on segments of speech. After hearing a recorded word with one or more phonemes missing, the subject must name the complete word (analysis task).</td>
</tr>
<tr>
<td><strong>Del Rec—Vis-Aud Lrng</strong></td>
<td><strong>Associative Memory (MA)</strong></td>
<td>Measures the ability to recall and relearn (after 1 to 8 days) the symbols (rebuses) presented in Visual-Auditory Learning. This is a &quot;relearning&quot; task as the subject relearns forgotten associations. Corrective feedback is provided to the subject during the task.</td>
</tr>
<tr>
<td>General Information</td>
<td>$G_c$ General Info (K0)</td>
<td>Measures knowledge of the common or typical characteristics of certain objects. The test has two components: &quot;what&quot; and &quot;where&quot; questions. The questions are presented orally and the subject must state the answer to &quot;where you would find....&quot; and &quot;what you would do with...&quot; questions.</td>
</tr>
<tr>
<td>---------------------</td>
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</tr>
<tr>
<td>Retrieval Fluency</td>
<td>$G_{lr}$ Ideational Fluency (FI)</td>
<td>Measures fluency in retrieving the names of objects. The subject is asked to state as many items as they can of three different types, &quot;things to eat or drink&quot;, &quot;names of people&quot;, and &quot;animals.&quot;</td>
</tr>
<tr>
<td>Picture Recognition</td>
<td>$G_v$ Visual Memory (MV)</td>
<td>Measures the ability to recognize a subset of previously presented pictures within a larger set of pictures.</td>
</tr>
<tr>
<td>Auditory Attention</td>
<td>$G_a$ Speech-sound Discrimination (US) Resistance to Auditory Stimulus Discrimination (UR) Attention/Concentration (AC)</td>
<td>Measures the ability to discriminate similar sounding words. An audio tape is used to present the words to the subject with increasing levels of background noise as a distracter.</td>
</tr>
<tr>
<td>Analysis-Synthesis</td>
<td>$G_f$ General Sequential Reasoning (RG)</td>
<td>Measures the ability to analyze the components of an incomplete logic puzzle and to determine and name the missing components. This is a &quot;learning&quot; test with corrective feedback and reinforcement of correct answers provided to the subject.</td>
</tr>
<tr>
<td>Decision Speed</td>
<td>$G_s$ Semantic Processing Speed (R4 Mental Comparison Speed (R7)</td>
<td>Measures the ability to rapidly scan a row of pictures and decide which of the two drawings are the most related. The decisions become slightly more abstract as the test progresses. The subject is instructed to complete as many rows of drawings as possible within a three-minute time limit.</td>
</tr>
<tr>
<td>Memory for Words</td>
<td>$G_{sm}$ Memory Span (MS)</td>
<td>Measures the ability to repeat lists of unrelated words in the correct sequence; words are presented by audio tape.</td>
</tr>
<tr>
<td>Rapid Picture Naming</td>
<td>$G_p$ Naming Facility (NA)</td>
<td>Measures the ability to rapidly identify and orally name pictures of common objects. The stimulus pictures are presented in rows of five. The test has a two-minute time limit.</td>
</tr>
<tr>
<td>Planning</td>
<td>$G_v$ Spatial Scanning (SS)</td>
<td>Measures the ability to plan a tracing route that covers as many segments of a dotted line drawing as possible without lifting the pencil or tracing over the same segment twice. The test requires &quot;forward thinking&quot; in that the subject is required to plan a sequence of steps prior to initializing the plan.</td>
</tr>
<tr>
<td>Pair Cancellation</td>
<td>$G_s$ Sustained Attention (AC) Rate-of-test-taking (R9)</td>
<td>Measures the capacity for sustained attention (vigilance). The subject is presented with rows that contain repeating pictures of a dog and a ball (in no particular sequence) and must circle all instances of when the “ball is followed by the dog”. The test has a three-minute time limit.</td>
</tr>
<tr>
<td>Memory for Names</td>
<td>$G_{lr}$ Associative Memory (MA)</td>
<td>Measures the ability to learn associations between unfamiliar auditory and visual stimuli (an auditory—visual association task). The task requires learning the names of a series of space creatures. This is a &quot;learning&quot; test where corrective feedback is provided to the subject.</td>
</tr>
<tr>
<td>Visual Closure</td>
<td>$G_v$ Closure Speed (CS)</td>
<td>Measures the ability to name a drawing or picture of a simple object that is represented by disconnected lines. The test requires the subject to visually combine the disconnected lines into a meaningful whole.</td>
</tr>
</tbody>
</table>
Note: Tests in italic font are part of the WJ III Diagnostic Supplement (Scrhanke et al, 2003)

