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Cross-Sectional Growth Curves for the Individual Tests for the WJ III Cognitive and Achievement Batteries

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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 $\pm$ 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[1]. 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 life-span (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

[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.

McGrew, K. S. & Woodcock, R. W. (2001). WJ III Technical Manual. Itasca, IL: Riverside Publishing.

McGrew, K. S., Woodcock, R. W., Ford, L. (2002). The Woodcock-Johnson Batter—Third Edition (WJ III). In A. S. Kaufman & E. O. Lichtenberger, Assessing Adolescent and Adult Intelligence (Second Edition). Boston: Allyn and Bacon.

Schrank, F. A., Mather, N., McGrew, K. S., & Woodcock, R. W. (2003). Manual. Woodcock-Johnson III Diagnostic Supplement to the Tests of Cognitive Abilities: Itasca, IL: Riverside Publishing.

[2] Similar growth curve plots for eight cognitive and three achievement clusters have previously been reported in McGrew, Woodock, & Ford (2002).

Description of WJ III tests and Broad and Narrow CHC Ability Classifications

Cognitive Tests (in order in battery)		
Test	**Broad and Narrow CHC Ability Classificaitons**	**Description of Test**
Verbal Comprehension	*Gc* Language Development (LD) Lexical Knowledge (VL)	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.
Visual-Auditory Learning	*Glr* Associative Memory (MA) Meaningful Memory (MM)	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 "learning" test where corrective feedback is provided to the subject.
Spatial Relations	*Gv* Visualization (Vz) Spatial Relations (SR)	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.
Sound Blending	Ga Phonetic Coding (PC) (synthesis)	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).
Concept Formation	*Gf* Induction (I)	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 "learning" test with corrective feedback and reinforcement of correct answers provided to the subject.
Visual Matching	*Gs* Perceptual Speed (P)	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
Numbers Reversed	*Gsm* Working Memory (MW)	Measures the ability to repeat a series of random numbers backward. The number sequences are presented by audio tape.
Incomplete Words	*Ga* Phonetic Coding (PC) (analysis)	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).
Del Rec—Vis-Aud Lrng	*Glr* Associative Memory (MA)	Measures the ability to recall and relearn (after 1 to 8 days) the symbols (rebuses) presented in Visual-Auditory Learning. This is a "relearning" task as the subject relearns forgotten associations. Corrective feedback is provided to the subject during the task.

General Information	*Gc* General Info (K0)	Measures knowledge of the common or typical characteristics of certain objects. The test has two components: "what" and "where" questions. The questions are presented orally and the subject must state the answer to "where you would find...." and "what you would do with..." questions
Retrieval Fluency	*Glr* Ideational Fluency (FI)	Measures fluency in retrieving the names of objects. The subject is asked to state as many items as they can of three different types, "things to eat or drink", "names of people", and "animals.
Picture Recognition	*Gv* Visual Memory (MV)	Measures the ability to recognize a subset of previously presented pictures within a larger set of pictures.
Auditory Attention	*Ga* Speech-sound Discrimination (US) Resistance to Auditory Stimulus Discrimination (UR) Attention/Concentration (AC)	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.
Analysis-Synthesis	*Gf* General Sequential Reasoning (RG)	Measures the ability to analyze the components of an incomplete logic puzzle and to determine and name the missing components. This is a "learning" test with corrective feedback and reinforcement of correct answers provided to the subject.
Decision Speed	*Gs* Semantic Processing Speed (R4 Mental Comparison Speed (R7)	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.
Memory for Words	Gsm Memory Span (MS)	Measures the ability to repeat lists of unrelated words in the correct sequence; words are presented by audio tape.
Rapid Picture Naming	*Gs* Naming Facility (NA)	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.
Planning	*Gv* Spatial Scanning (SS)	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 "forward thinking" in that the subject is required to plan a sequence of steps prior to initializing the plan.
Pair Cancellation	*Gs* Sustained Attention (AC) Rate-of-test-taking (R9)	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.
Memory for Names	*Glr* Associative Memory (MA)	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 "learning" test where corrective feedback is provided to the subject.
Visual Closure	*Gv* Closure Speed (CS)	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.

Note: Tests in italic font are part of the WJ III Diagnostic Supplement (Scrhank et al, 2003)

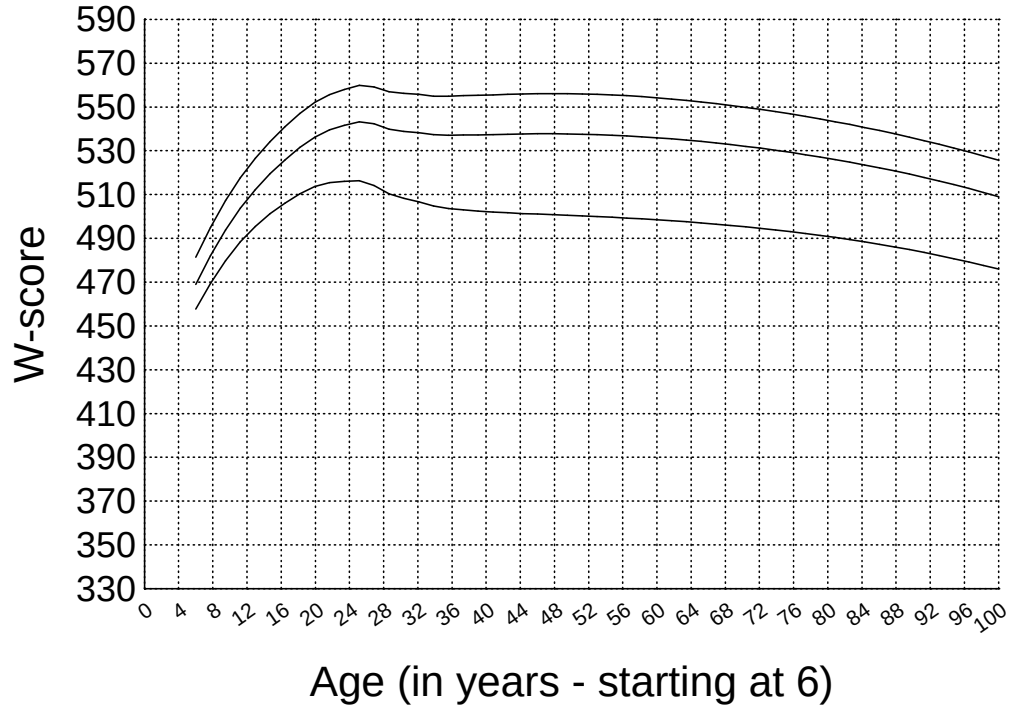
Sound Patterns-Voice	*Ga* General Sound Discrimination (U3) Resistance to Auditory Stimulus Distortion (UR)	Measures the ability to indicate whether pairs of complex sounds are the same or different. The sounds resemble speech sounds. The pairs may differ in pitch, rhythm, or sound content.
Number Series	*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)	Measures the ability to recall (after 1 to 8 days) the space creatures presented in Memory for Names.

Achievement Tests (in order in battery)		
Letter-Word Ident	*Grw* Reading Decoding (RD)	Measures the subject's reading skills in identifying isolated letters and words. It is not necessary that the subject knows the meaning of any words correctly identified.
Reading Fluency	*Grw, Gs* Reading Speed (RS) Semantic Processing Speed (R4)	Measures the ability to quickly comprehend the correctness of simple sentences. The subject is presented a series of simple sentences and must circle whether each sentence is true or false. The subject is required to complete as many items as possible within a 3-minute time limit.
Story Recall	*Gc, Glr* List. Ability (LS) Meaning. Mem (MM)	Measures the ability to recall increasingly complex stories presented orally to the subject. The subject is asked to tell back as much of the story as they can. The score is based on the number of correctly recalled story elements.
Understanding Directions	*Gc, Gsm* Listening Ability (LS) Working Memory (MW)	Measures comprehension of linguistic concepts (receptive language). The subject is asked to follow oral directions by pointing to different items in a picture.
Calculation	*Gq* Mathematics Achievements (A3)	Measures the ability to perform mathematical calculations ranging from simple addition to calculus. The subject is not required to make any decisions about what operations to use or what data to include.
Math Fluency	*Gq* Mathematics Achievements (A3) Numerical Facility (N-Gs)	Measures the ability to quickly perform single-digit addition, subtraction, and multiplication facts. The subject is presented a series of simple arithmetic problems on a worksheet. The subject has two minutes to complete as many problems as possible.
Spelling	*Grw* Spelling Ability (SG)	Measures the ability to write correct spellings of orally presented words.
Writing Fluency	*Grw* Writing Ability (WA)	Measures the ability to formulate and write simple sentences quickly. This subtest has a 7-minute time limit.
Passage Comprehension	*Grw* Reading Comprehension (RC)	Measures the subject's skill in reading a short passage and identifying a missing key word. In this modified cloze procedure, the subject must exercise a variety of comprehension and vocabulary skills.
Applied Problems	*Gq* Mathematics Achievements (A3)	Measures the ability to analyze and solve problems in mathematics. The subject must decide not only the appropriate mathematical operations to use but also which of the data to include in the calculation.
Writing Samples	*Grw* Writing Ability (WA)	Measures the ability to write responses to a variety of demands. The subject must phrase and present written sentences that are evaluated with respect to the quality of expression. The subject is not penalized for errors in the basic mechanics of writing (spelling; punctuation).
Del. Rec.- Story Recall	*Glr* Meaningful Memory (MM)	Measures the ability to recall (after 1 to 8 days) the stories presented in Oral Recall.

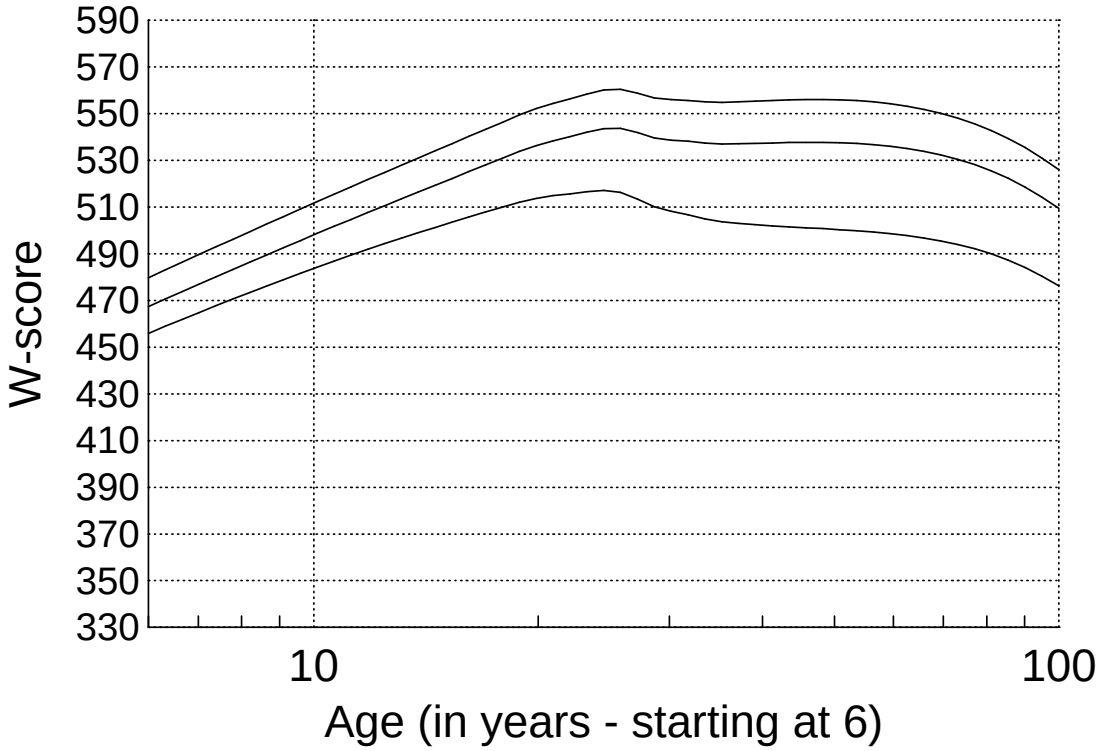
Word Attack	*Grw* Reading Decoding (RD)	Measures the ability to apply phonic and structural analysis skills to the pronunciation of unfamiliar printed words. The subject reads aloud letter combinations that are linguistically logical in English but that do not form actual words (nonsense word), or words that constitute low-frequency words in the English language.
Picture Vocabulary	*Gc* Lexical Knowledge (VL)	Measures vocabulary development and knowledge of culture.
Oral Comprehension	*Gc* Listening Ability (LS)	Measures the ability to listen to a short tape-recorded passage and to verbally supply the single word missing at the end of the passage.
Editing	*Grw* English Usage Knowledge (EU)	Measures the ability to identify, and indicate how to correct, mistakes in typewritten passages. The error in the passage may be incorrect punctuation or capitalization, inappropriate word usage, or a misspelling.
Reading Vocabulary	*Grw, Gc* Reading Comprehension (RC) Lexical Knowledge (VL)	Measures subject's skill in reading and understanding the meanings of words. In Part A: Synonyms, the subject must read a word and provide a word similar in meaning to the word presented. In Part B: Antonyms, the subject must read a word and provide a word that is opposite in meaning to the word presented. In Part C: Analogies, the subject must read an analogy and provide the missing word.
Quantitative Concepts	*Gq, Gf* Mathematics Knowledge (KM) Quantitative Reasoning (RQ)	Measures the subject's mathematical vocabulary, concepts and quantitative reasoning. The test consists of a mixture of number series items and items requiring the subject to display mathematical knowledge. The number series items require the subject to identify the underlying numerical relation in a series of numbers and then apply this principle by supplying a missing number in the series.

Academic Knowledge	*Gc* General Information (K0) General Science Information (K1) Information about Cultulture (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

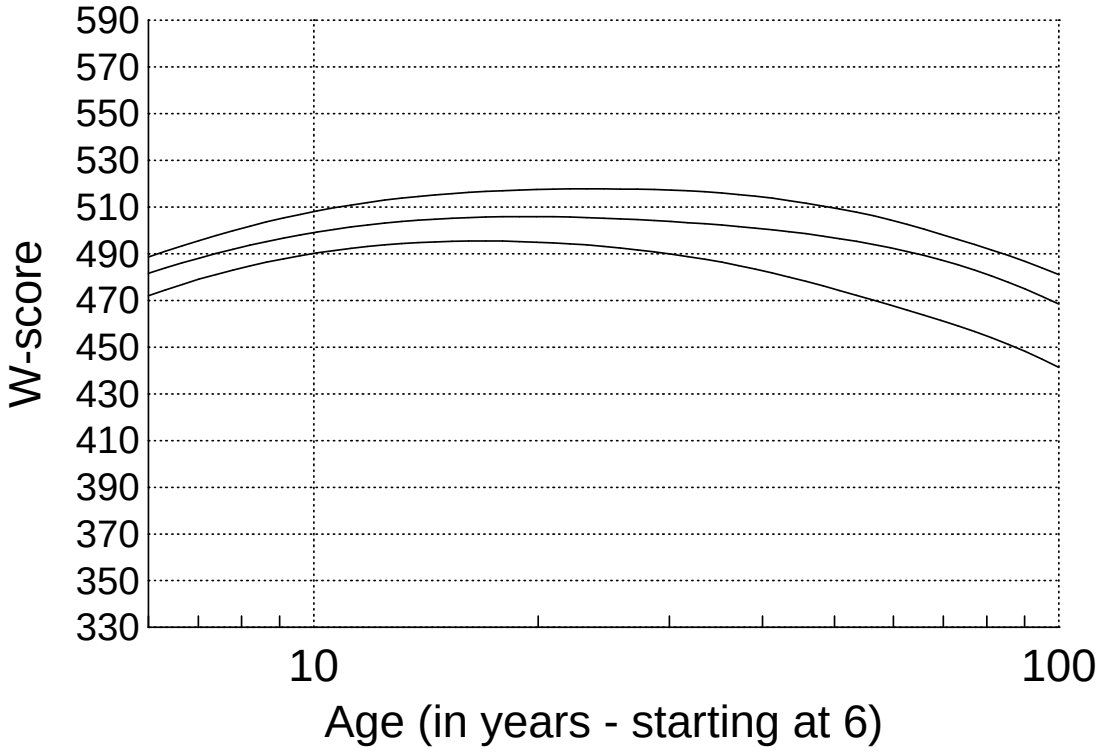


Verbal Comprehension

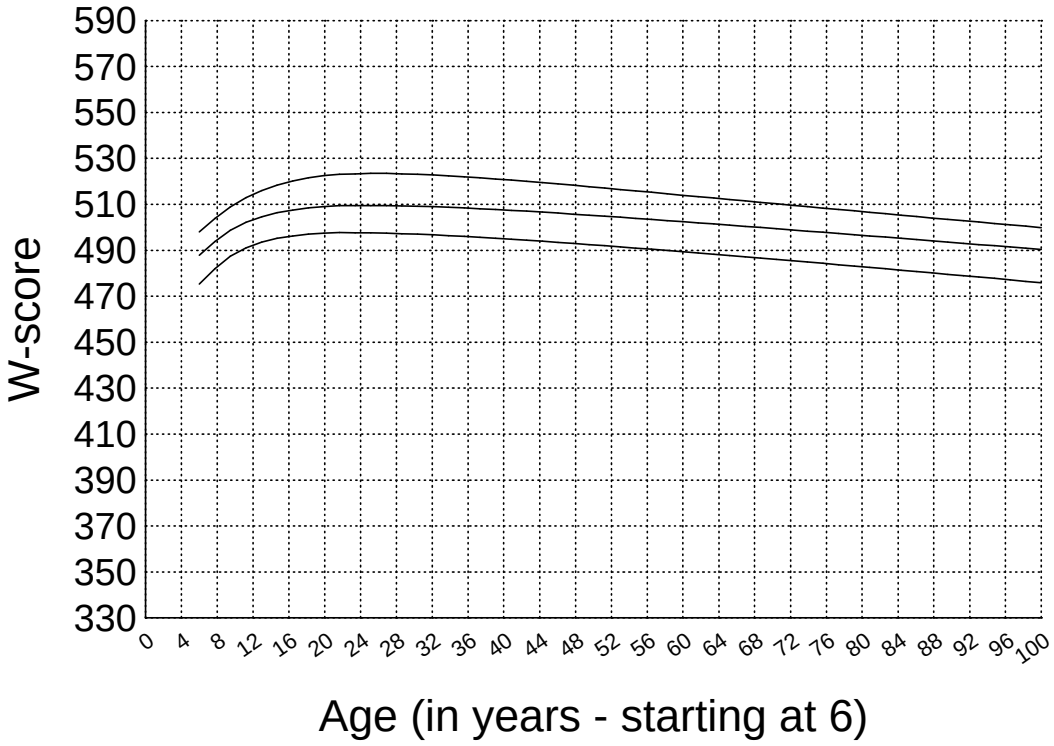


Visual-Auditory Learning

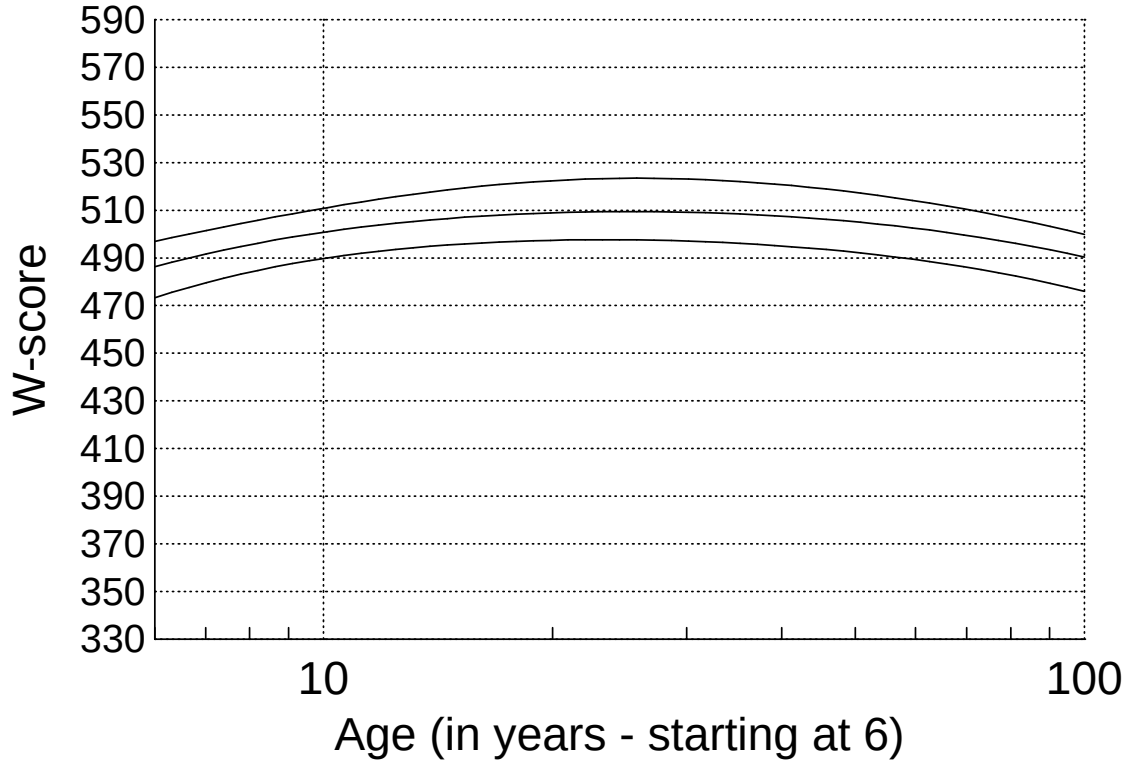
Visual-Auditory Learning



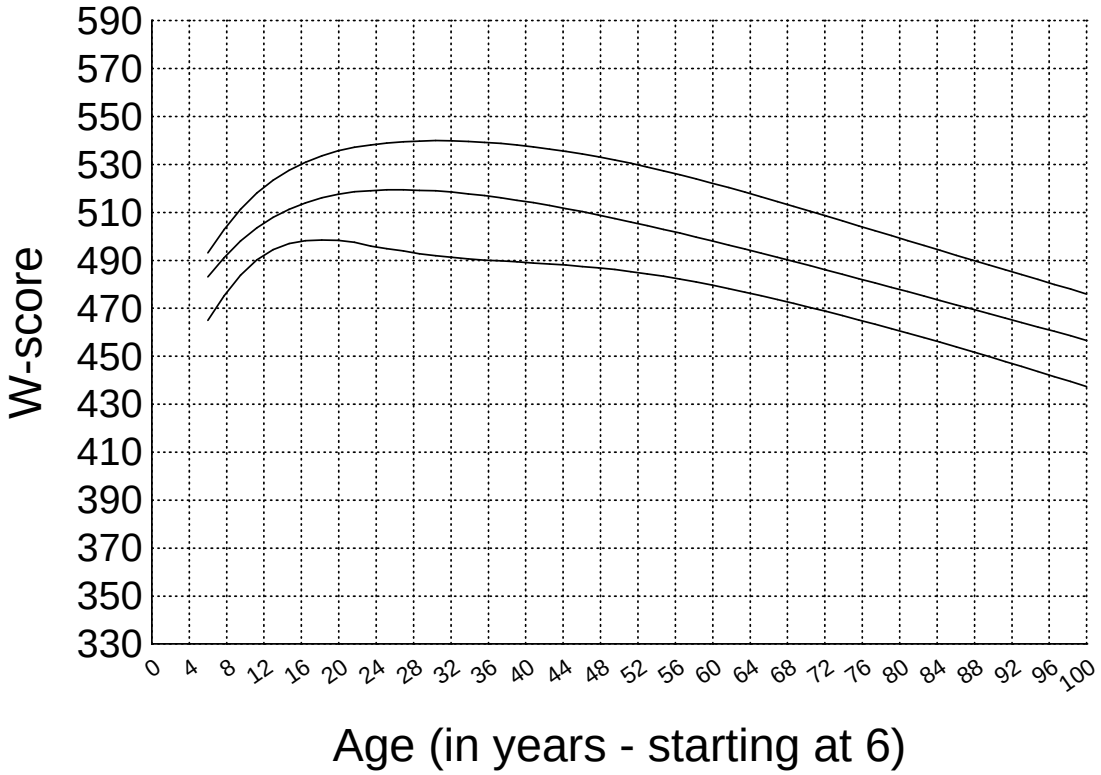
Spatial Relations



Spatial Relations



Sound Blending



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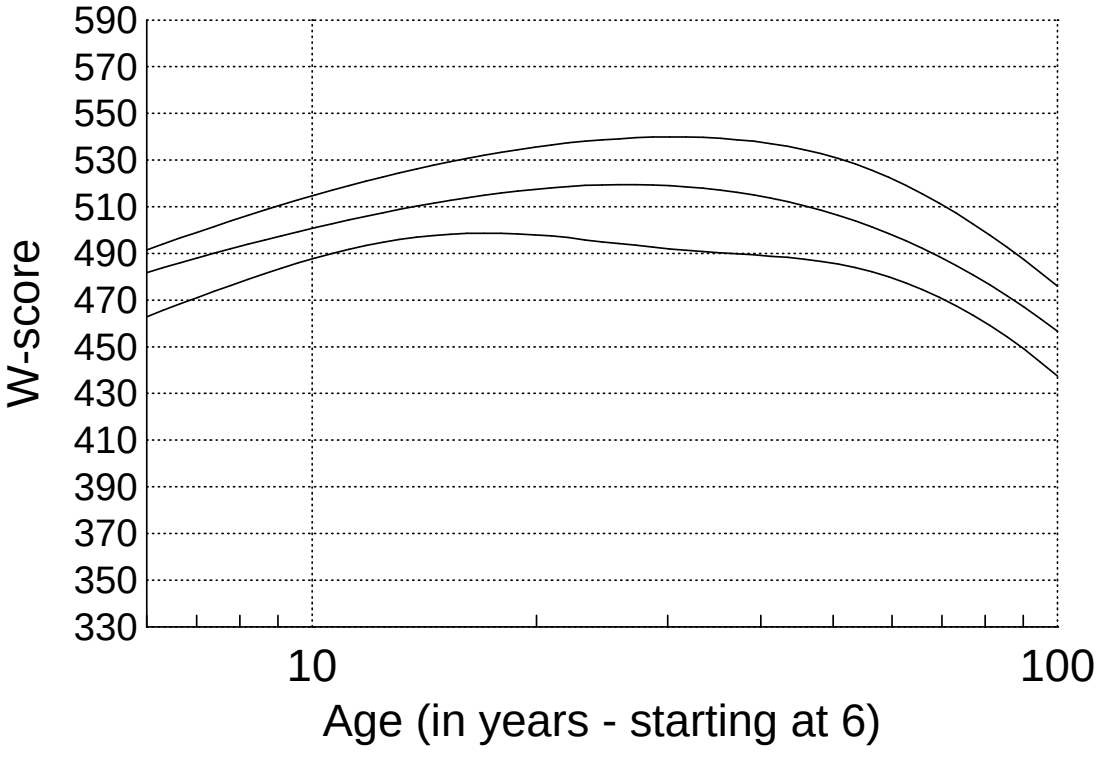
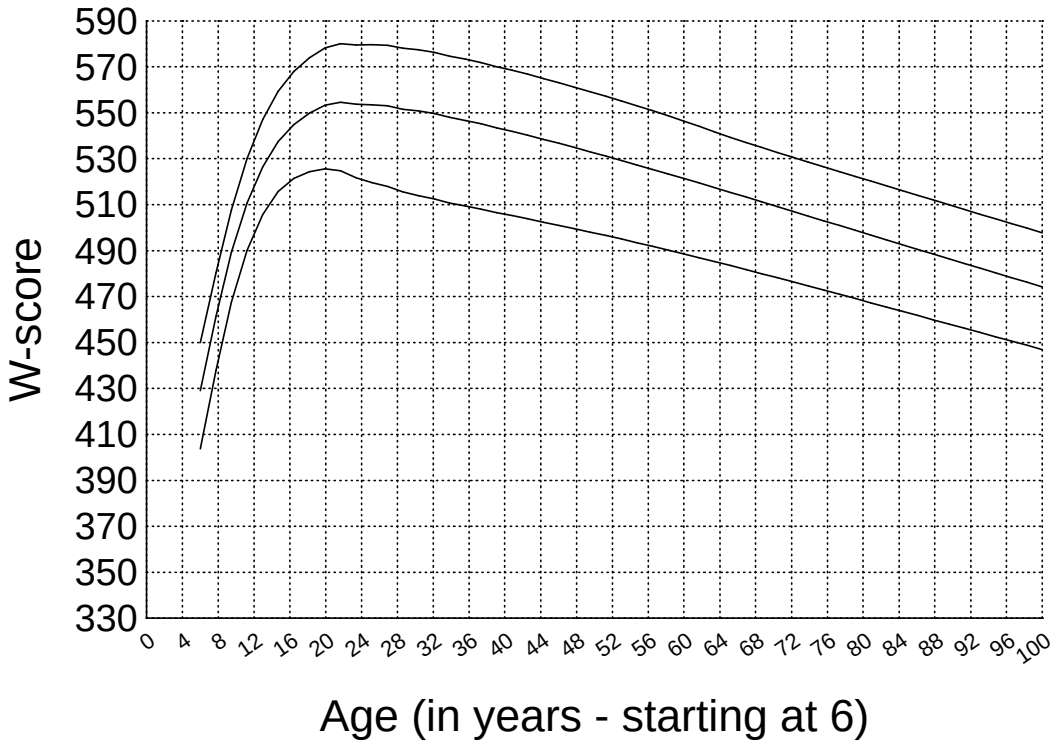


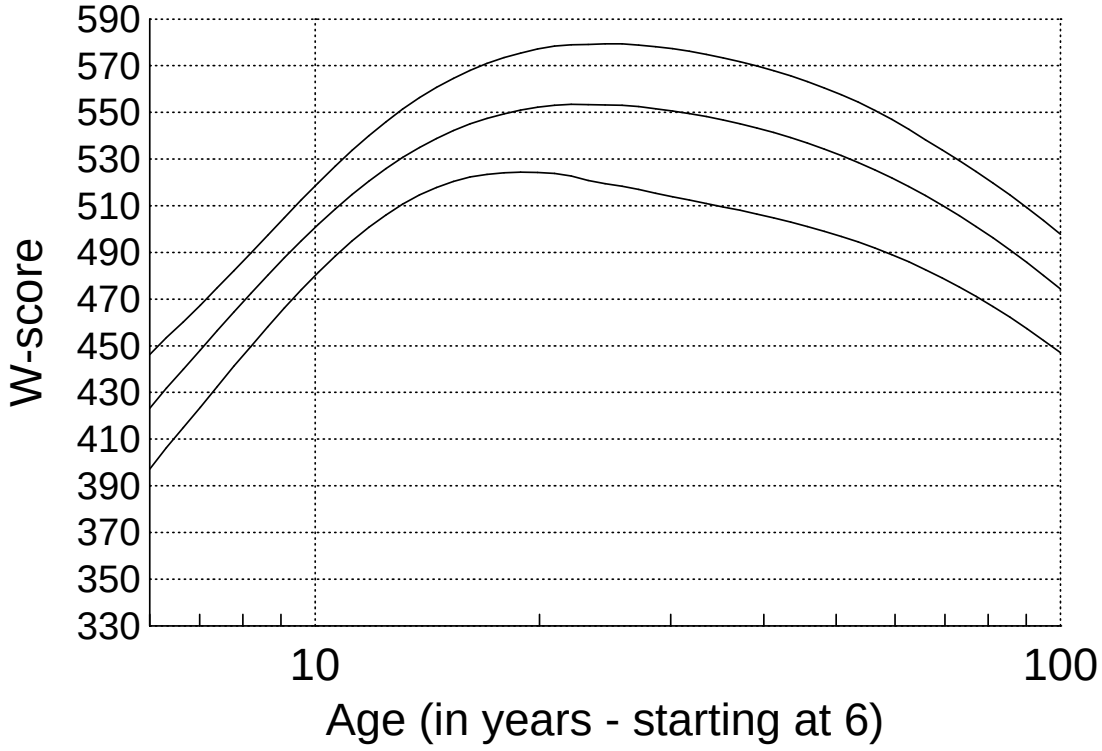
Concept Formation

Concept Formation

Visual Matching



Visual Matching

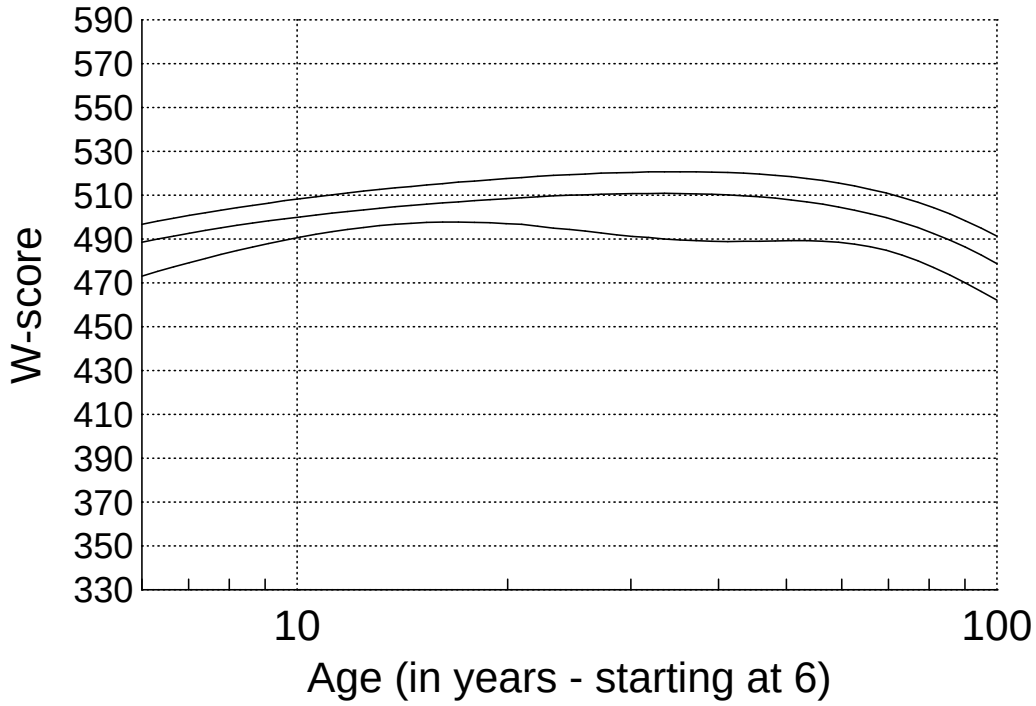


Numbers Reversed

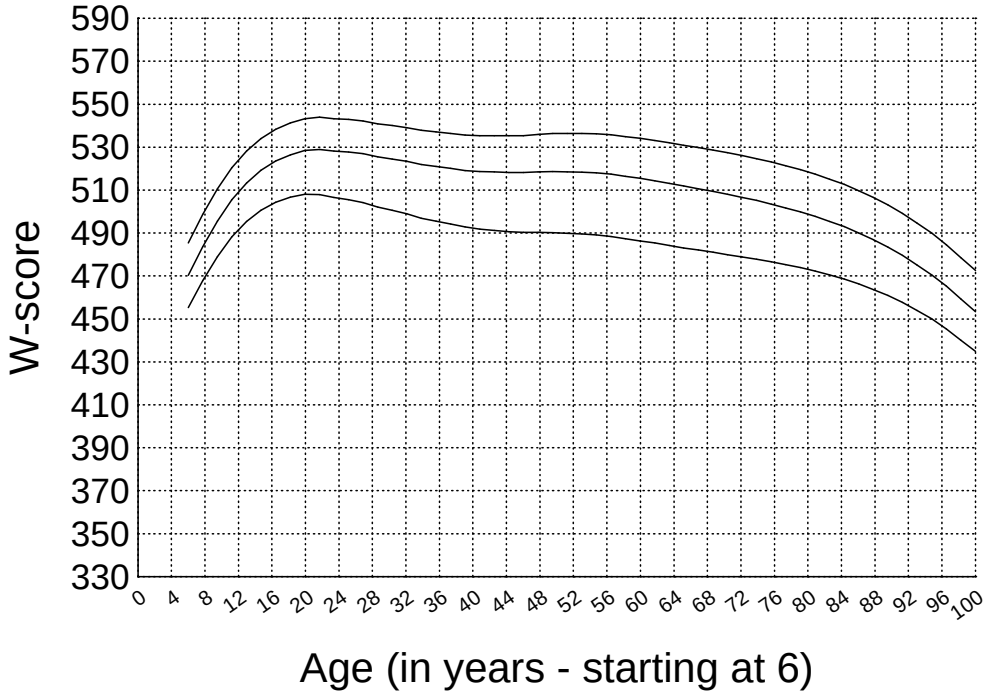
Numbers Reversed

Incomplete Words

Incomplete Words



Auditory Working Memory



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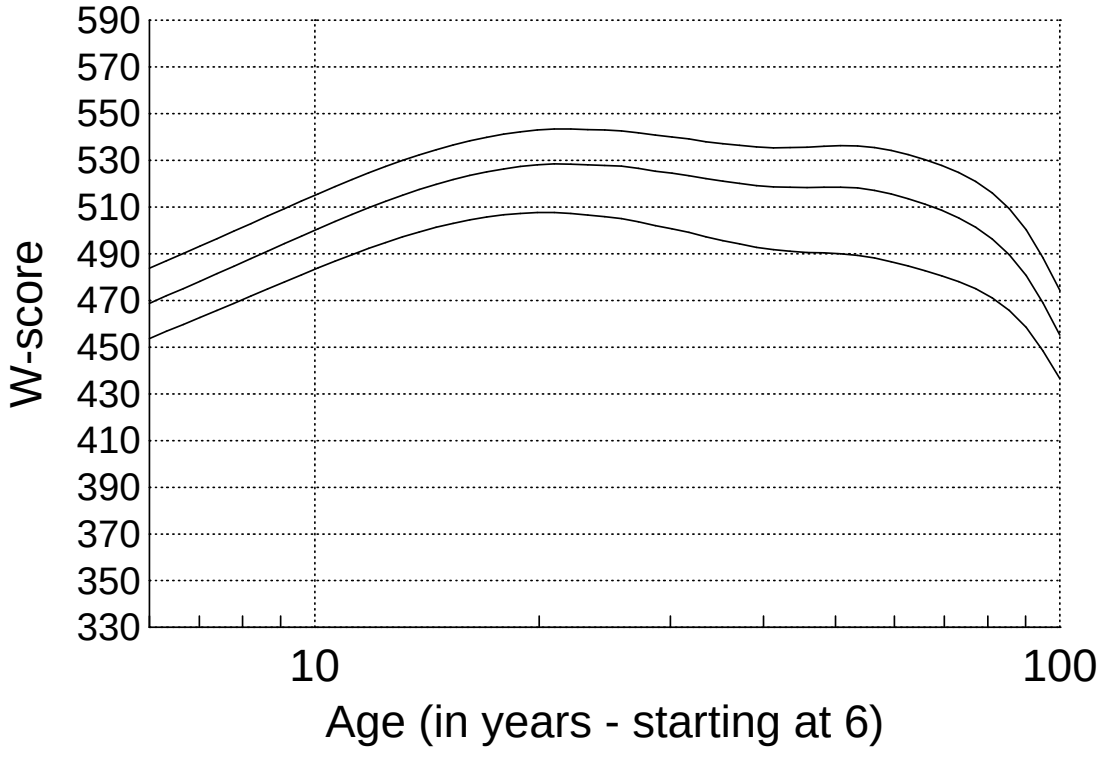
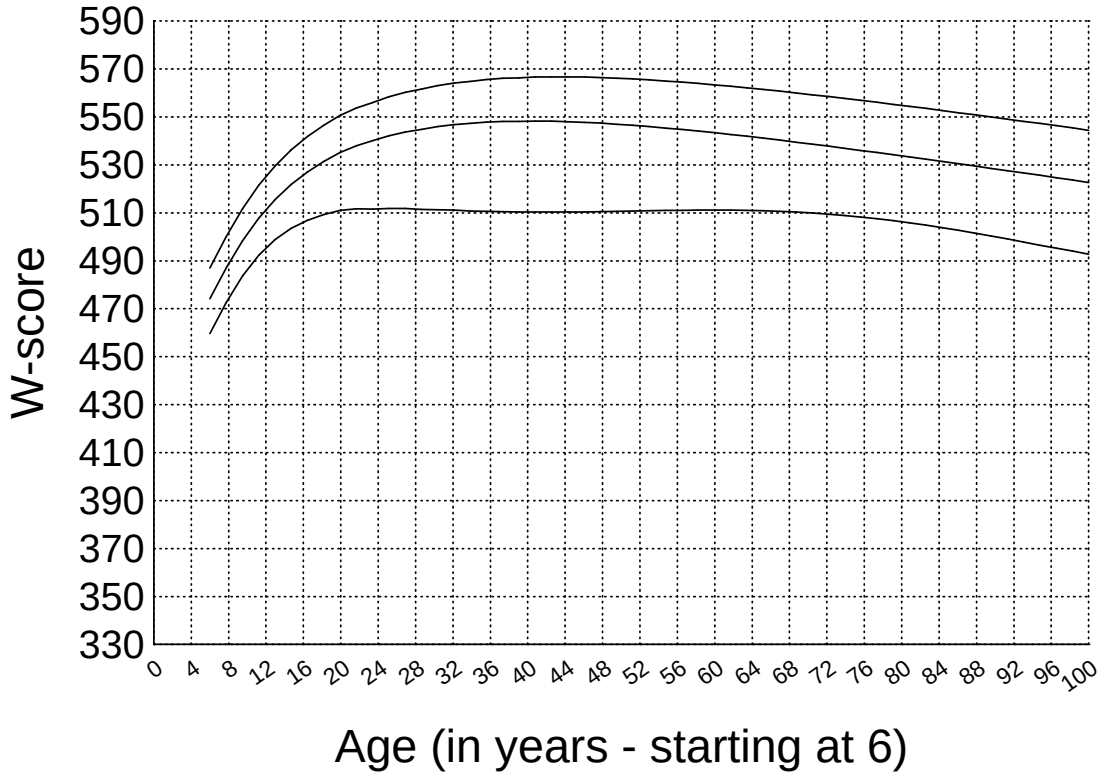