| Sound Patterns-Voice | Ga | General Sound Discrimination (U3)  
| Resistance to Auditory Stimulus Distortion (UR) | Measures the ability to indicate whether pairs of complex sounds are the same or different. The sounds resemble speech sounds. The pairs may differ in pitch, rhythm, or sound content. |
| Number Series | Gf | Quantitative Reasoning (RQ)  
| | Measures the ability to identify the quantitative principle that underlies a sequence of numbers in a series of numbers and then apply the principle to supply a missing number in the series. |
| Number Matrices | Gf | Quantitative Reasoning (RQ)  
| | Measures the ability to identify the quantitative principle that underlies a series of numbers in matrices and then apply the principle to supply a missing number in the matrix. |
| Cross Out | Gs | Perceptual Speed (P)  
| | Measures the ability to quickly scan and compare visual information. The subject must mark the five drawings in a row of 20 drawings that are identical to the first drawing in the row. The subject is given a 3-minute time limit to complete as many rows of items as possible. |
| Memory for Sentences | Gsm | Memory Span (MS)  
| | Measures the ability to remember and repeat simple words, phrases, and sentences presented auditorily by a tape player. |
| Block Rotation | Gv | Visualization (Vz)  
| Spatial Relations (SR) | Measures the ability to recognize two geometric designs, in a row of five, which are identical, although rotated to a different visual perspective from the target geometric design. Below the target stimulus are five pictures of geometric shapes or three-dimensional block strings that have been rotated in space. The subject must identify which two drawings are replications of the target item. |
| Sound Patterns-Music | Ga | Musical Discrimination and Judgement (U9)  
| | Measures the ability to indicate whether parts of music are the same or different. The patterns of music may differ in pitch, rhythm, or sound content. |
| Del Rec—Mem Names | Glr | Associative Memory (MA)  
<p>| | Measures the ability to recall (after 1 to 8 days) the space creatures presented in Memory for Names. |</p>
<table>
<thead>
<tr>
<th><strong>Achievement Tests</strong> (in order in battery)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Letter-Word Id</strong></td>
</tr>
<tr>
<td><strong>Reading Fluency</strong></td>
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<tr>
<td><strong>Story Recall</strong></td>
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<tr>
<td><strong>Understanding Directions</strong></td>
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<tr>
<td><strong>Calculation</strong></td>
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<tr>
<td><strong>Math Fluency</strong></td>
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<tr>
<td><strong>Spelling</strong></td>
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<tr>
<td><strong>Writing Fluency</strong></td>
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<tr>
<td><strong>Passage Comprehension</strong></td>
</tr>
<tr>
<td><strong>Applied Problems</strong></td>
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<tr>
<td><strong>Writing Samples</strong></td>
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<tr>
<td><strong>Del. Rec.- Story Recall</strong></td>
</tr>
<tr>
<td>Test Domain</td>
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</tr>
<tr>
<td>Word Attack</td>
</tr>
<tr>
<td>Picture Vocabulary</td>
</tr>
<tr>
<td>Oral Comprehension</td>
</tr>
<tr>
<td>Editing</td>
</tr>
<tr>
<td>Reading Vocabulary</td>
</tr>
<tr>
<td>Quantitative Concepts</td>
</tr>
</tbody>
</table>
| Academic Knowledge | $G_c$  
General Information (K0)  
General Science Information (K1)  
Information about Culture (K2)  
Geography Achievement (A5) | Measures the subject’s knowledge in various areas of the biological and physical sciences, history, geography, government, economics, art, music, and literature. |
|---------------------|----------------------------------------|
| Spelling of Sounds  | $Grw$, $Ga$  
Spelling Ability (SG)  
Phonetic Coding (PC) | Measures the ability to listen to a nonsense word and produce a written response representing the likely spelling of that word if it were a real English word. It is a measure of the subject’s comprehension of the “alphabetic principle.” The subject is presented the nonsense word from an audio tape and is asked to write it. |
| Sound Awareness     | $Ga$  
Phonetic Coding (PC) | Measures oral sound analysis skills at the preschool and primary level of development. It contains four parts: Rhyming, Substitution, Deletion, and Reversal. The items are presented orally by the examiner, or by tape, and the subject responds orally. |
| Punctuation & Capitalization | $Grw$  
English Usage & Knowledge | Measures knowledge of punctuation and capitalization |
Verbal Comprehension