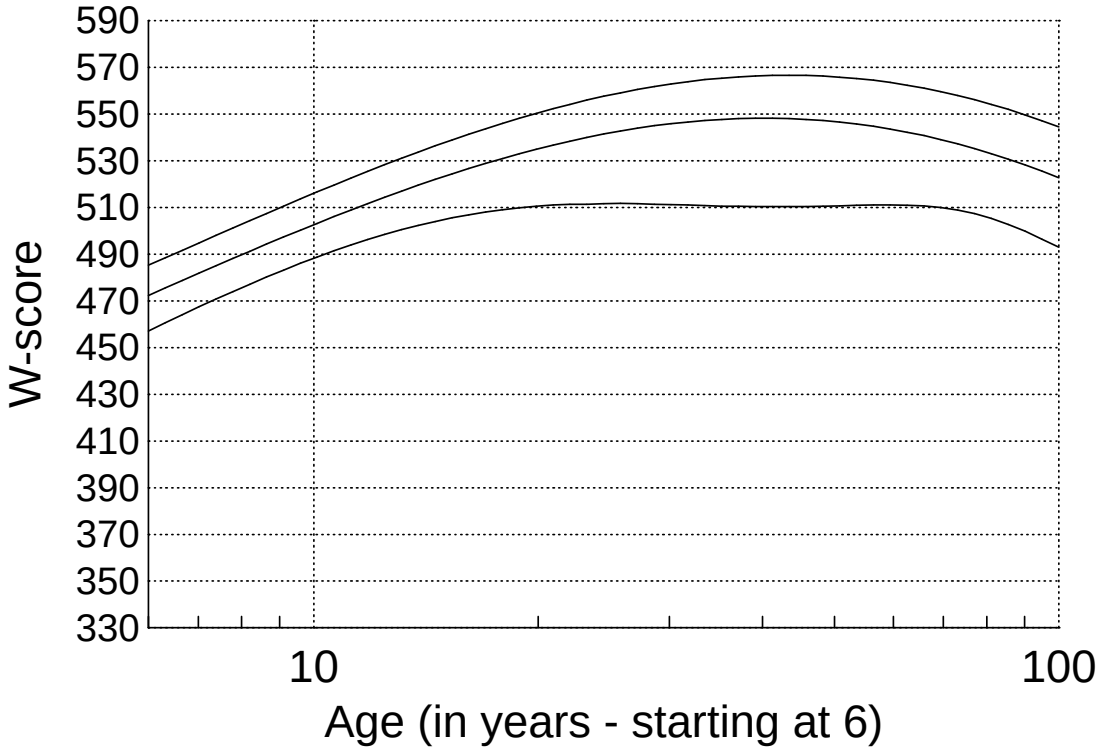
Visual-Aud. Learning Delayed

Visual-Aud. Learning Delayed

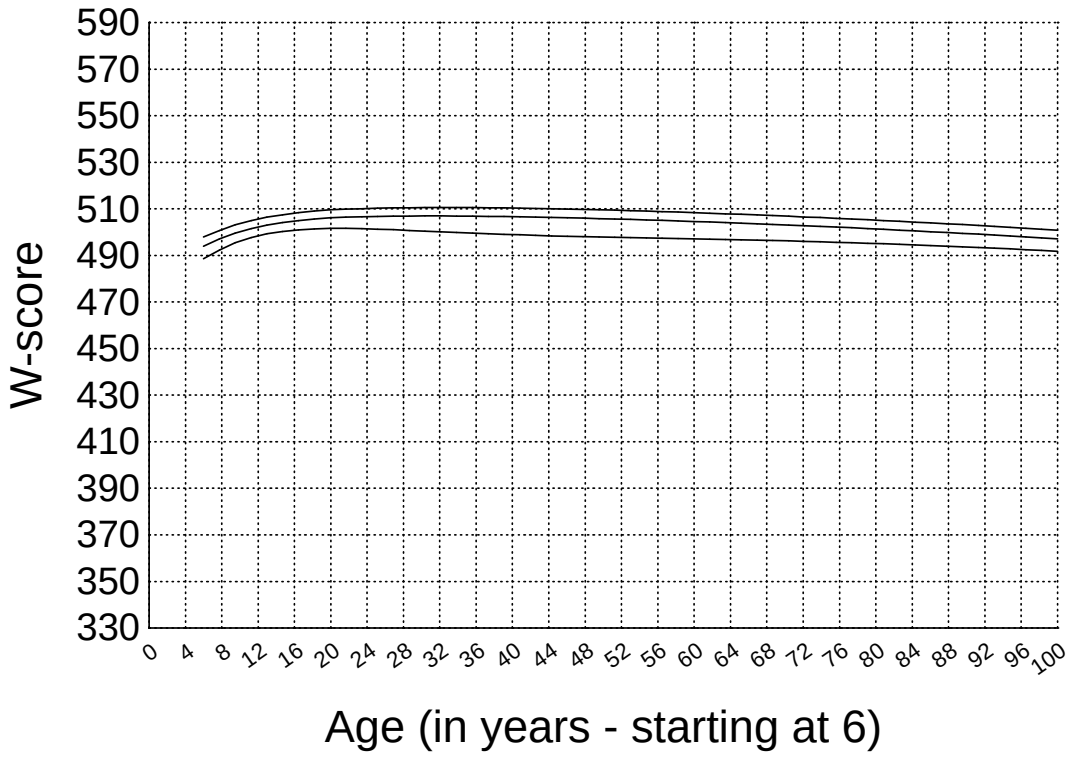
General Information



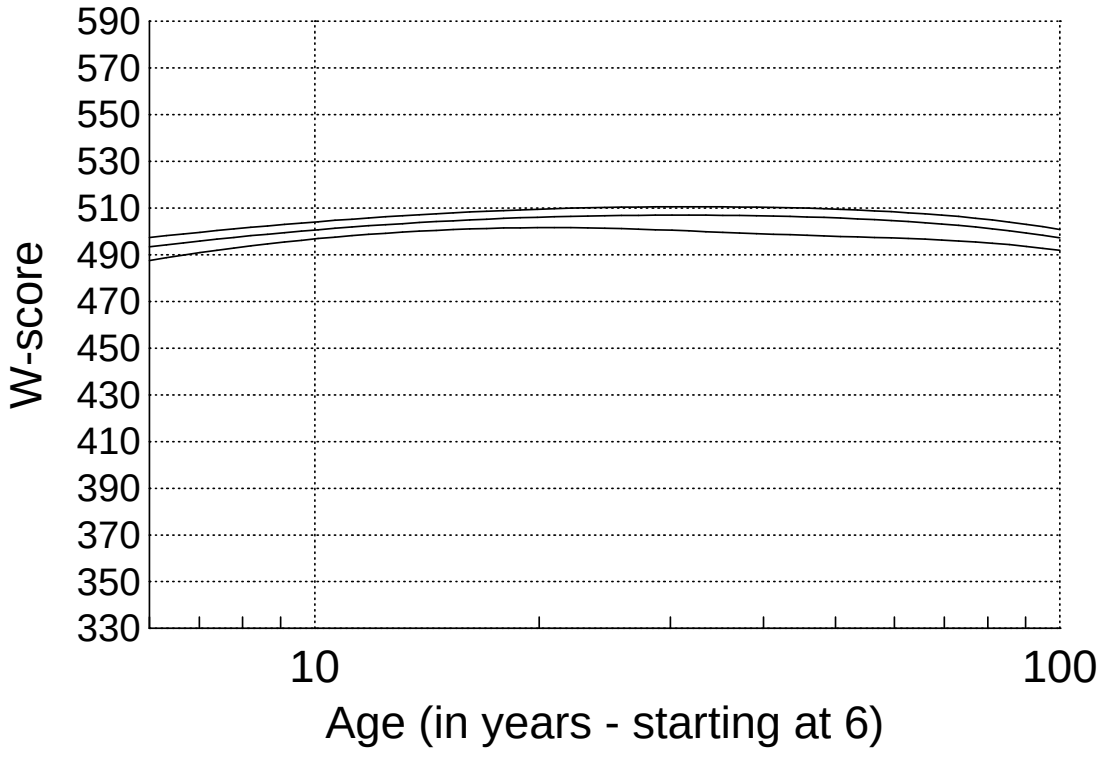
General Information



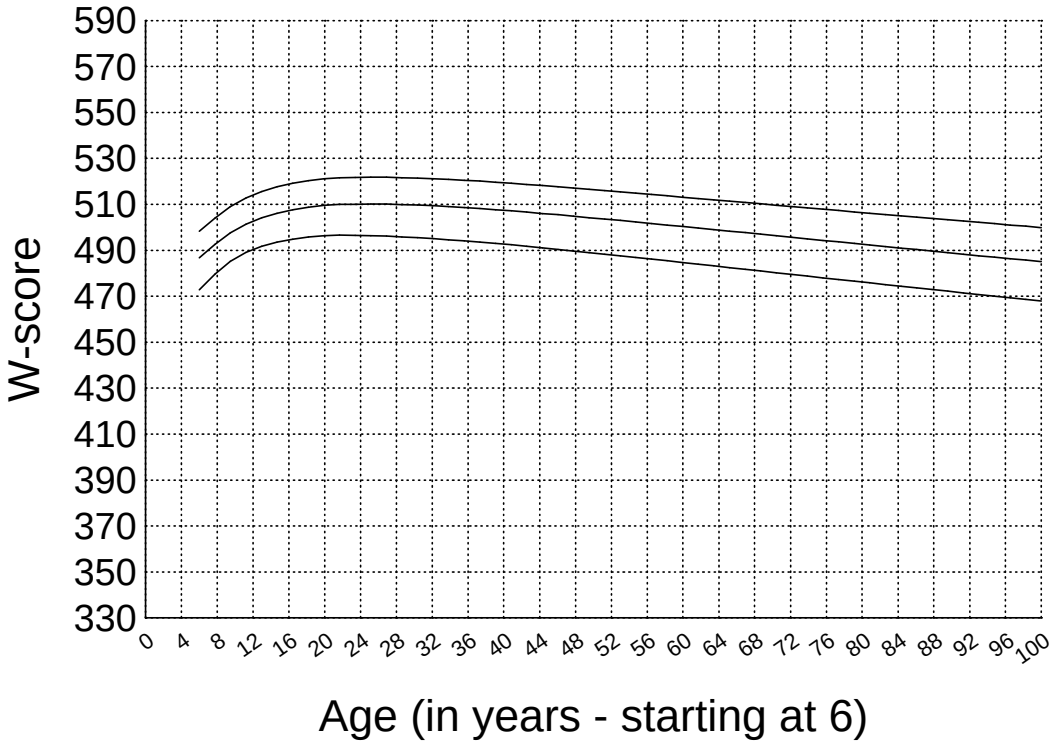
Retrieval Fluency



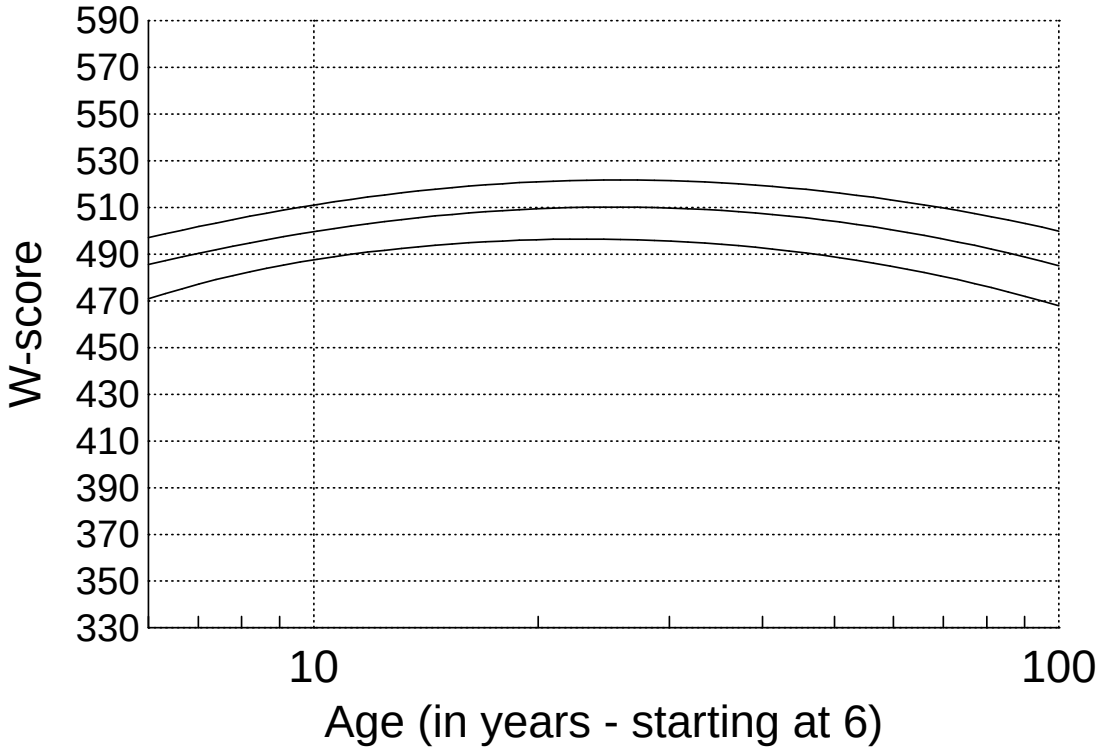
Retrieval Fluency



Picture Recognition



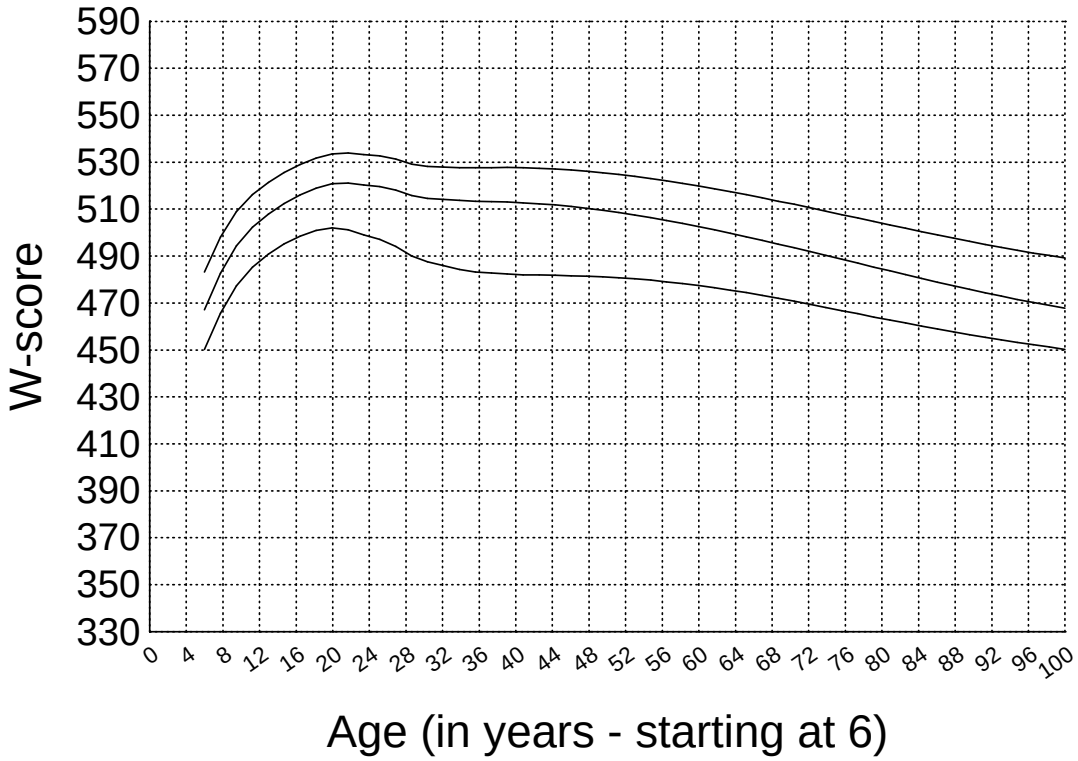
Picture Recognition



Auditory Attention

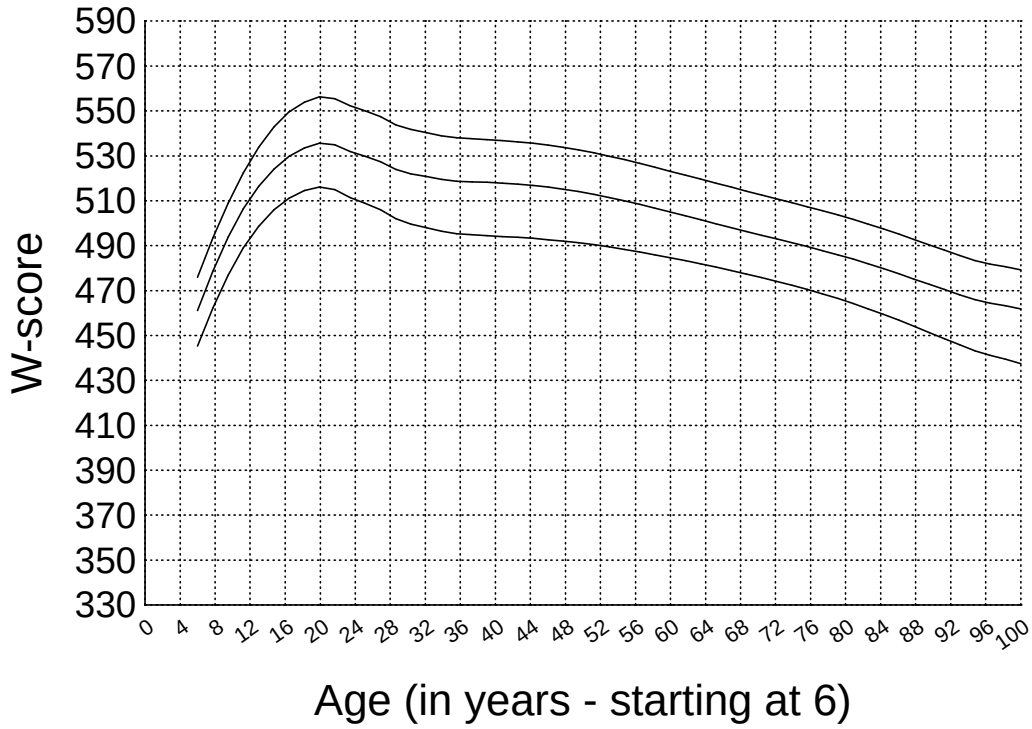
Auditory Attention

Analysis-Synthesis



Analysis-Synthesis

Decision Speed

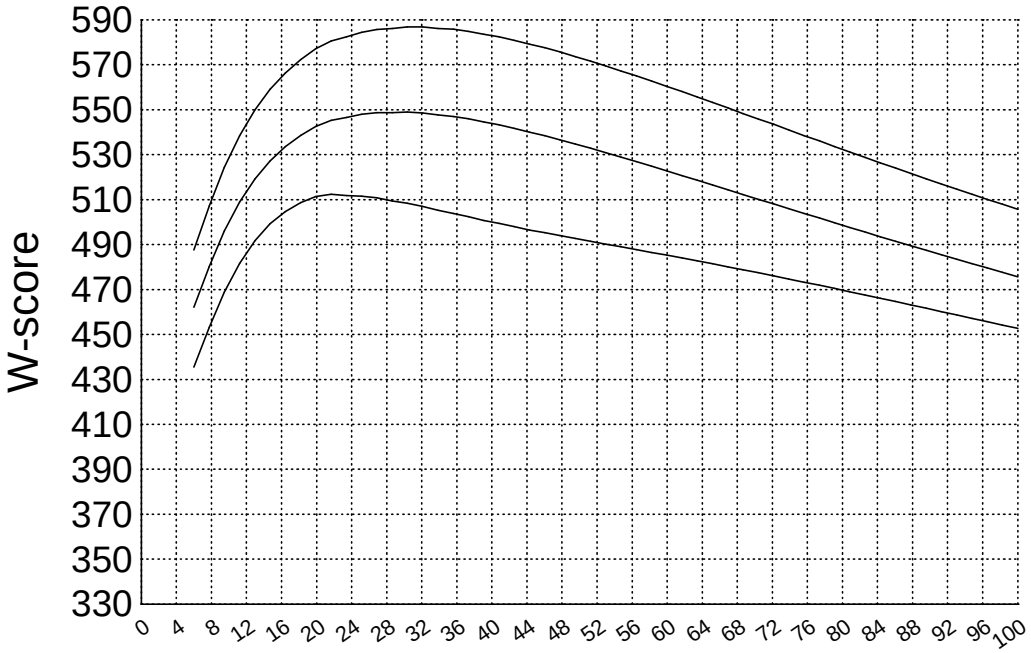


Decision Speed

Memory for Words

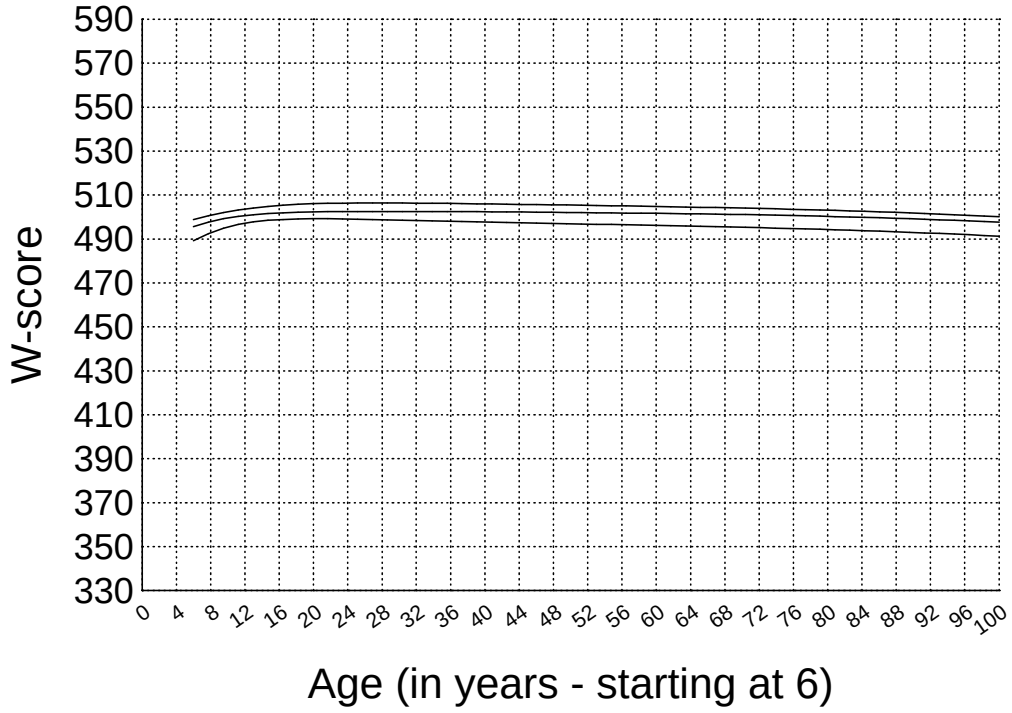
Memory for Words

Rapid Picture Naming

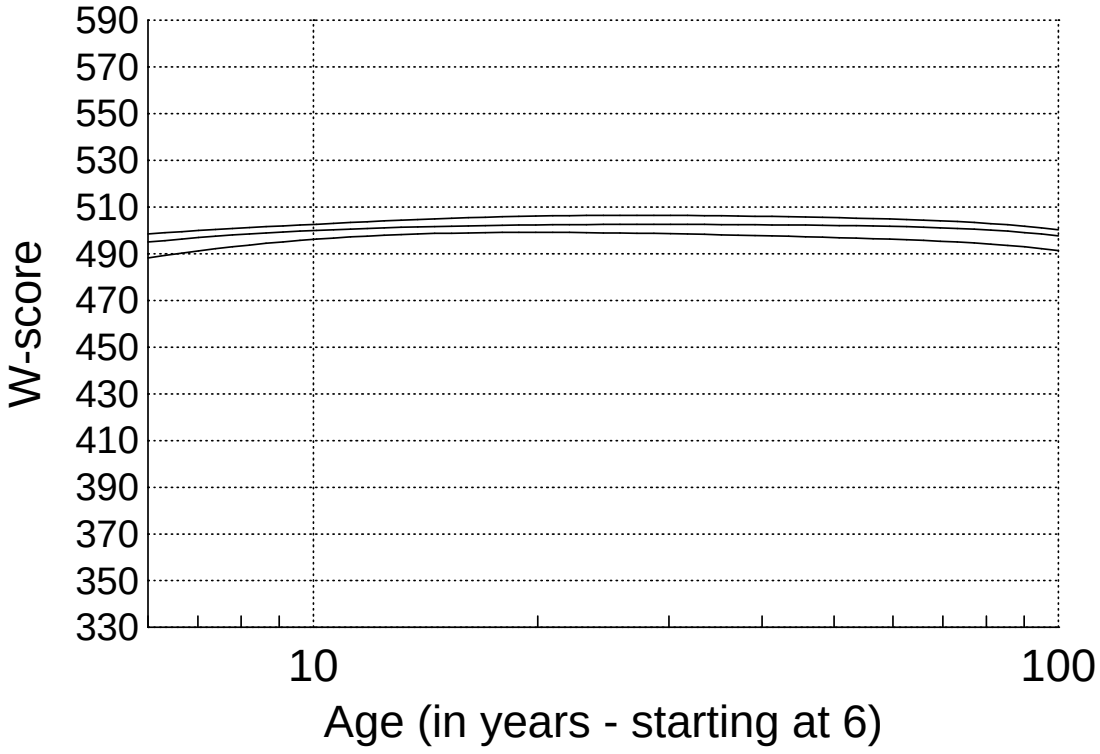


Rapid Picture Naming

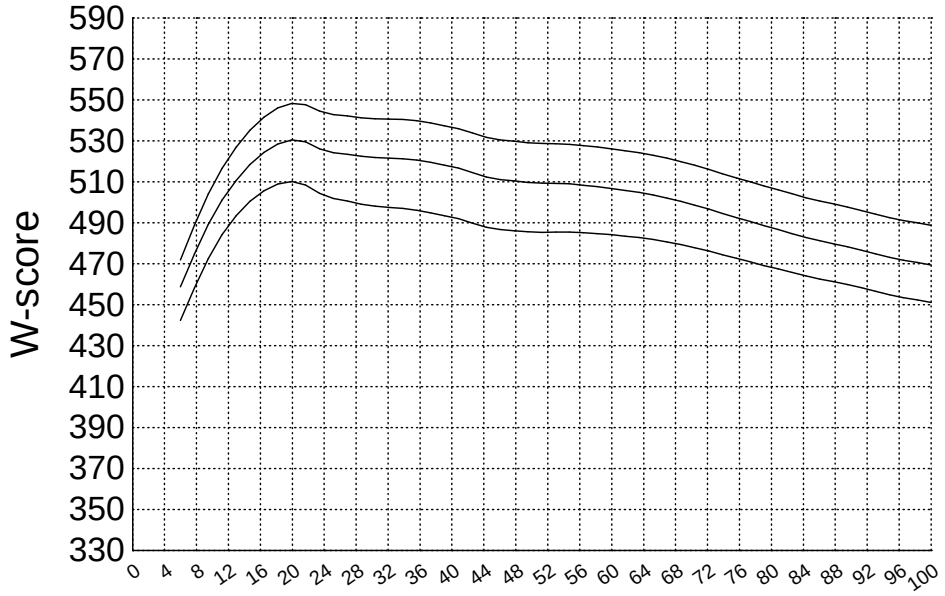
Planning



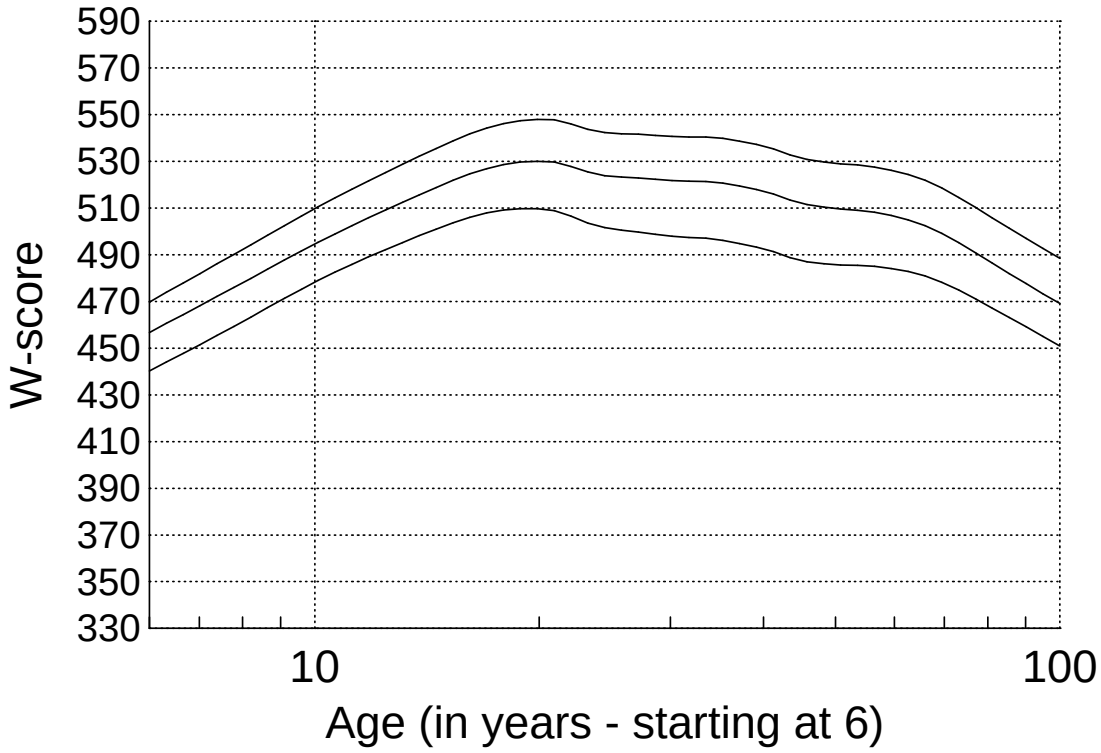
Planning



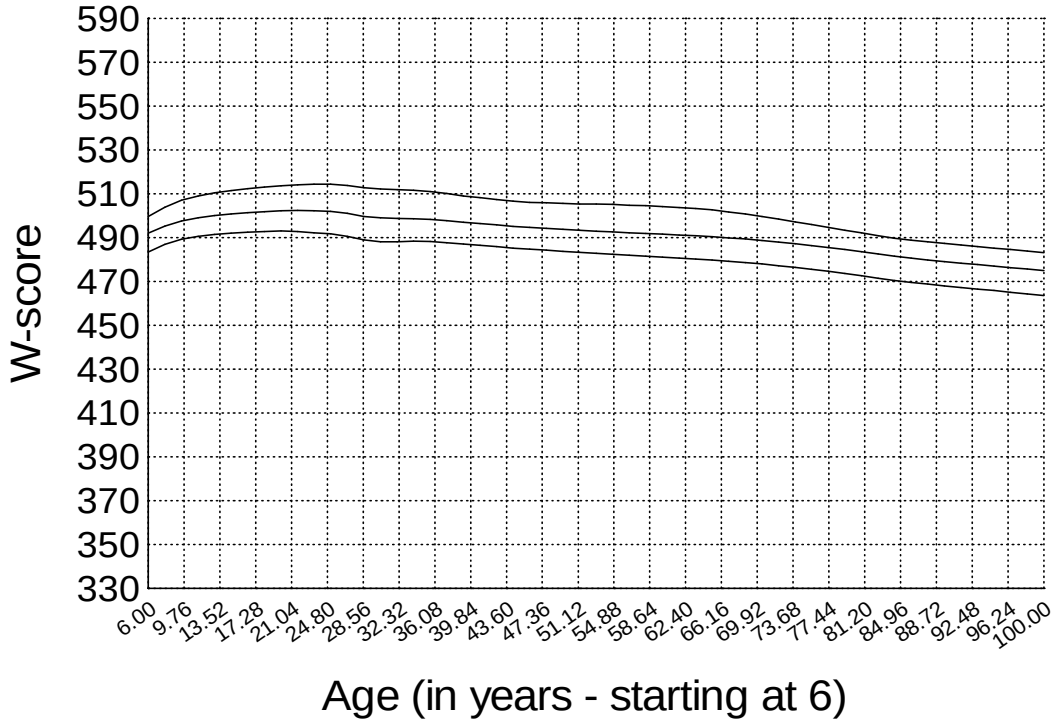
Pair Cancellation



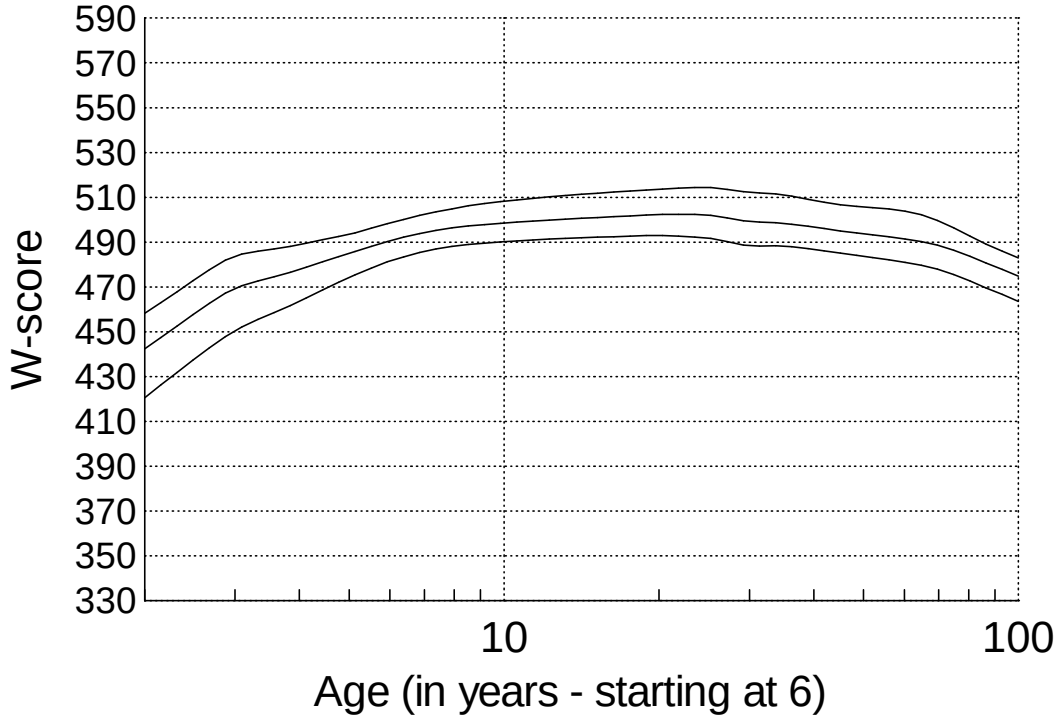
Pair Cancellation



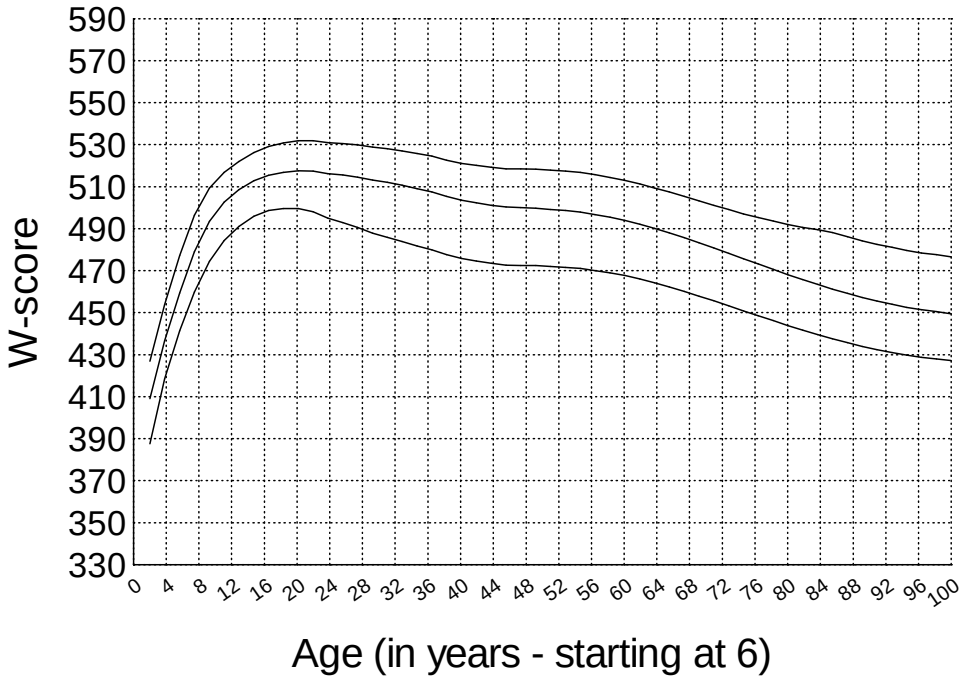
Memory for Names



Memory for Names

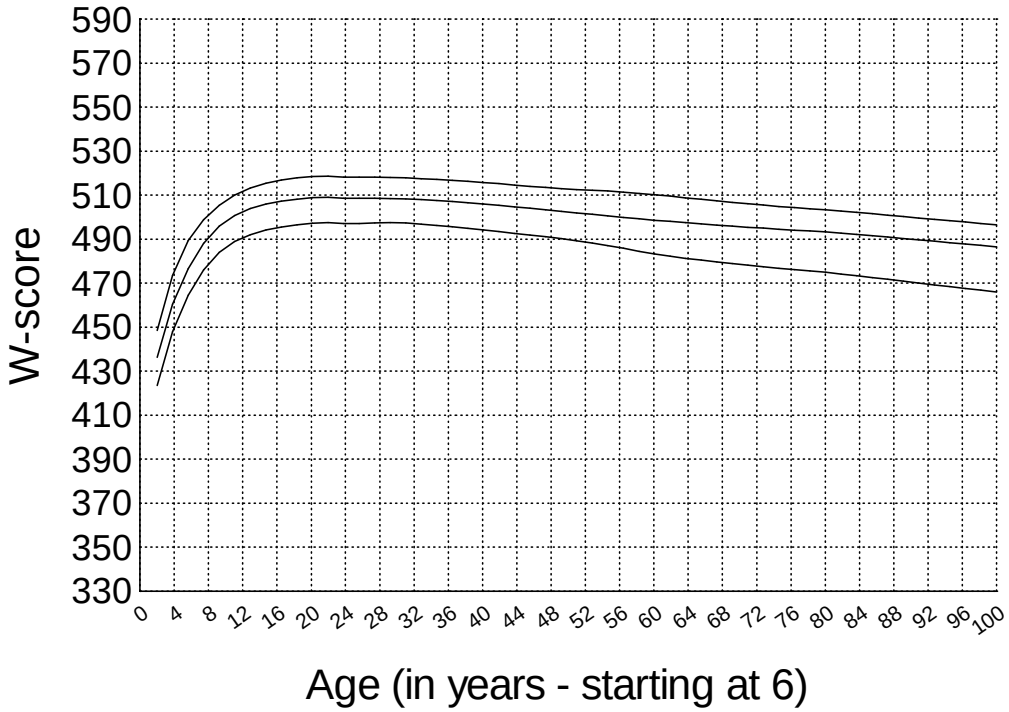


Visual Closure

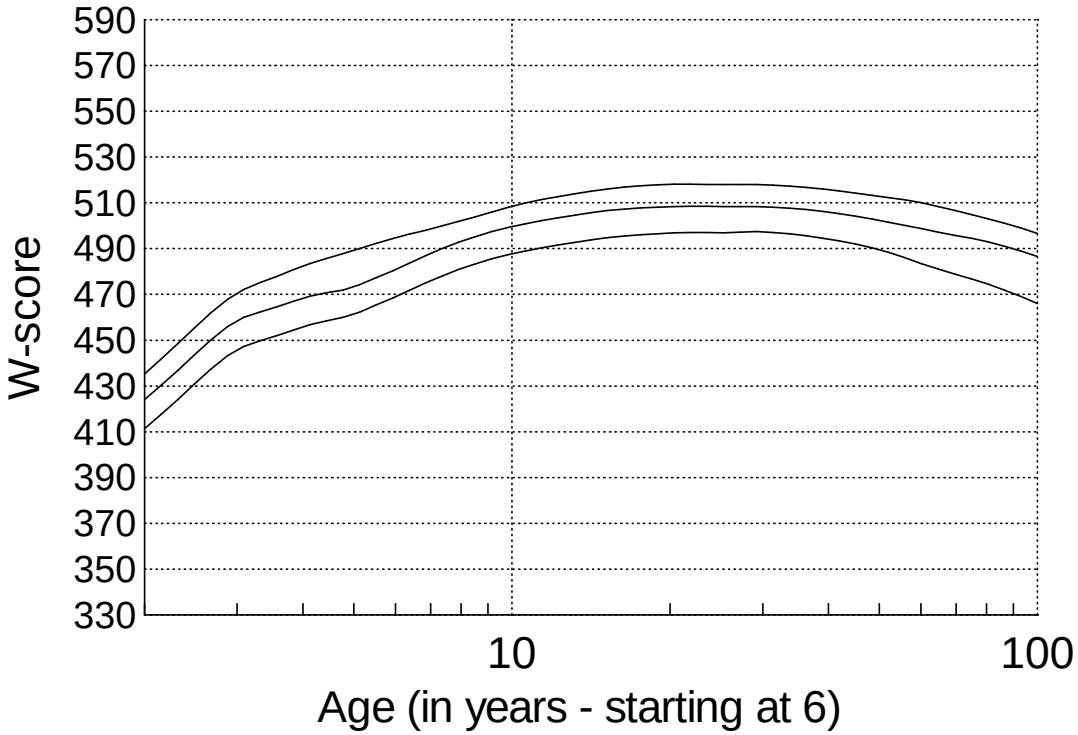


Visual Closure

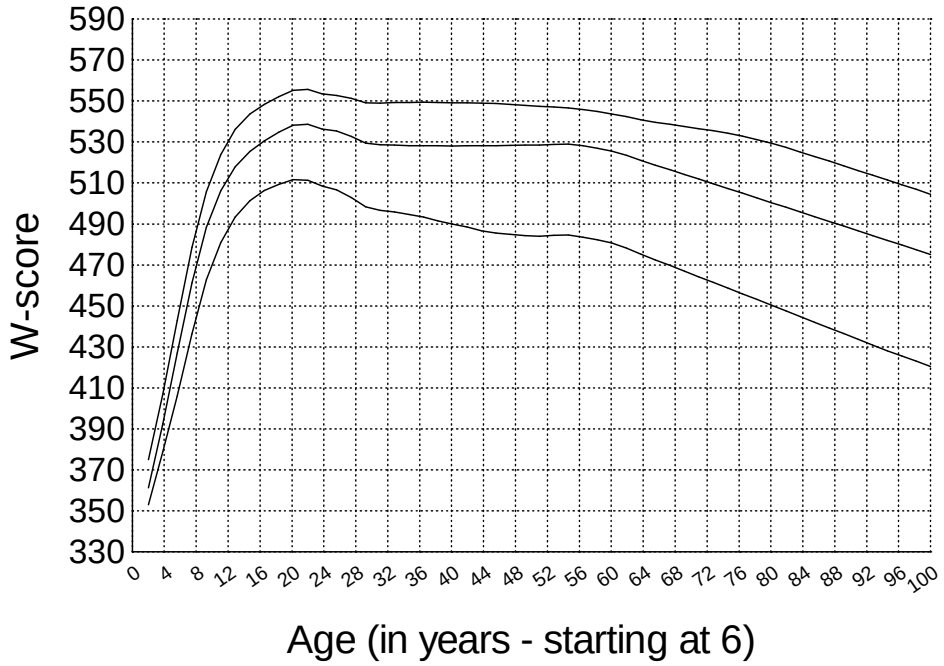
Sound Patterns - Voice



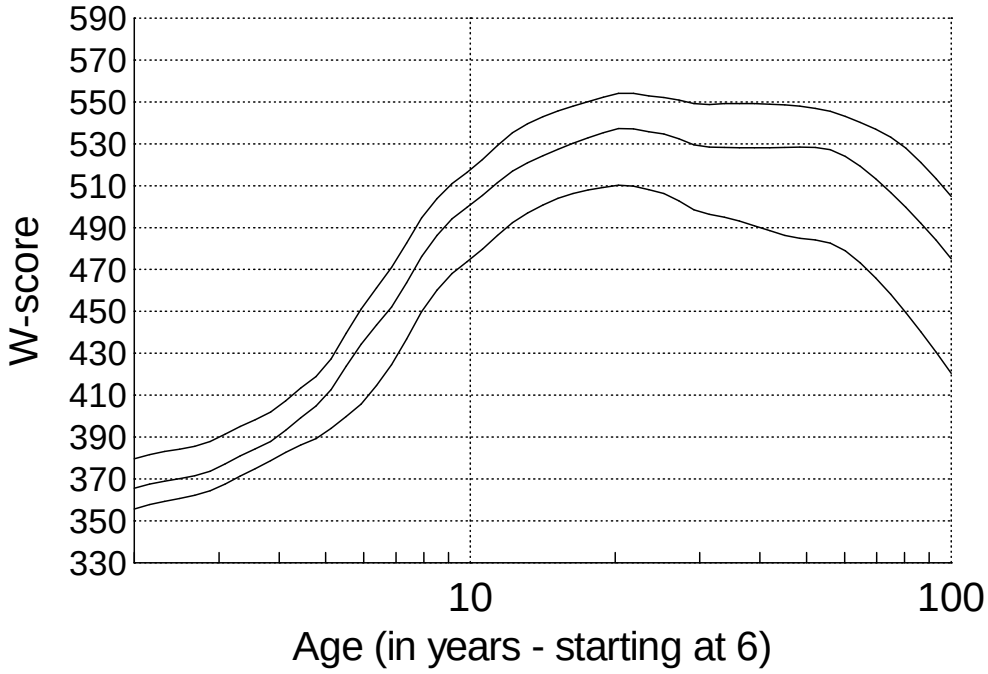
Sound Patterns - Voice



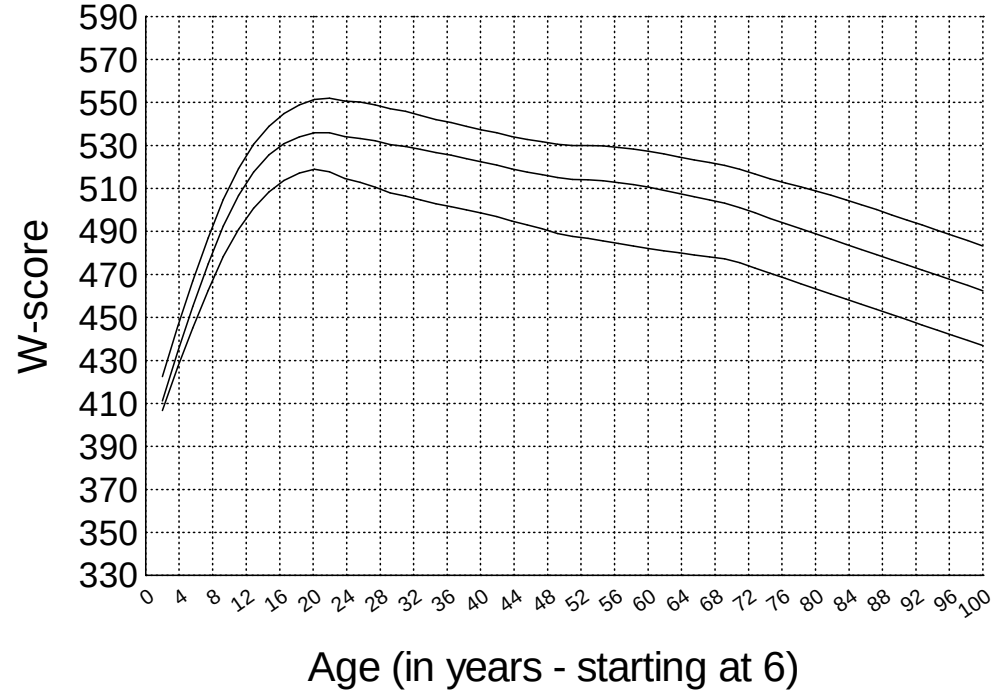