Age (in years - starting at 6)

W-score

Verbal Comprehension

Age (in years - starting at 6)
Spatial Relations

Age (in years - starting at 6)

Spatial Relations

Age (in years - starting at 6)
Concept Formation

![Graph of Concept Formation](image)

Age (in years - starting at 6)

W-score
Visual Matching

Age (in years - starting at 6)

W-score

Visual Matching

Age (in years - starting at 6)

W-score
Incomplete Words

Age (in years - starting at 6)

W-score

Incomplete Words

Age (in years - starting at 6)
Visual-Aud. Learning Delayed

Age (in years - starting at 6)
Picture Recognition

Age (in years - starting at 6)

Picture Recognition

Age (in years - starting at 6)
Auditory Attention

Age (in years - starting at 6)

Auditory Attention

Age (in years - starting at 6)
Decision Speed

Age (in years - starting at 6)

W-score

Decision Speed

Age (in years - starting at 6)
Memory for Words

Age (in years - starting at 6)

W-score

Memory for Words

Age (in years - starting at 6)
Rapid Picture Naming

Rapid Picture Naming

Age (in years - starting at 6)

W-score

Age (in years - starting at 6)
Pair Cancellation

Age (in years - starting at 6)
Memory for Names

Age (in years - starting at 6)

W-score

Memory for Names

Age (in years - starting at 6)
Visual Closure
Sound Patterns - Voice

Age (in years - starting at 6)

Sound Patterns - Voice

Age (in years - starting at 6)
Number Series

Age (in years - starting at 6)

W-score vs. Age (in years - starting at 6)
Memory for Sentences

![Graph showing memory for sentences over age]

Age (in years - starting at 6)
Memory for Names - Delayed

Age (in years - starting at 6)

Memory for Names - Delayed

Age (in years - starting at 6)
Understanding Directions

Age (in years - starting at 6)

Understanding Directions

Age (in years - starting at 6)
Calculation

Age (in years - starting at 6)

Calculation

Age (in years - starting at 6)
Math Fluency

Age (in years - starting at 6)

Math Fluency

Age (in years - starting at 6)
Writing Fluency

Age (in years - starting at 6)

Writing Fluency

Age (in years - starting at 6)
Applied Problems

![Graph of W-score vs Age](image)

Age (in years - starting at 6)

Applied Problems

![Graph of W-score vs Age](image)

Age (in years - starting at 6)
Writing Samples

Age (in years - starting at 6)

W-score
Word Attack

![Graph showing growth curve for Word Attack](image_url)
Picture Vocabulary

Age (in years - starting at 6)

Picture Vocabulary

Age (in years - starting at 6)
Oral Comprehension

Age (in years - starting at 6)
Quantitative Concepts

Age (in years - starting at 6)

Quantitative Concepts

Age (in years - starting at 6)
Academic Knowledge

Age (in years - starting at 6)

Academic Knowledge

Age (in years - starting at 6)
Spelling of Sounds

![Graph showing W-score for spelling of sounds against age (in years - starting at 6).](image-url)

Age (in years - starting at 6)

Spelling of Sounds

![Graph showing W-score for spelling of sounds against age (in years - starting at 6).](image-url)

Age (in years - starting at 6)
Sound Awareness

Age (in years - starting at 6)

Sound Awareness

Age (in years - starting at 6)
Punctuation & Capitalization

![Graph showing growth curves for punctuation and capitalization](image)

Age (in years - starting at 6)