Number Series



Number Series

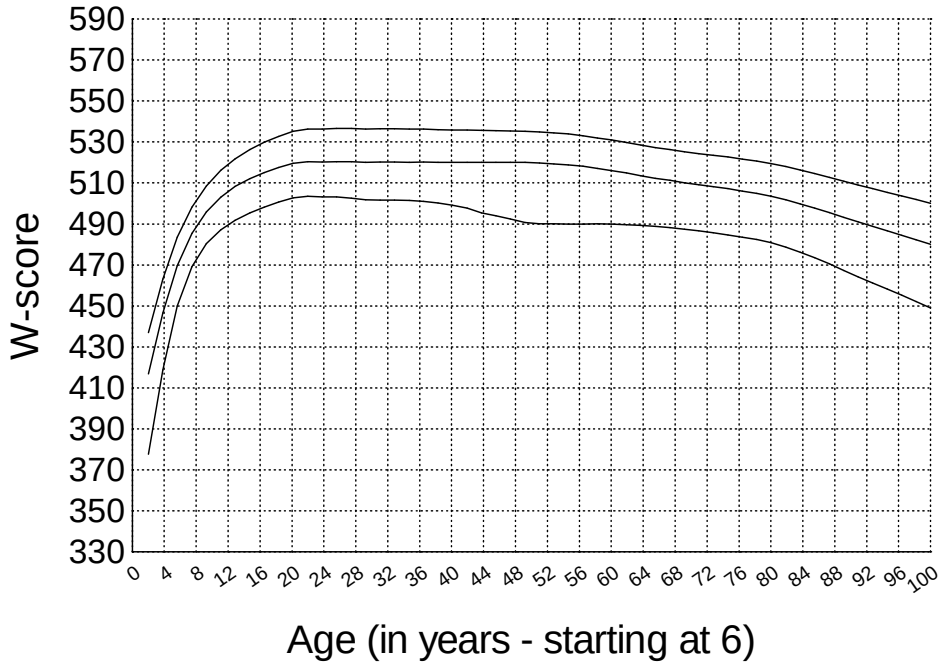


Cross Out



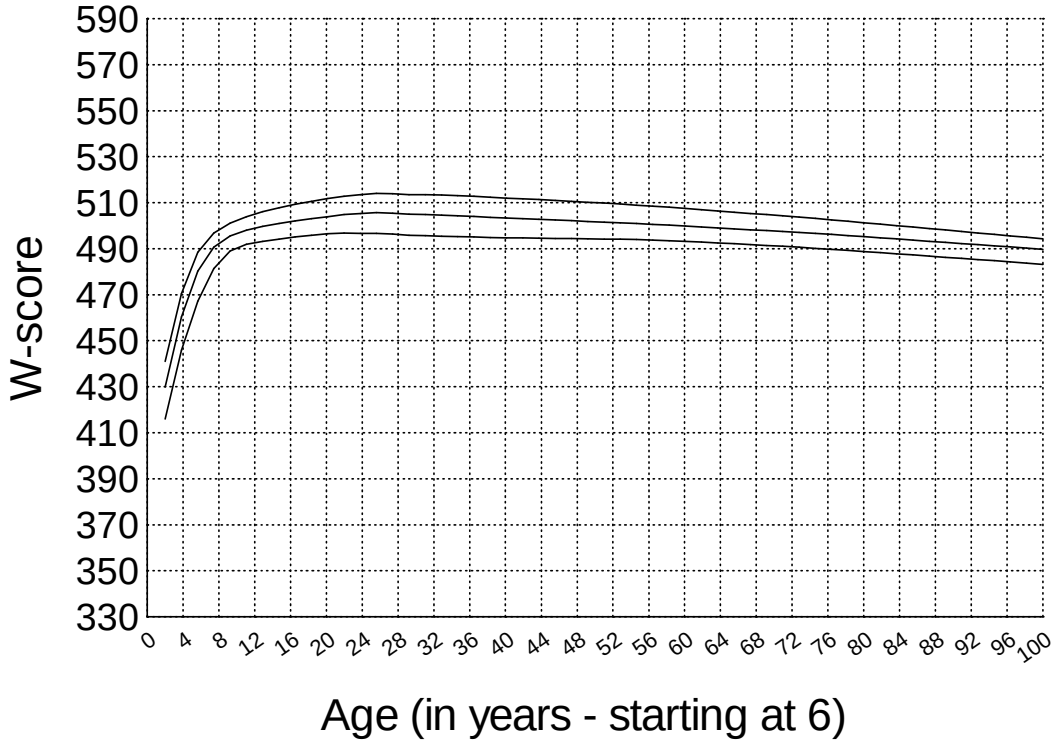
Cross Out

Memory for Sentences

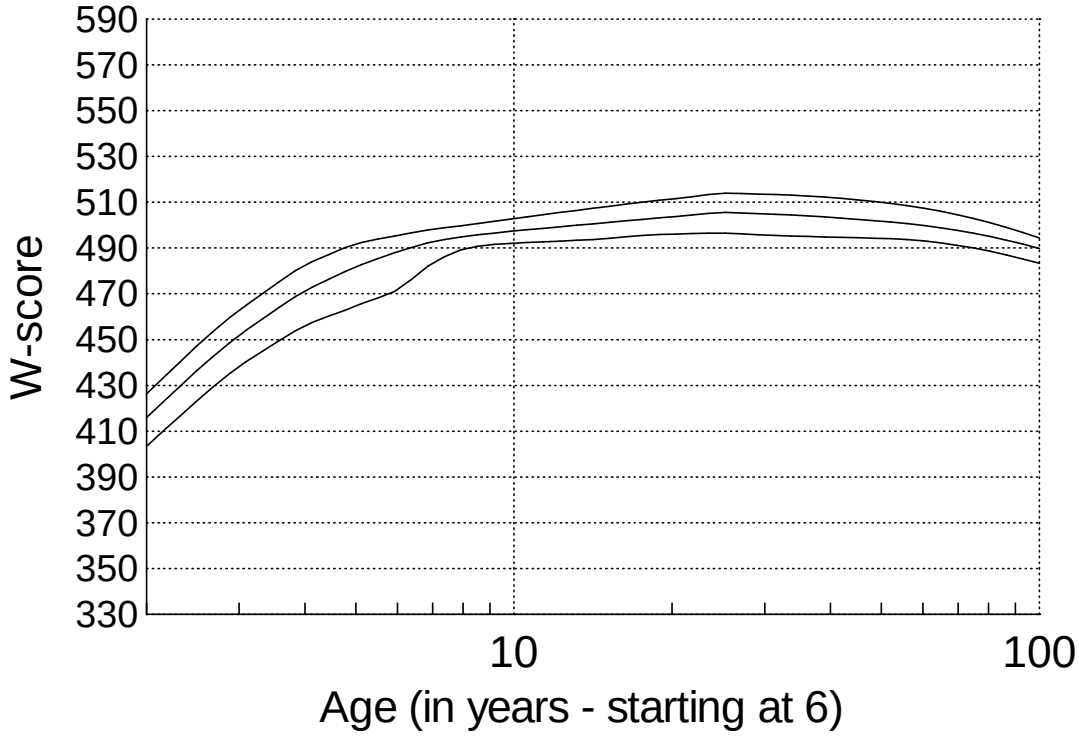


Memory for Sentences

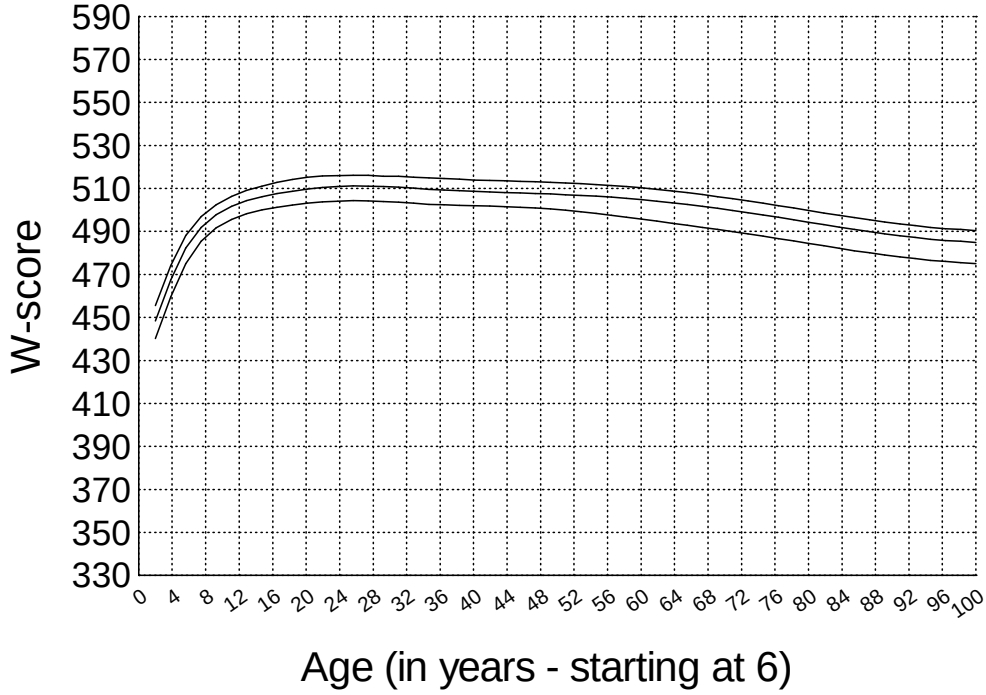
Block Rotation



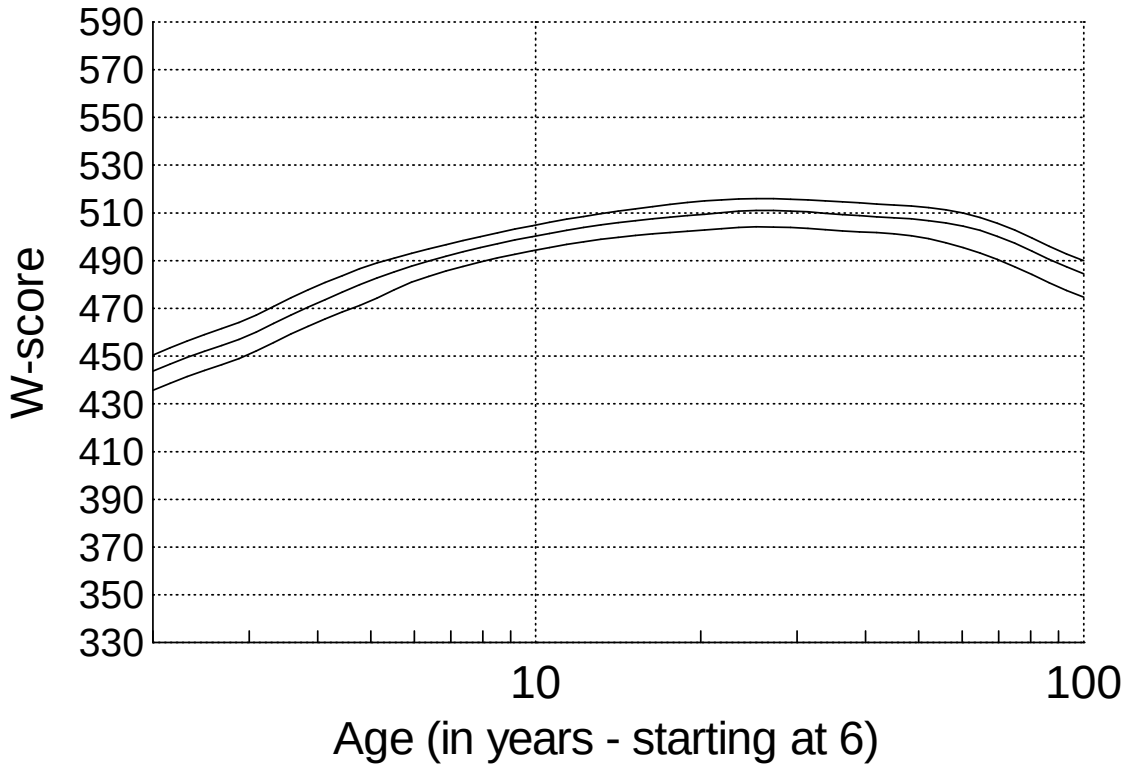
Block Rotation



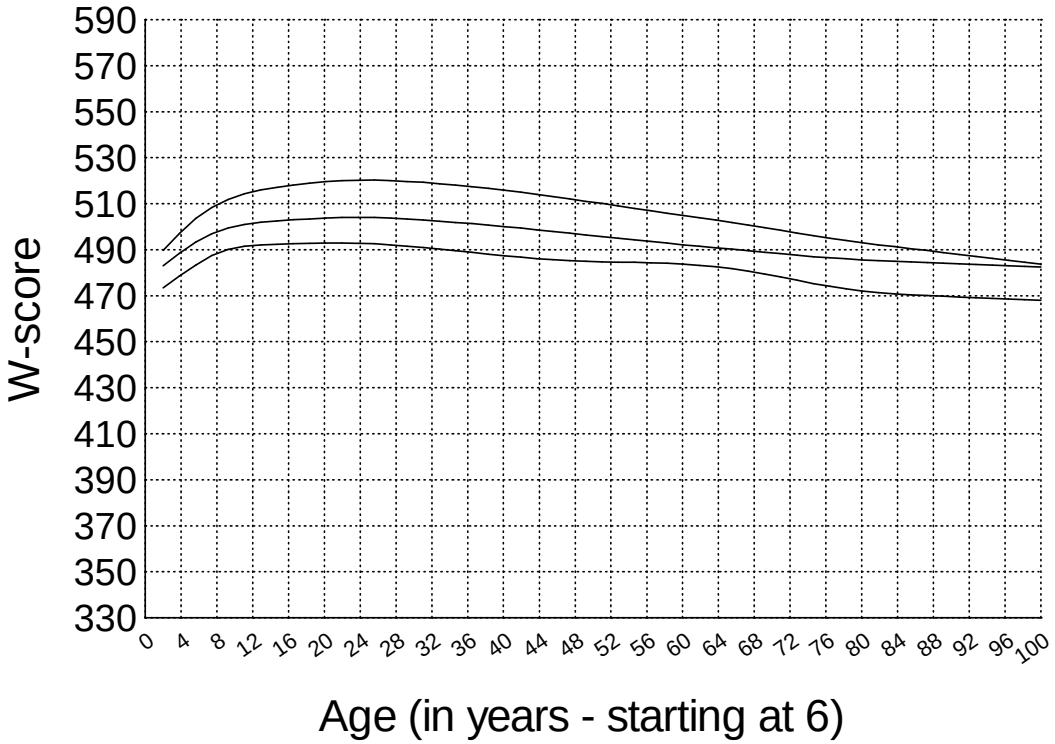
Sound Patterns - Music



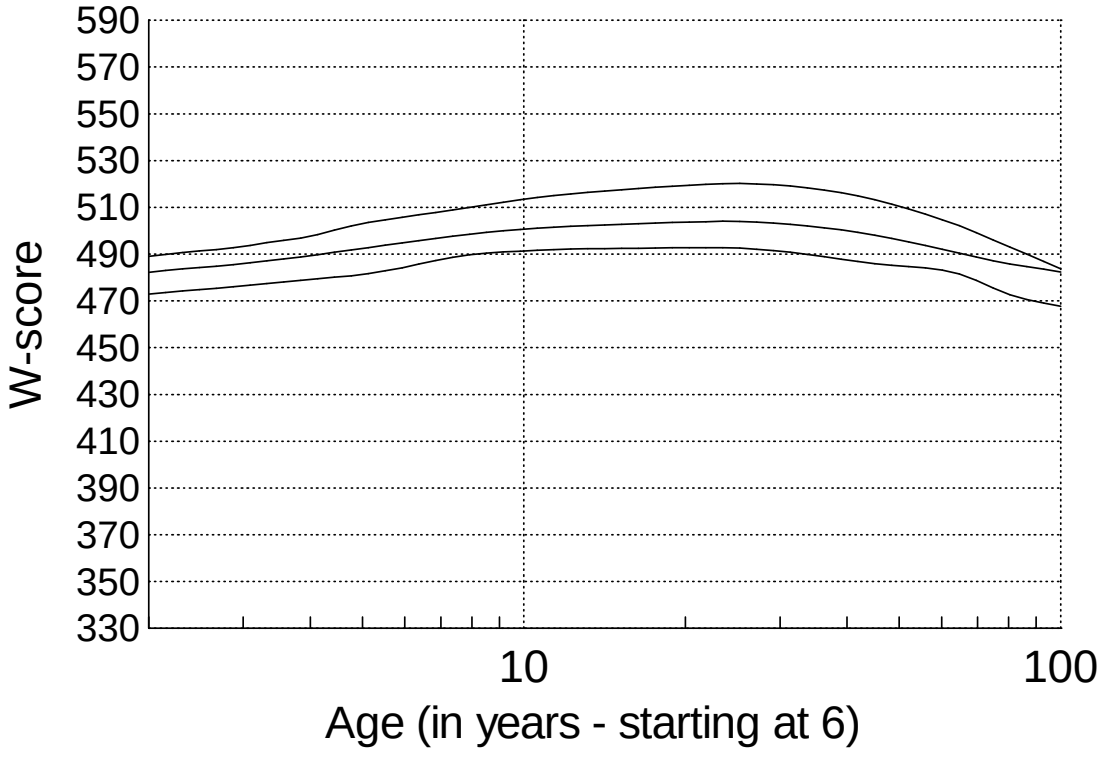
Sound Patterns - Music



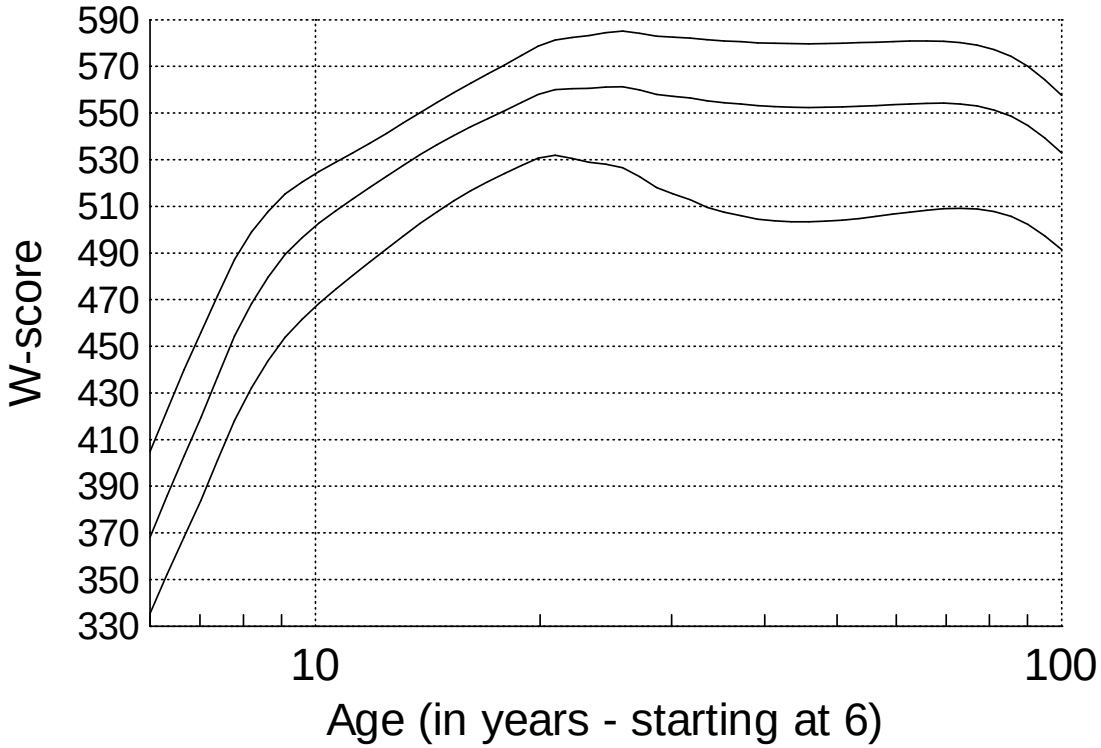
Memory for Names - Delayed



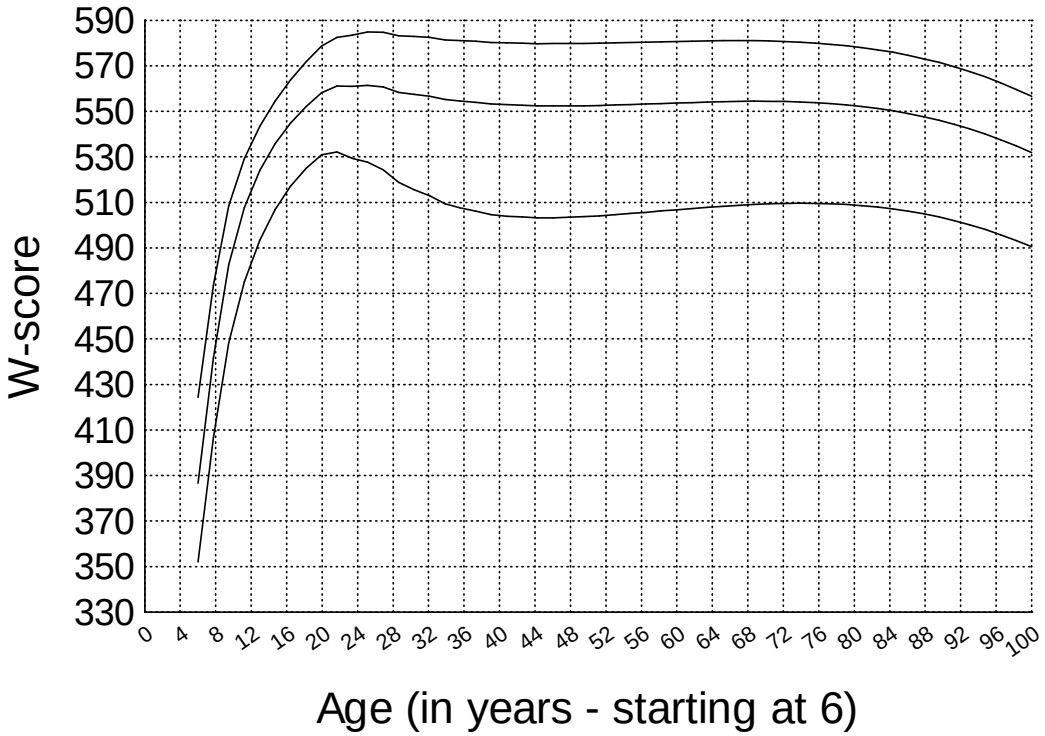
Memory for Names - Delayed



Letter-Word Identification

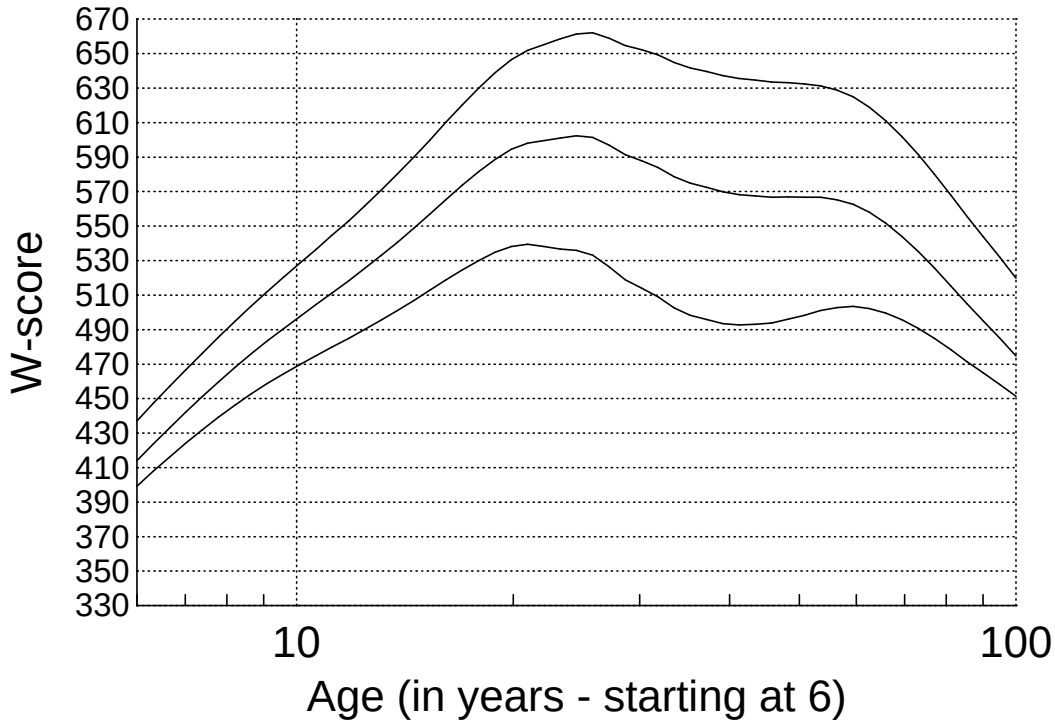


Letter-Word Identification

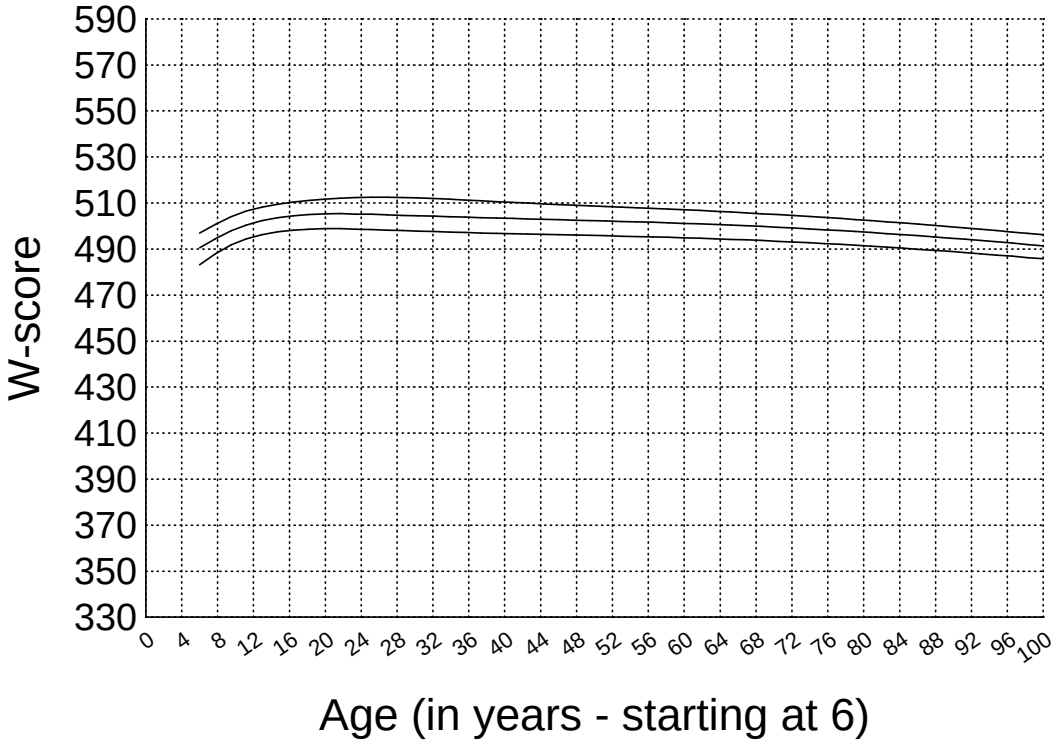


Reading Fluency

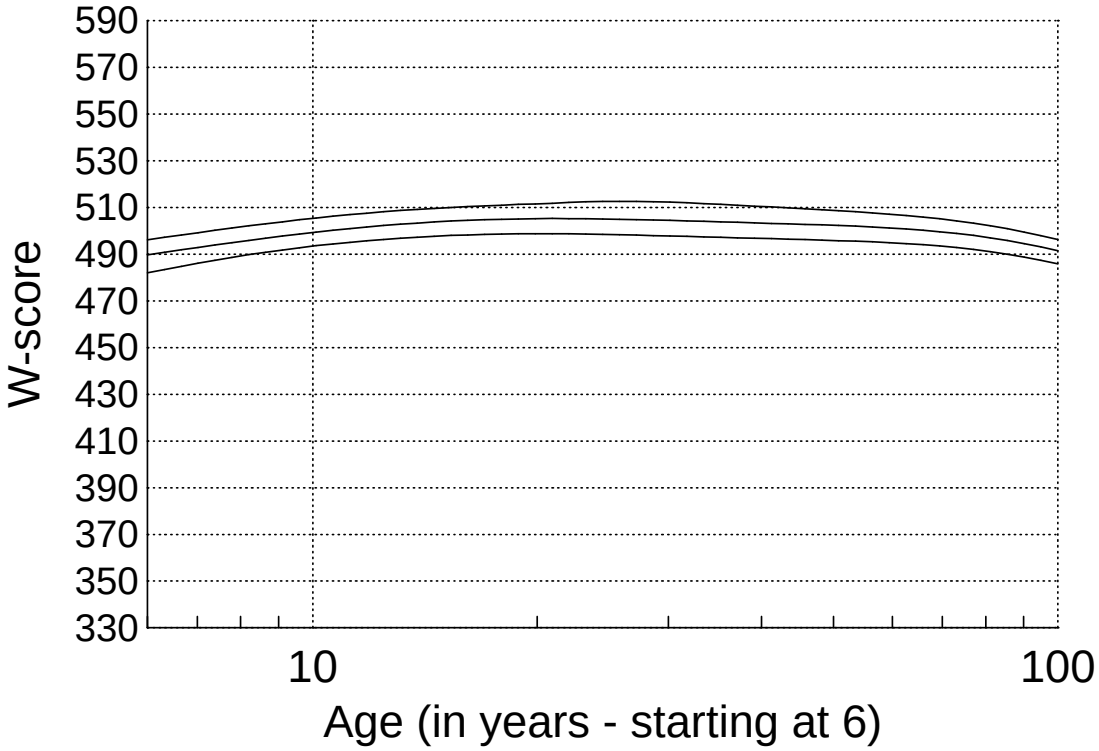
Reading Fluency



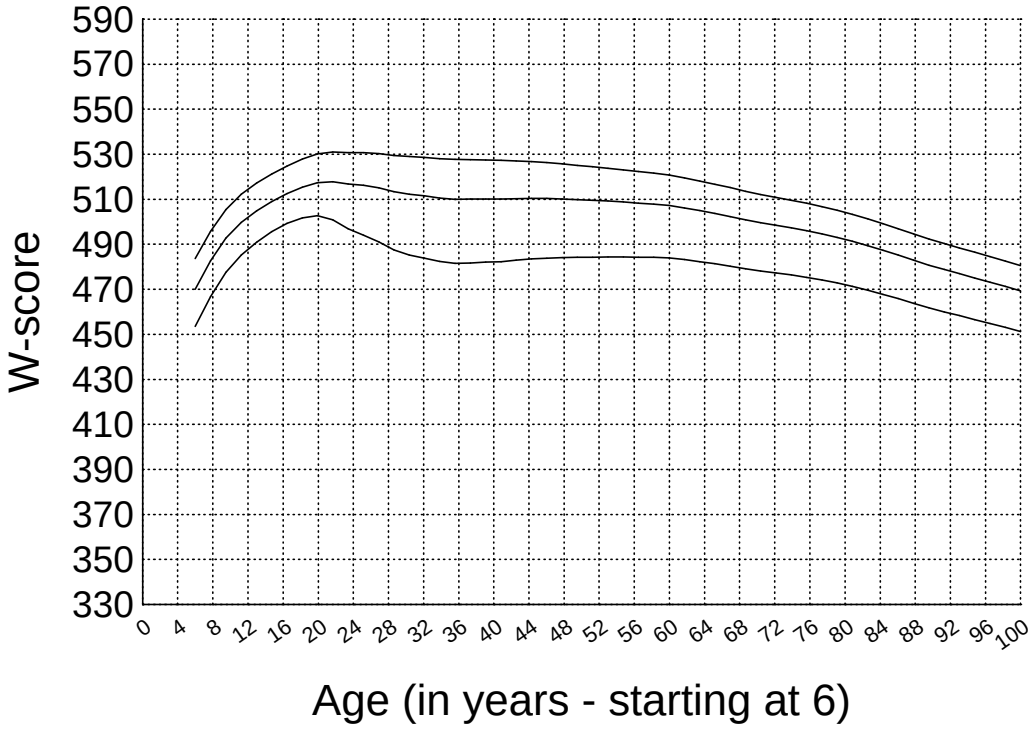
Story Recall



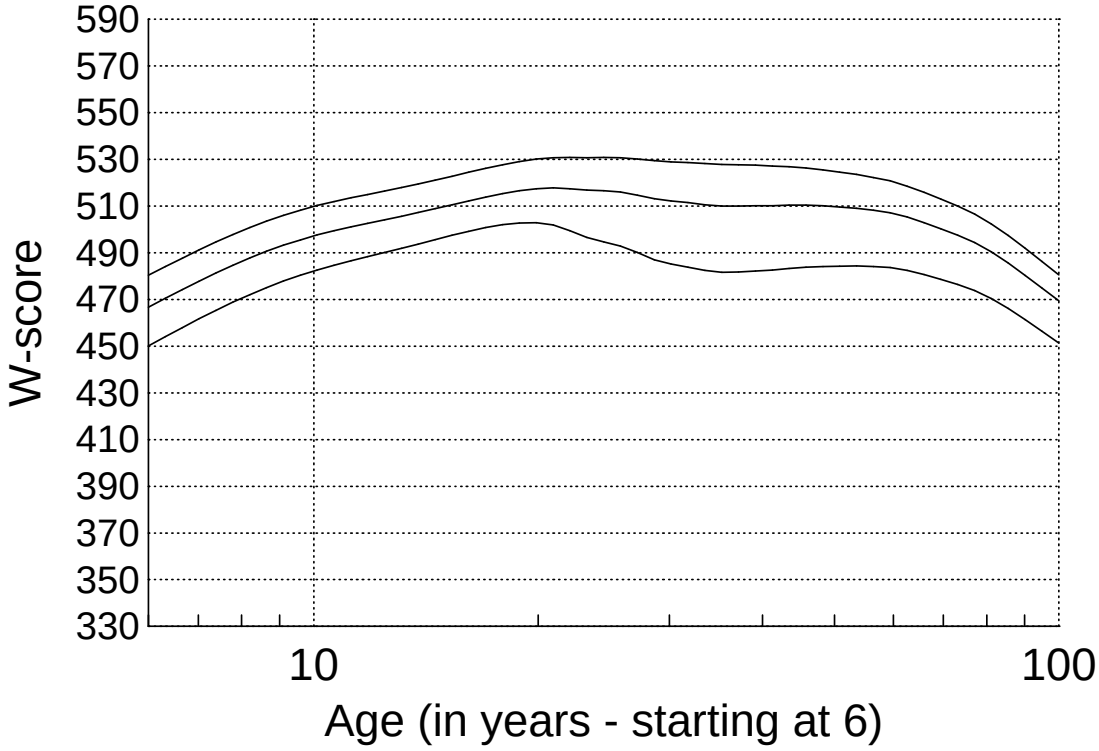
Story Recall



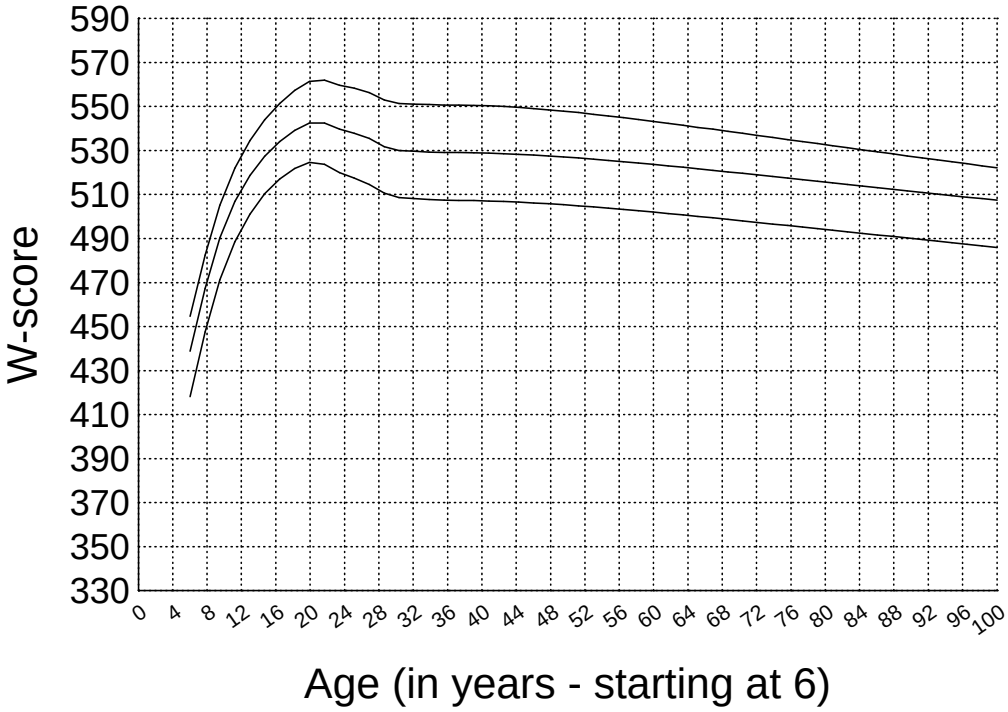
Understanding Directions



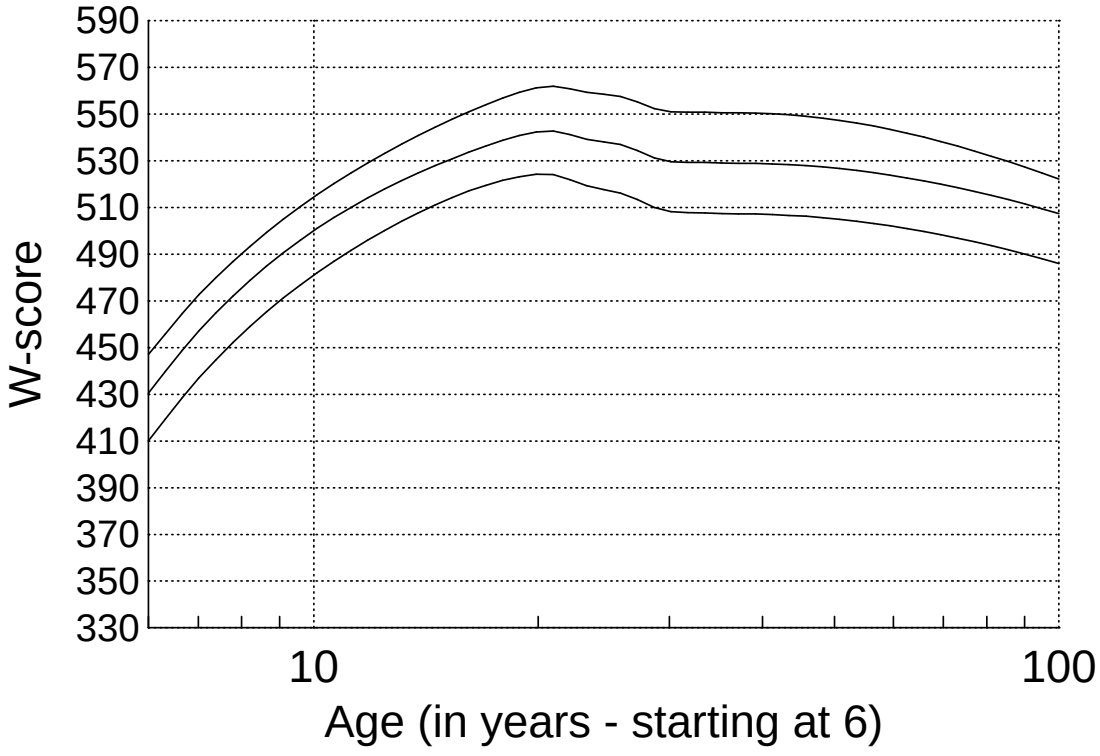
Understanding Directions



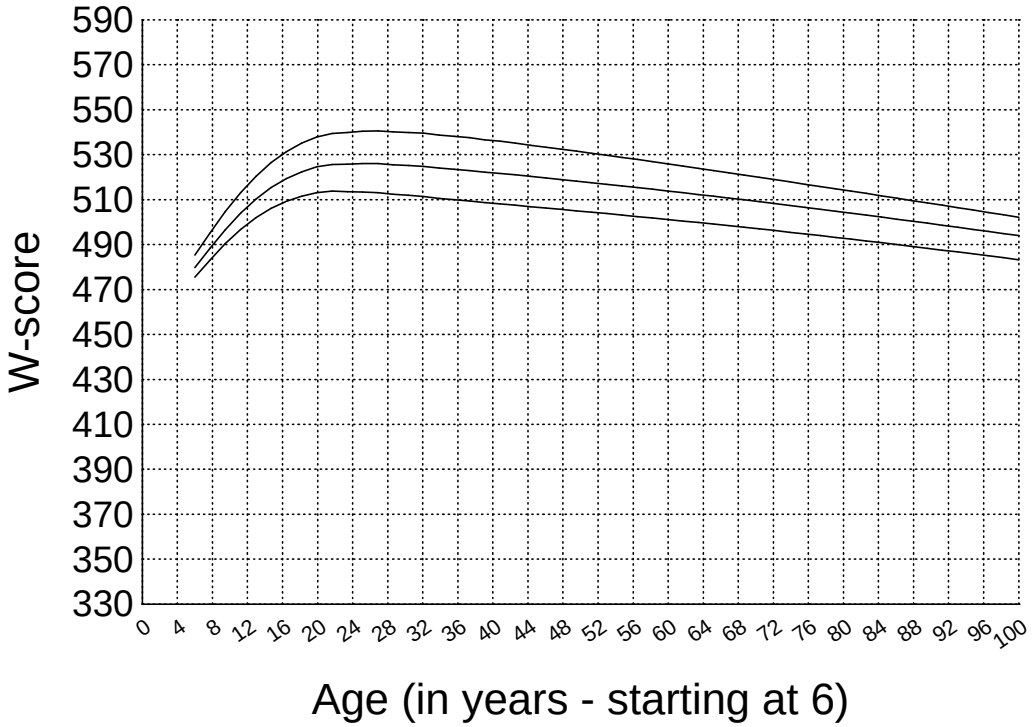
Calculation



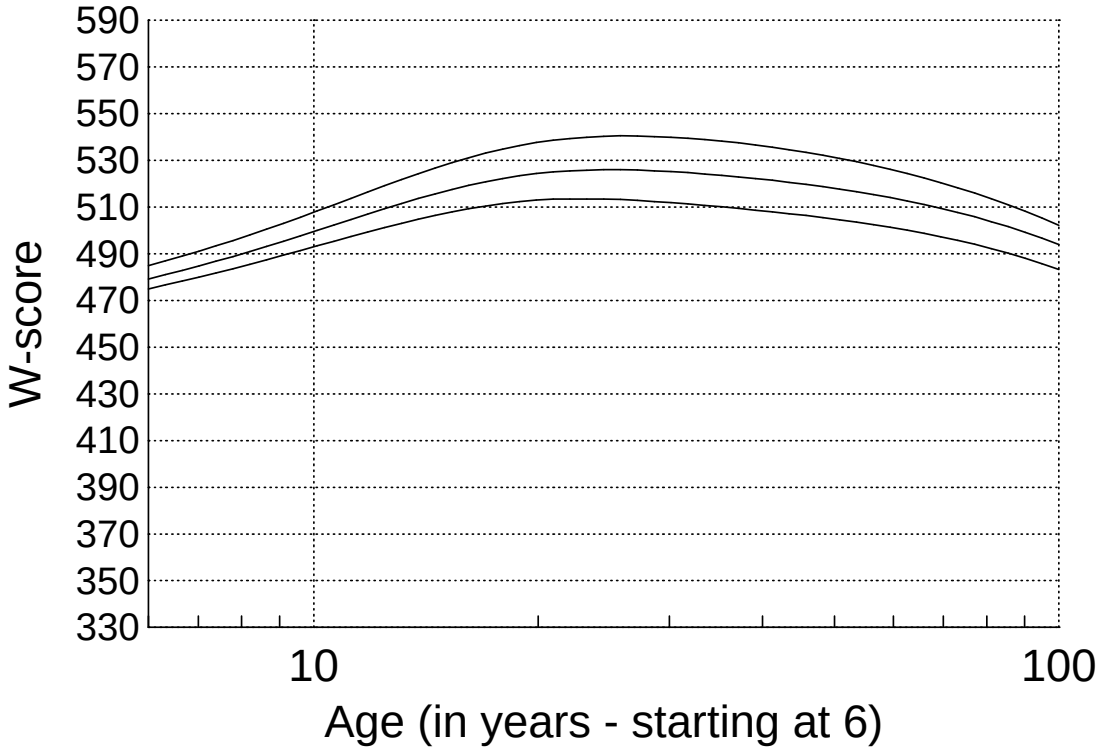
Calculation



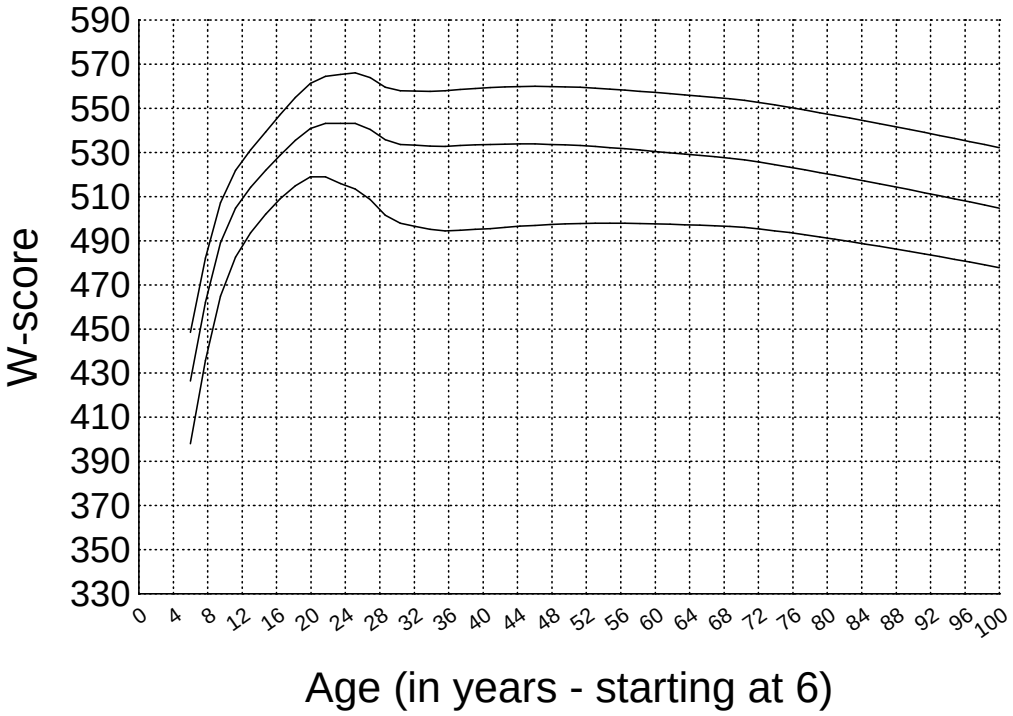
Math Fluency



Math Fluency

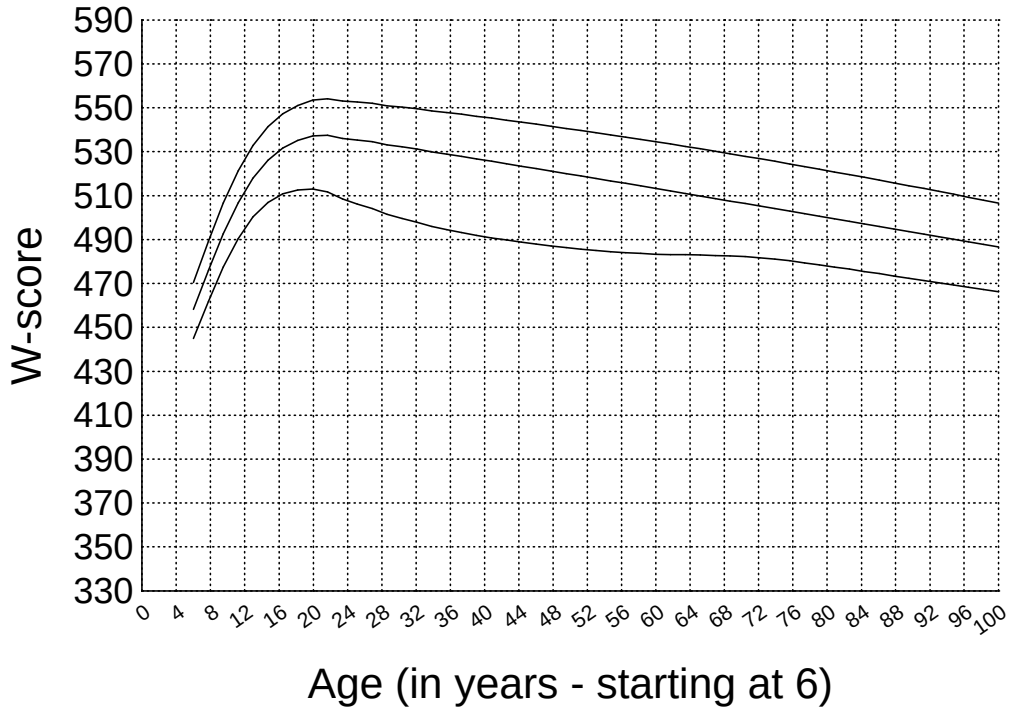


Spelling



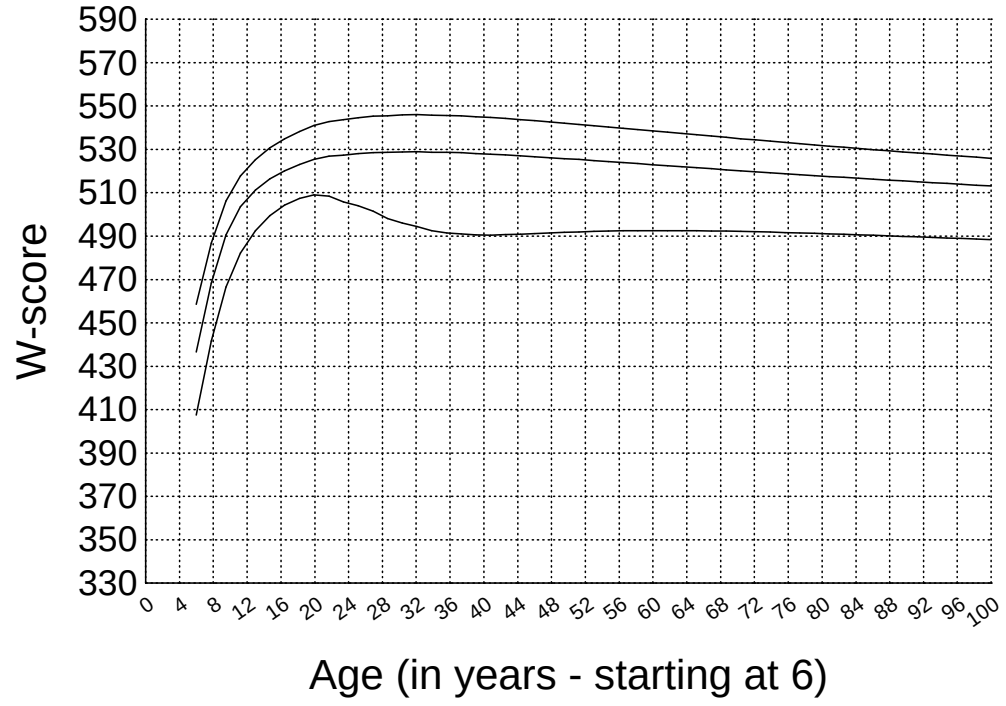
Spelling

Writing Fluency

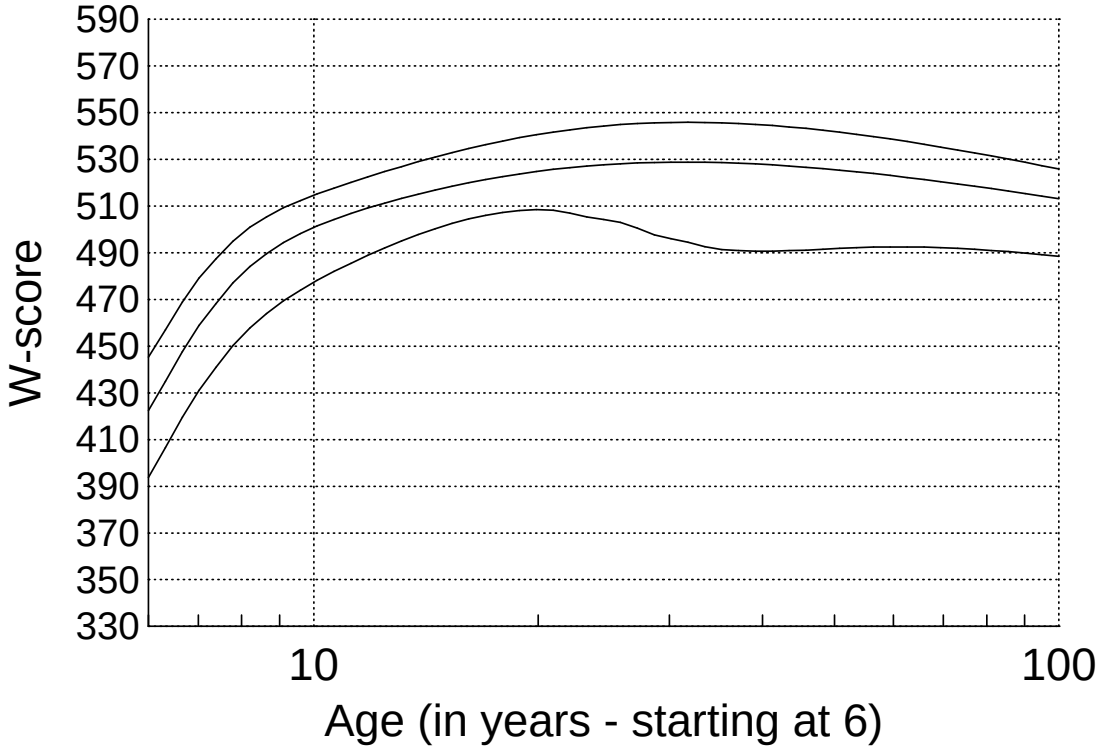


Writing Fluency

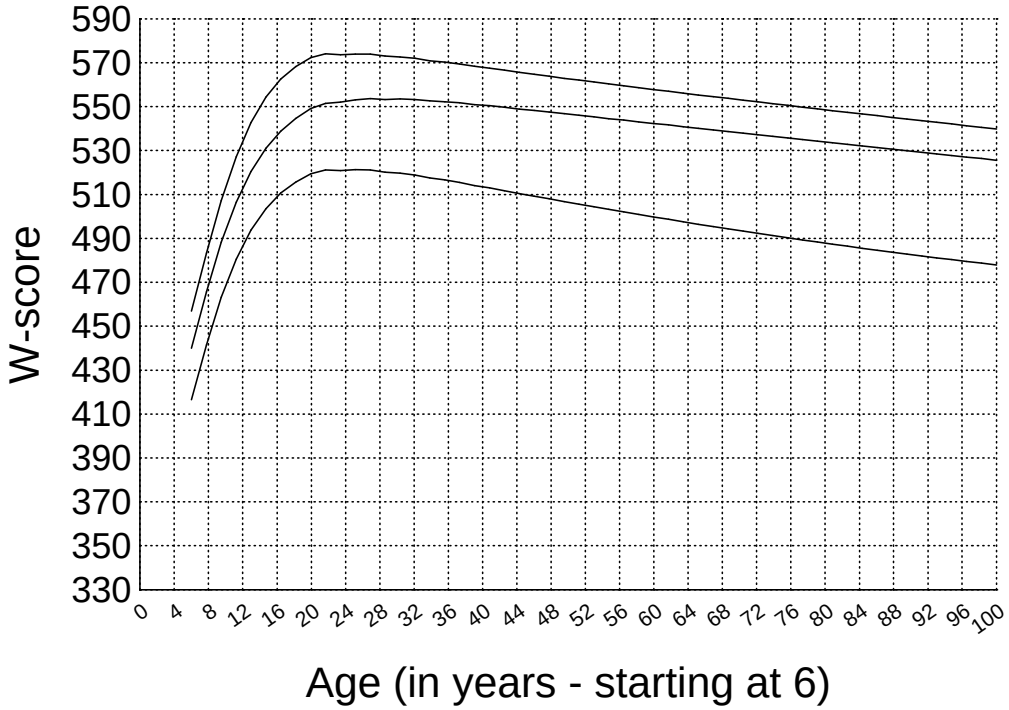
Passage Comprehension



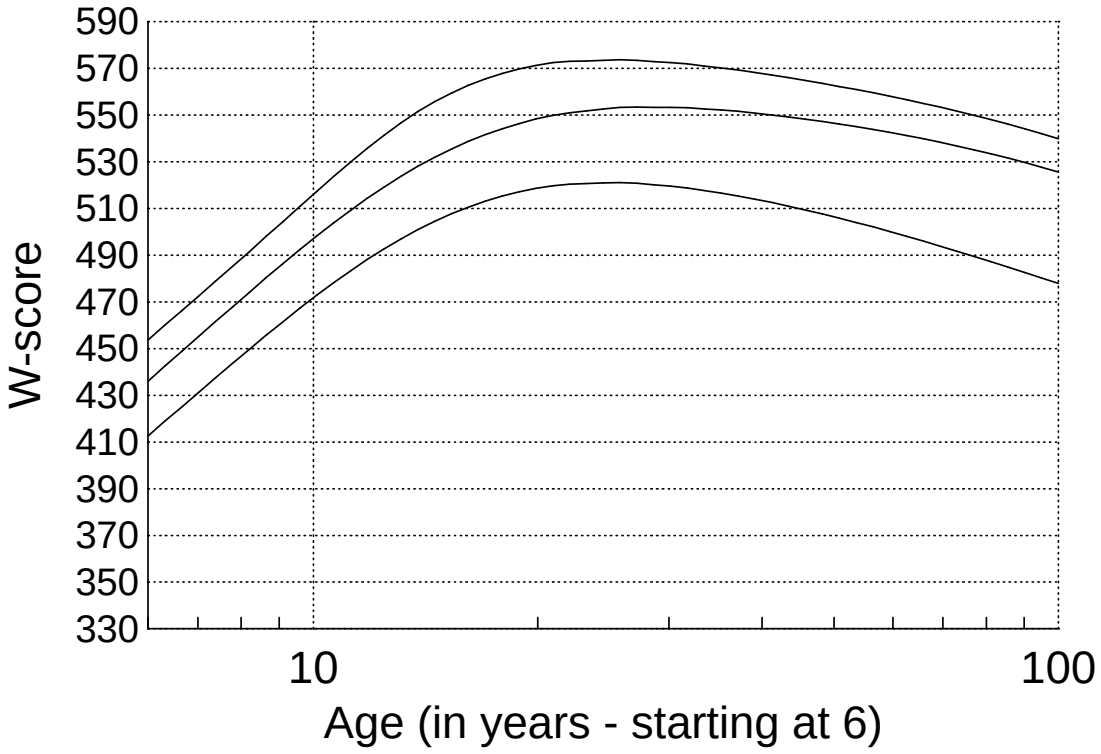
Passage Comprehension



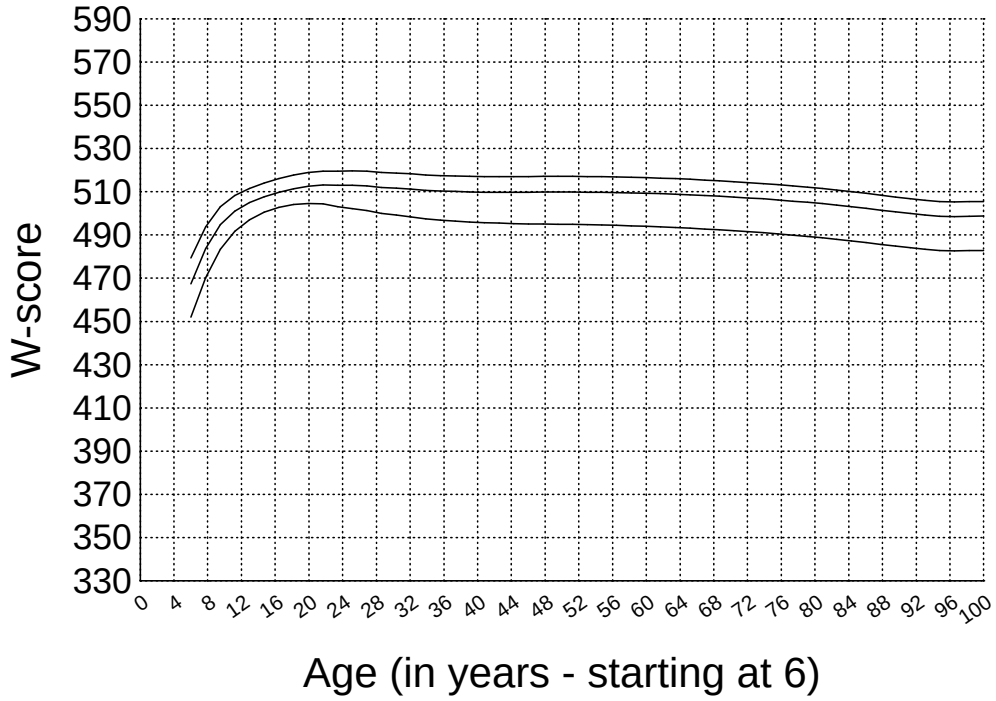
Applied Problems



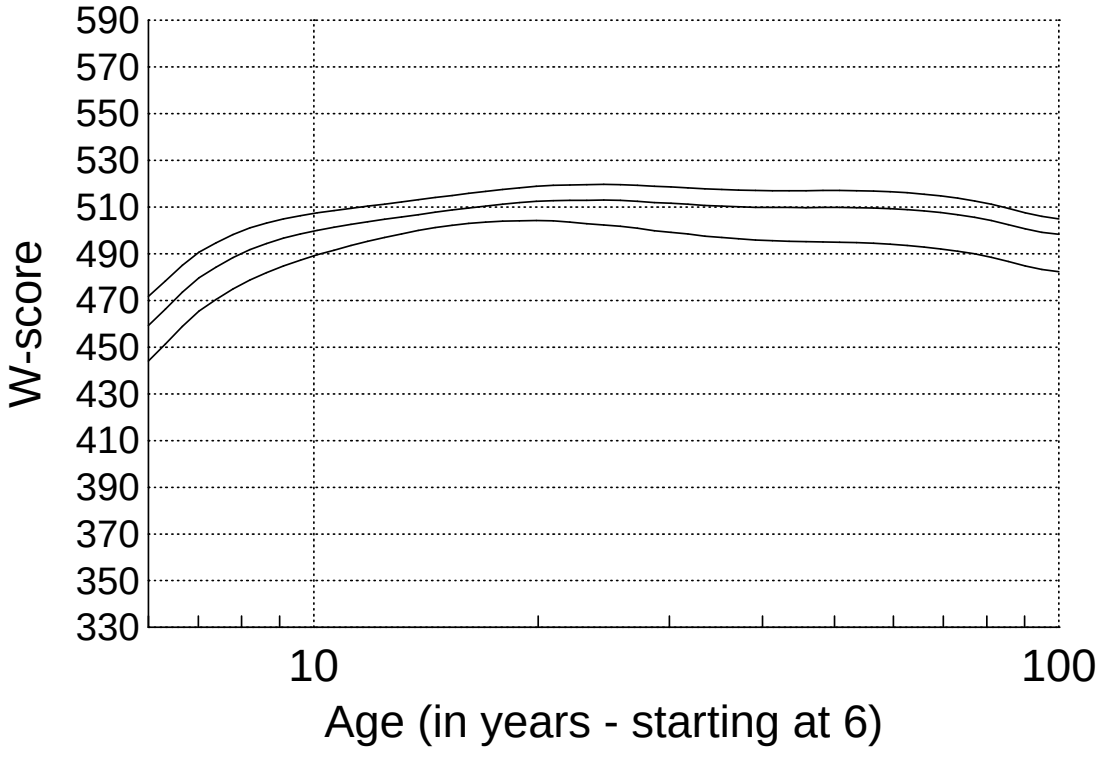
Applied Problems



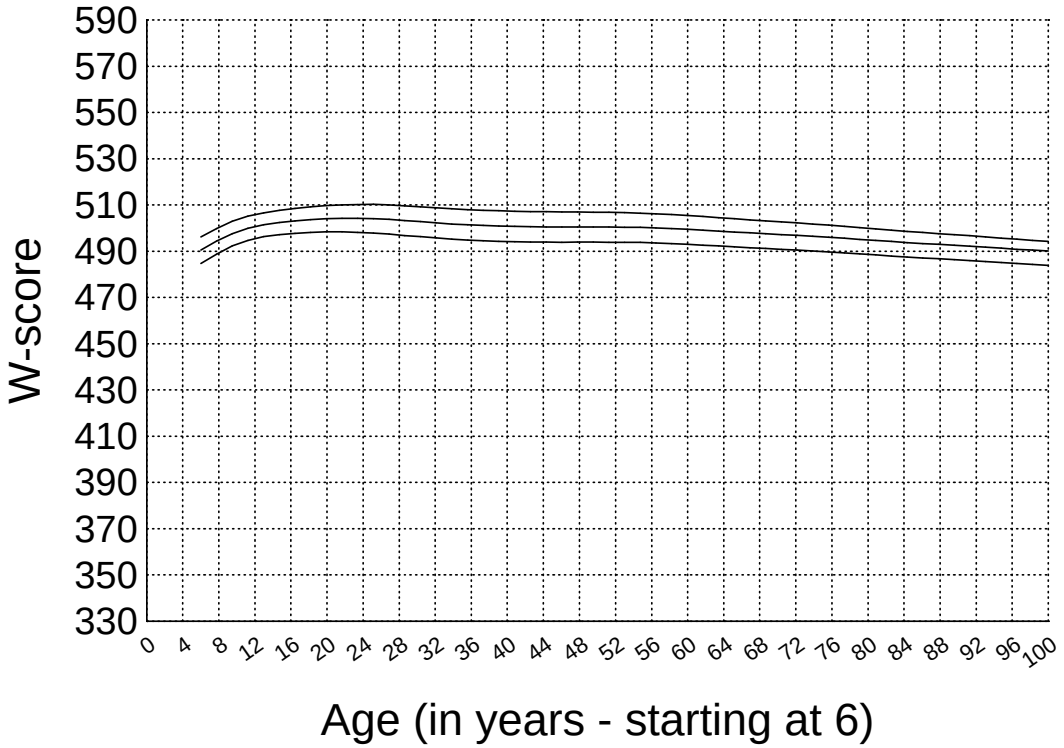
Writing Samples



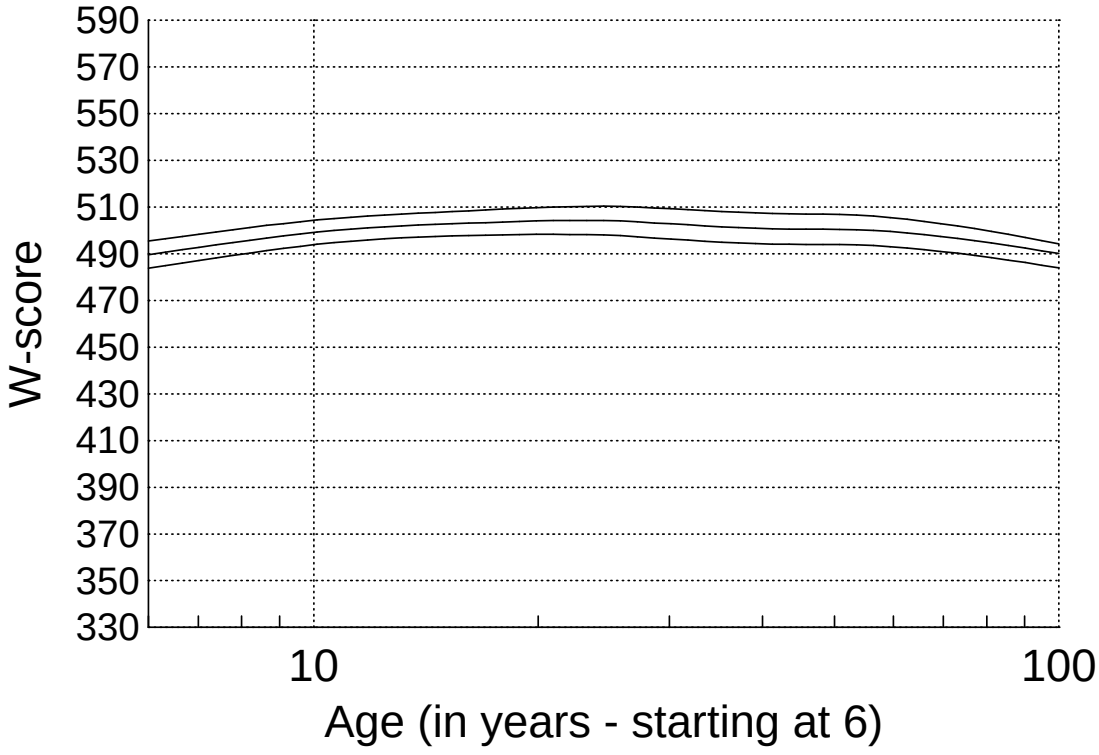
Writing Samples



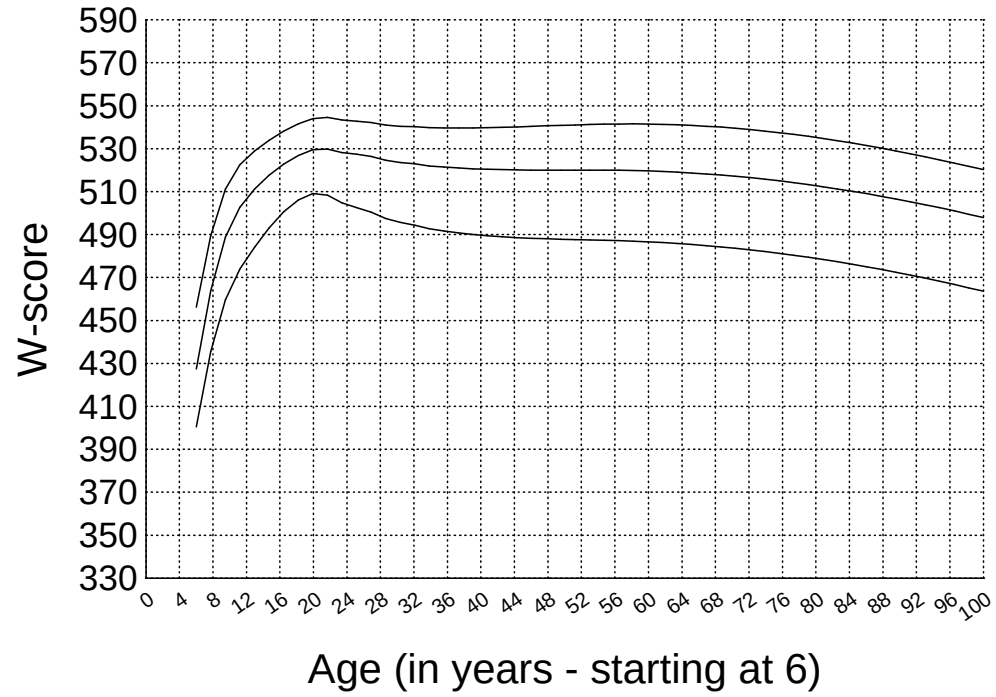
Story Recall-Delayed



Story Recall-Delayed



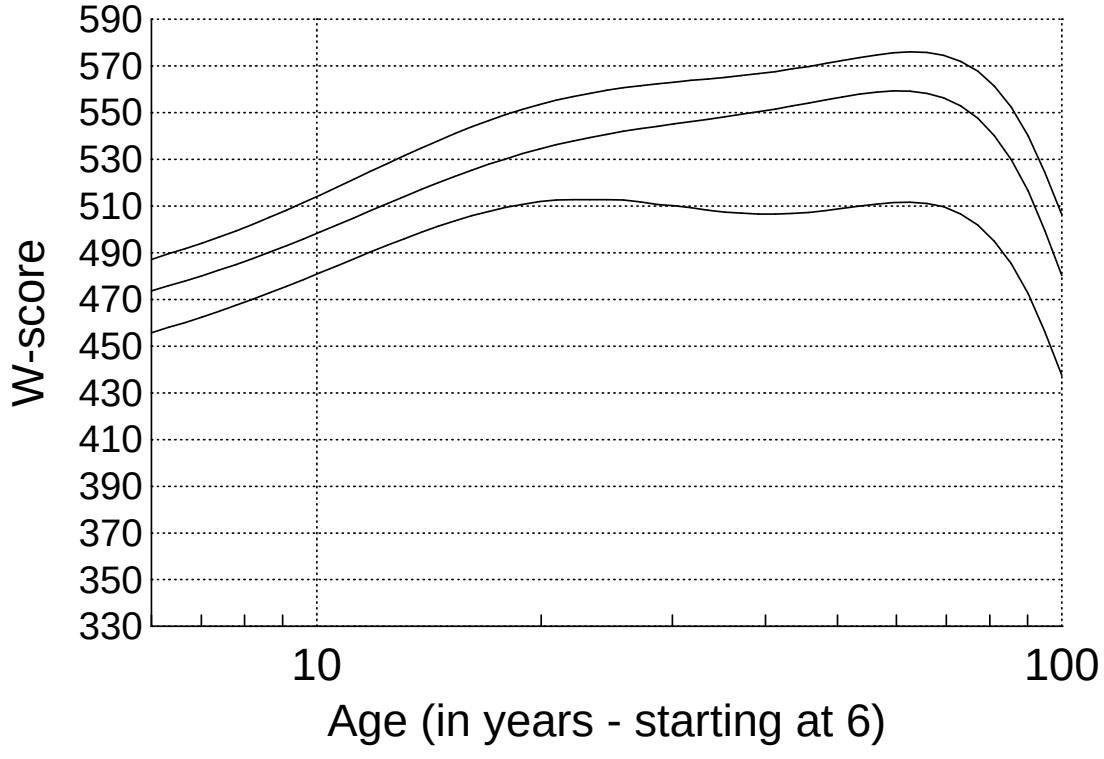
Word Attack



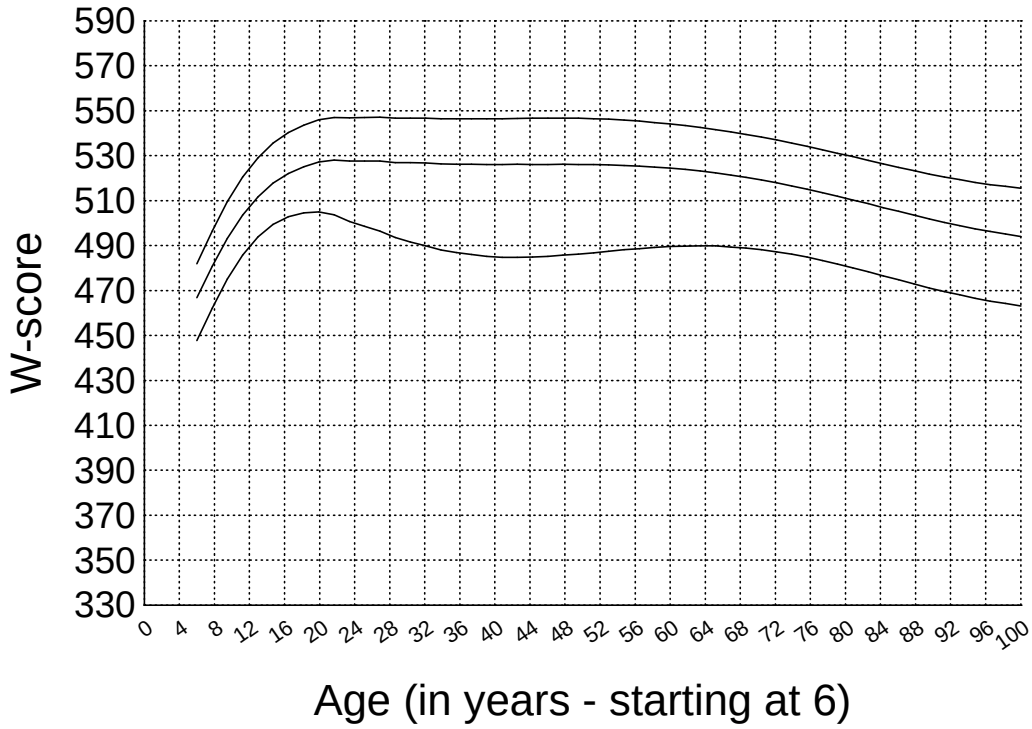
Word Attack

Picture Vocabulary

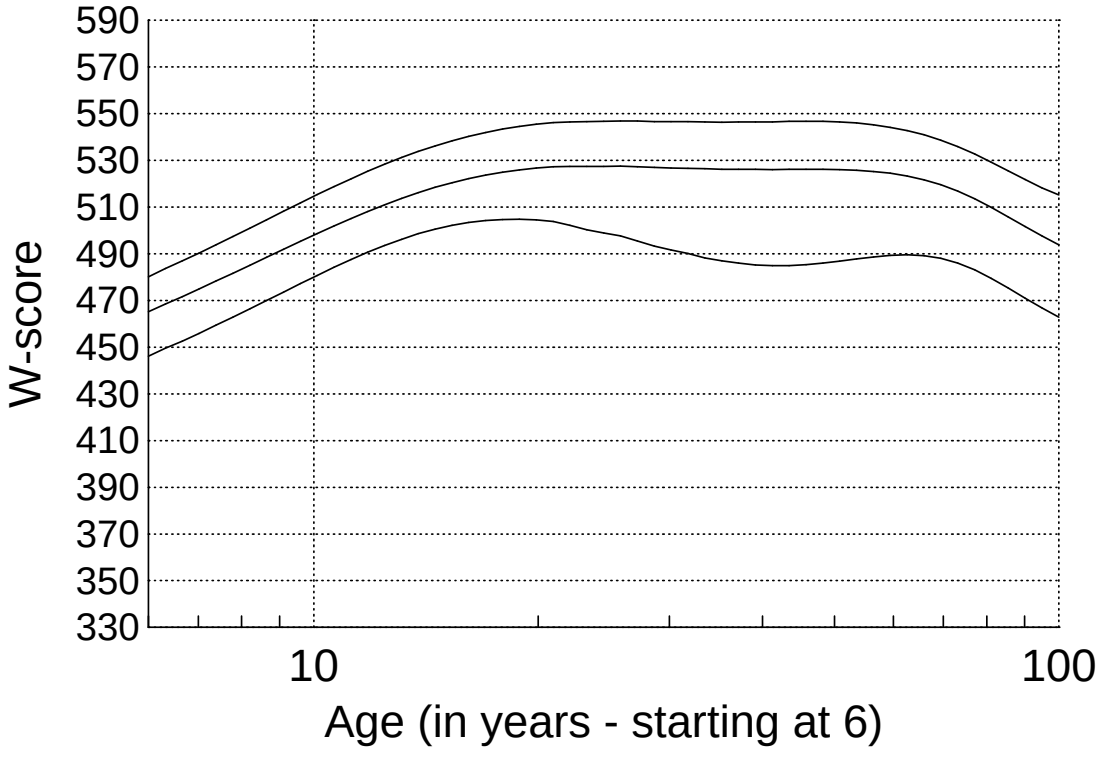
Picture Vocabulary



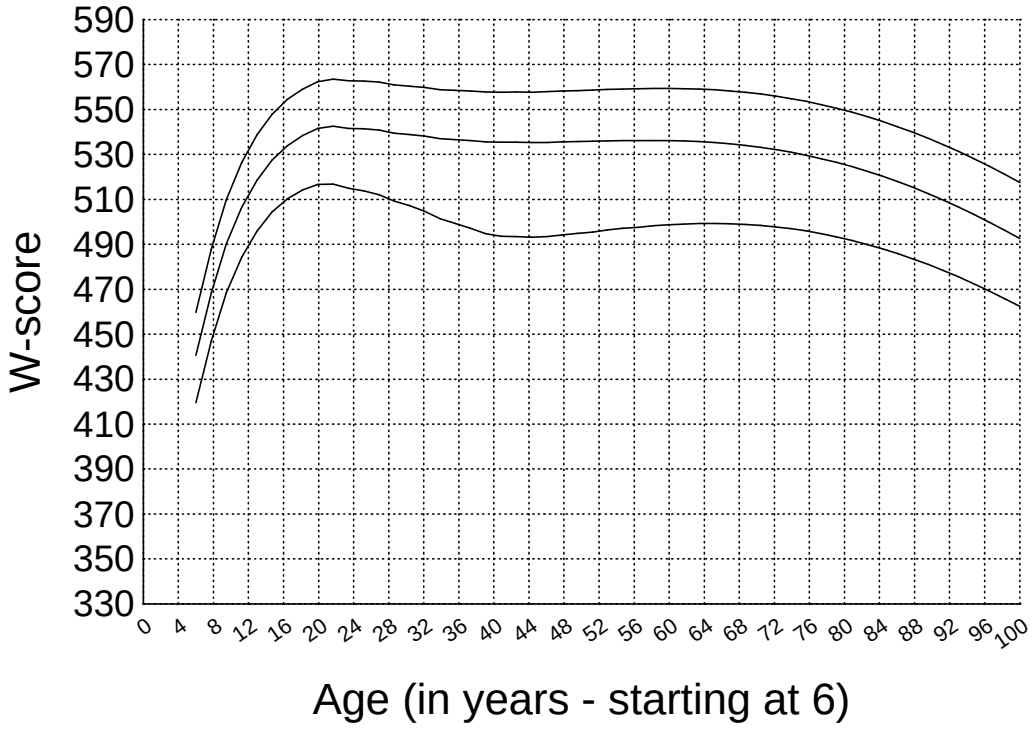
Oral Comprehension



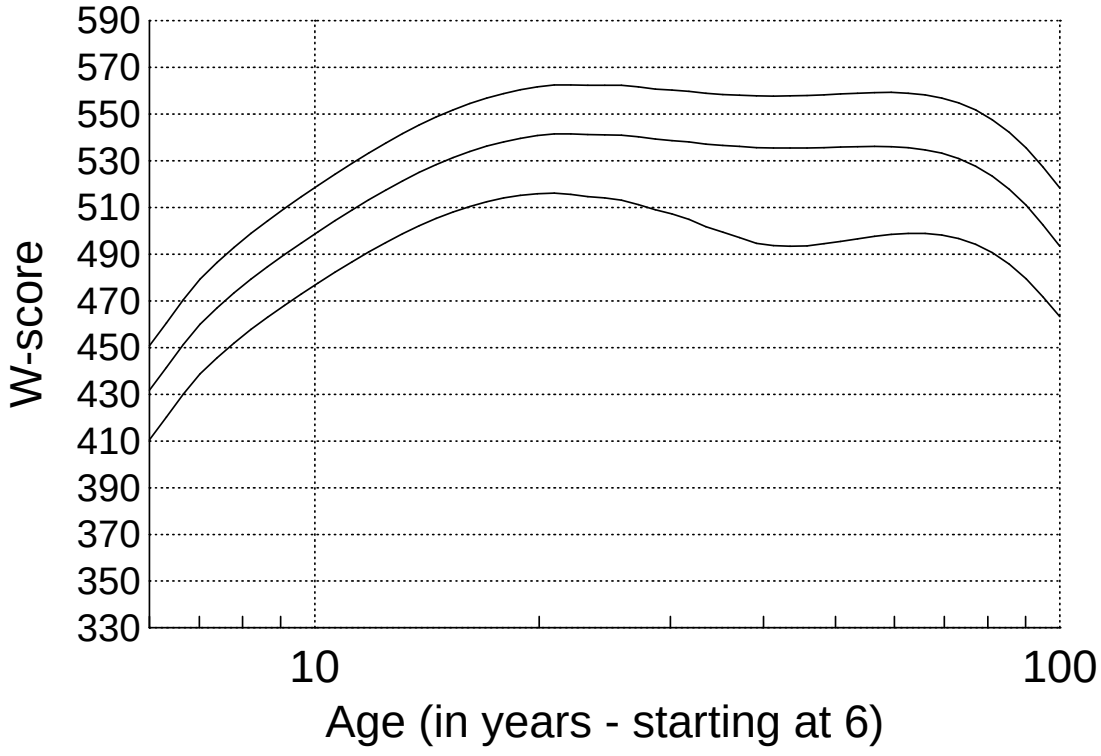
Oral Comprehension



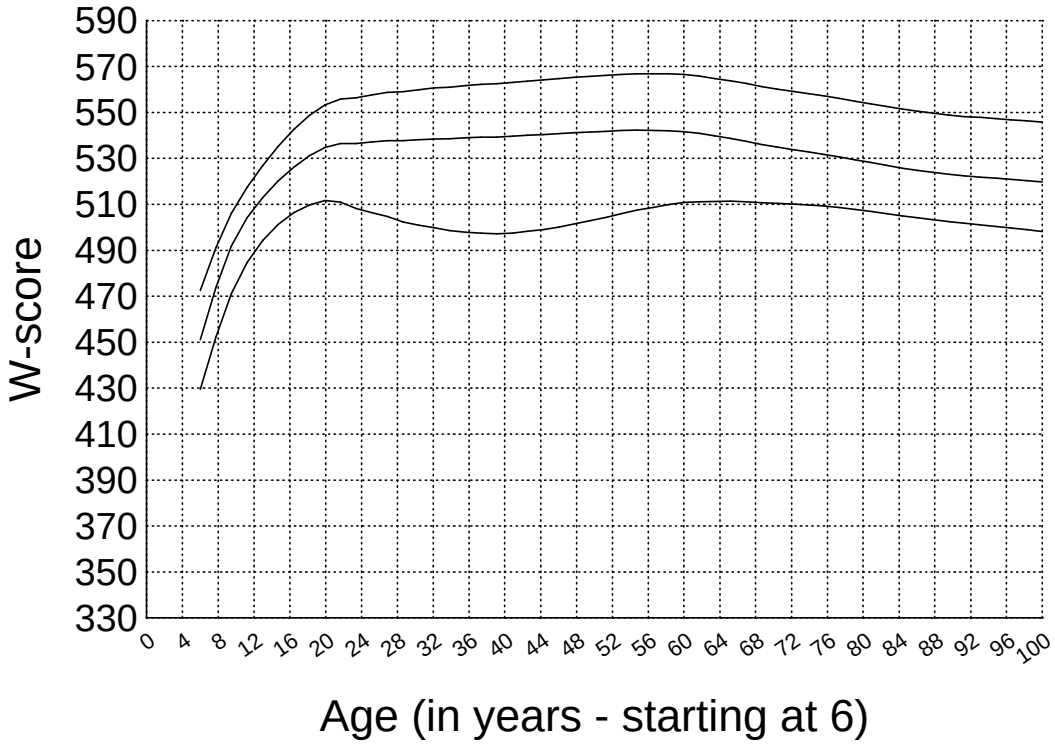
Editing



Editing

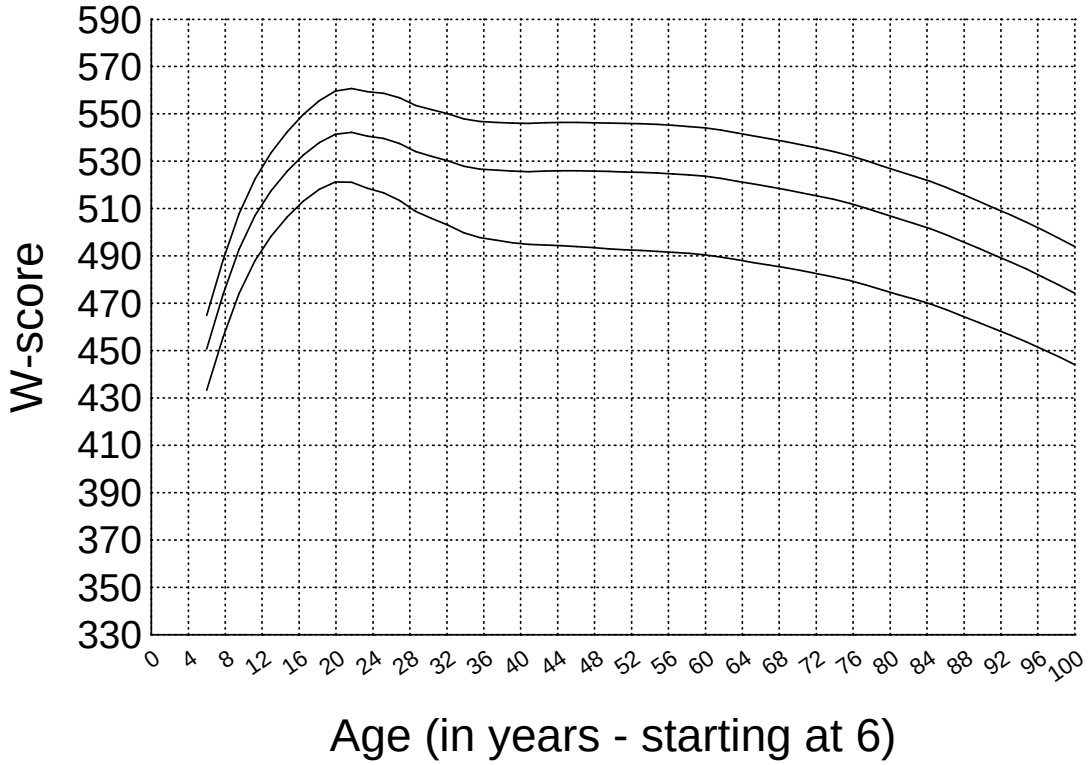


Reading Vocabulary

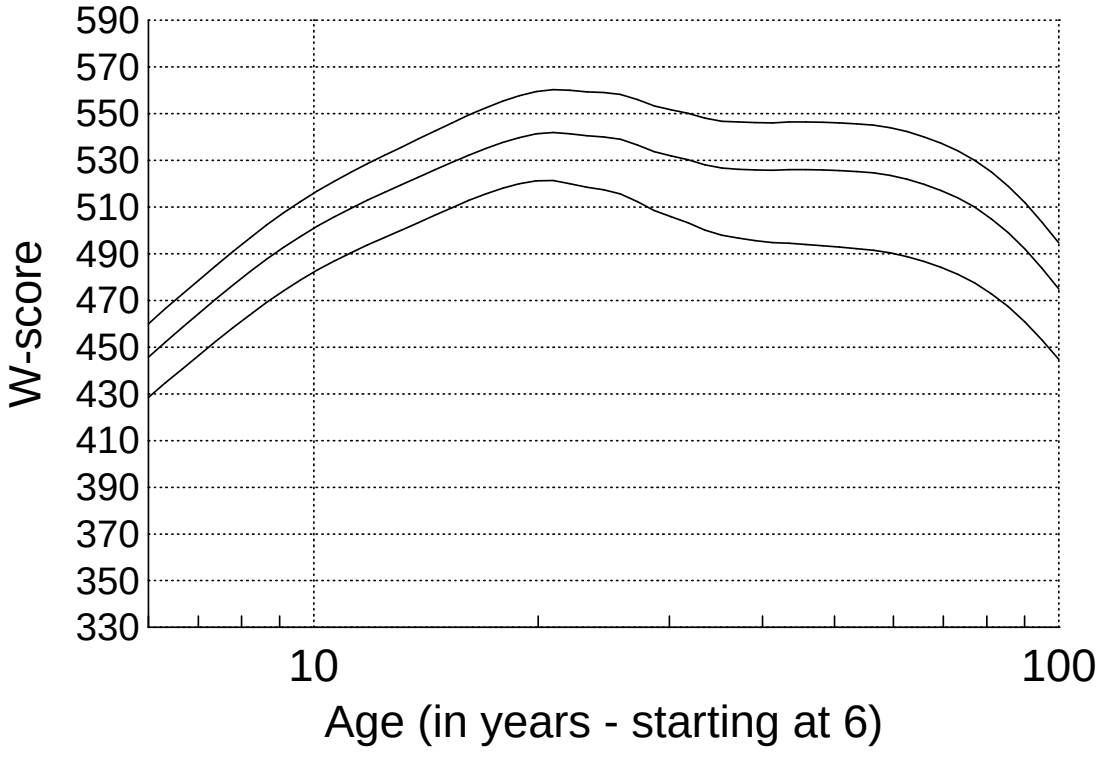


Reading Vocabulary

Quantitative Concepts



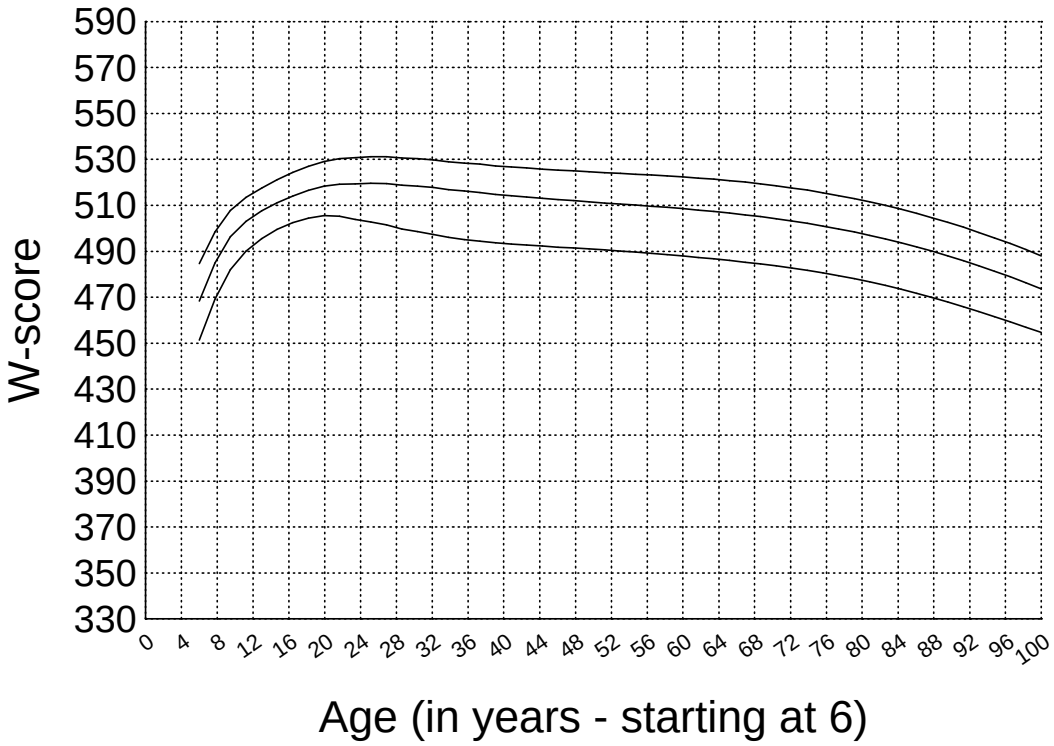
Quantitative Concepts



Academic Knowledge

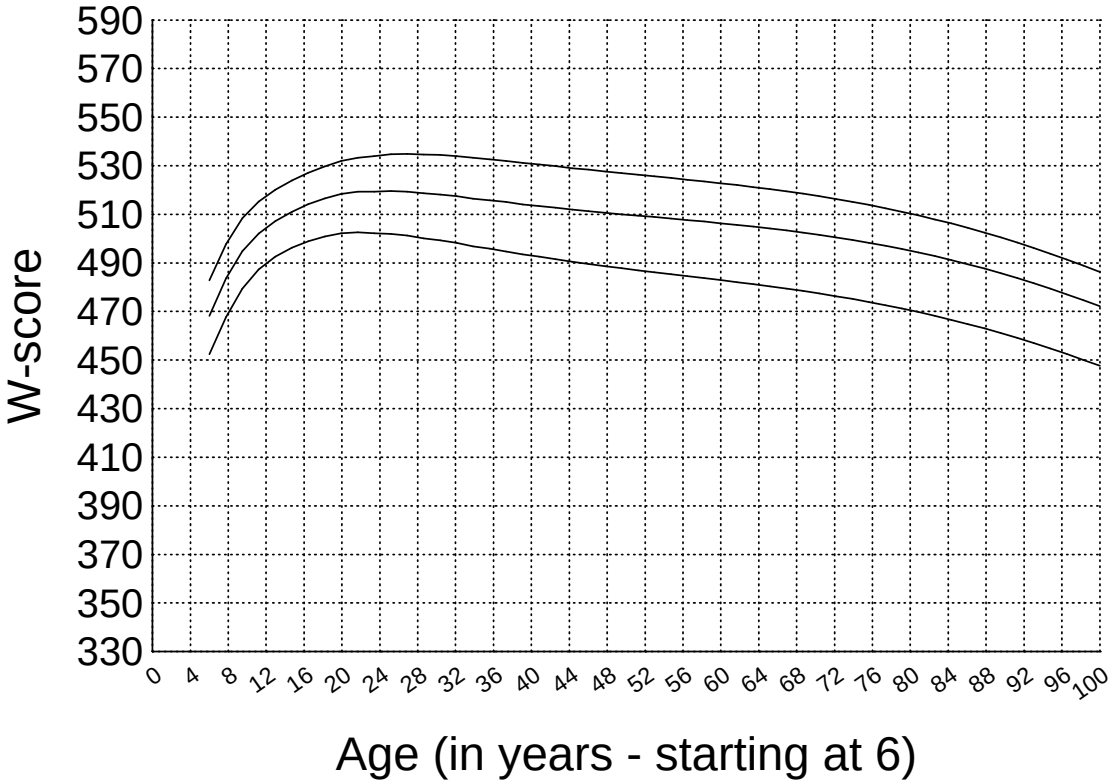
Academic Knowledge

Spelling of Sounds



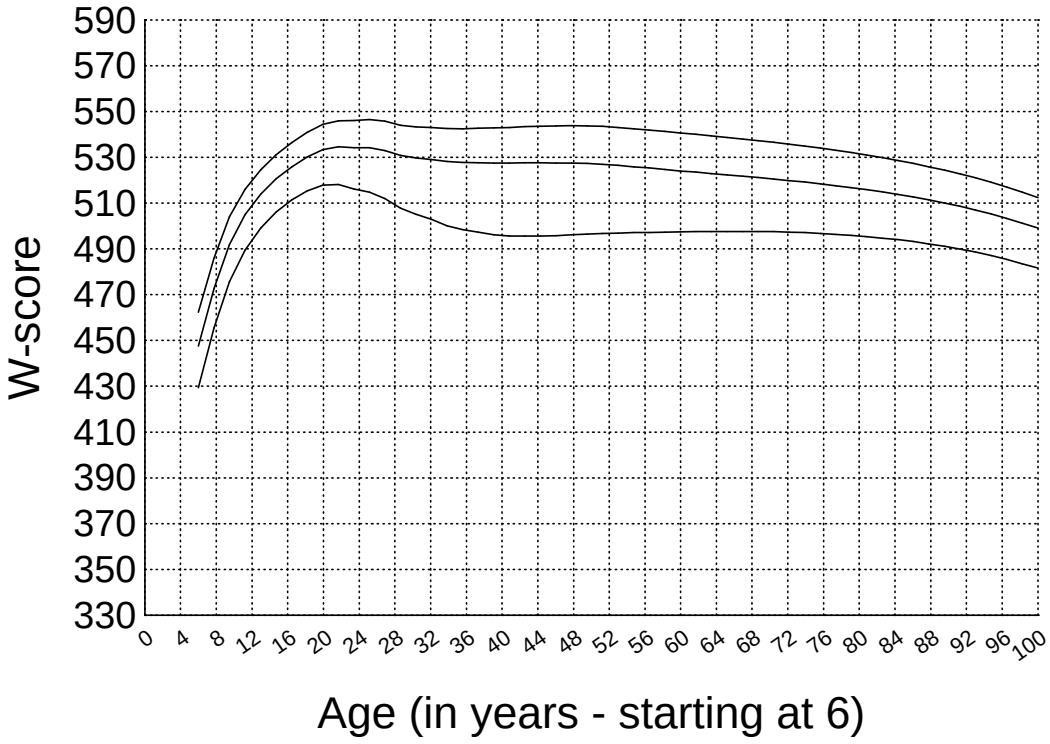
Spelling of Sounds

Sound Awareness



Sound Awareness

Punctuation & Capatilization



Punctuation & Capatilization