THE GIBSON TEST *of cognitive skills*

v2

Version 2, CBT

Overview

The Gibson Test of Cognitive Skills (V2) is a web-based screening tool that informs clinicians, teachers, and parents about performance on tasks that measure 1) working memory, 2) long-term memory, 3) processing speed, 4) auditory processing, 5) visual processing, 6) logic & reasoning, and 7) word attack skills. The 45-minute assessment includes nine different mental tasks organized like puzzles and games on a computer. The tasks provide a snapshot of five primary cognitive skills, as well as auditory processing and word attack skills that serve as the foundation for reading.

The GTCS is a screening tool and not designed for diagnostic use. However, test users can confidently use the GTCS to:

- Evaluate the effect of a cognitive training or educational intervention
- Establish current skill levels across multiple cognitive constructs
- Conduct research
- Monitor progress or decline in cognitive skill levels over time

The GTCS (V2) can be administered on a computer or tablet. The instructions have been translated in 14 languages, including English, Arabic, Mandarin, Cantonese, Turkish, Spanish (Mexico), Spanish (Spain), Portuguese, Filipino, Indonesian, Hindi, Vietnamese, Malay, and Taiwanese. Responses are captured and scored automatically by the web-based program.

System requirements:

Computer or tablet
Broadband internet access
Keyboard or keypad
Mouse or touchscreen
Adobe Flash
Speakers (headphones recommended)

Data security measures include a Secure Socket Layer (SSL), firewall, encrypted local storage and data transfer, password requirements for administrative users, and password protection.

Standardization

Norming Sample

The Gibson Test of Cognitive Skills V2 (CBT) was normed on a sample of 2,820 children and adults (ages 5-85) in 45 states[1], plus Canada and U.S. territories Guam and Puerto Rico. Norming sites were selected based on representation from the four primary geographic regions of the United States and Canada: Northeast, South, Midwest, and West.

Tests were administered in three types of settings between 2014 and 2016. First, test results were collected from new and existing clients in seven LearningRx Centers. The test was also administered to students from 23 different elementary schools, high schools, or universities in California, Colorado, Washington DC, Florida, Illinois, Kentucky, Maryland, Minnesota, North Carolina, New Mexico, New York, Pennsylvania, South Dakota, Texas, Virginia, and Wisconsin. Finally, adults and children from 45 states[1], two U.S. territories, and Canada responded via social media to complete the test from a home computer or tablet. Demographics for age, geographical region, gender, race, and income are presented in Tables 1 – 3.

Table 1. Demographics of Norming Sample by Age and Geographic Region

Age	West n	West %	South n	South %	Northeast n	Northeast %	Midwest n	Midwest %	Total n	Total %
5	2	<1	1	<1	0	0	0	0	3	<1
6	14	1	3	<1	0	0	0	0	17	<1
7	127	11	6	<1	1	1	13	2	147	5
8	174	15	17	2	1	1	62	12	254	9
9	169	14	36	4	1	1	71	13	277	10
10	163	14	24	3	3	3	59	11	249	9
11	134	11	38	4	6	7	72	14	250	9
12	93	8	39	4	6	7	56	11	194	7
13	85	7	41	4	2	2	29	5	157	6
14	33	3	88	9	2	2	18	3	141	5
15	7	<1	71	8	1	1	3	<1	82	3
16	3	<1	69	7	1	1	6	1	79	3
17	0	0	65	7	2	2	3	<1	70	3
18	5	<1	30	3	2	2	4	1	41	2
19-24	13	1	92	10	10	11	8	2	123	4
25-29	17	1	41	4	5	6	12	2	75	3
30-39	37	3	48	5	12	14	27	5	124	5
40-49	48	4	95	10	14	16	41	8	198	7
50-59	37	3	77	8	10	11	33	6	157	6
60-69	20	2	28	3	6	7	15	3	69	3
70+	6	<1	21	2	2	2	1	<1	30	1
Total	1187	43	930	34	87	3	533	20	2737	100

[1]All U.S. states were represented EXCEPT Alaska, Delaware, Rhode Island, Vermont, and West Virginia.

Table 2. Demographics of Norming Sample by Age and Gender

Age	Female n	Female %	Male n	Male %	Total n	Total %
5	1	<1	2	<1	3	<1
6	7	<1	10	<1	17	<1
7	81	5	66	6	147	5
8	123	8	131	11	254	9
9	130	8	147	13	277	10
10	138	9	111	10	249	9
11	116	7	134	12	250	9
12	84	5	110	10	194	7
13	75	5	82	7	157	6
14	79	5	62	5	141	5
15	38	2	44	4	82	3
16	48	3	31	3	79	3
17	44	3	26	2	70	3
18	23	1	18	2	41	2
19-24	87	6	36	3	123	4
25-29	55	4	20	2	75	3
30-39	100	6	24	2	124	5
40-49	162	10	36	3	198	7
50-59	129	8	28	2	157	6
60-69	50	3	19	2	69	3
70+	18	1	12	1	30	1
Total	1588	58	1149	42	2737	100

Table 3. Demographics of Norming Sample by Race and Household Income

Characteristic	n	%
Race		
White	1862	68
Black/African American	363	13
Asian/Pacific Islander	74	3
Hispanic	291	11
Native American	9	<1
Other	136	5
Not Reported	2	<1
Household Income[1]		
Under 25,000	2	<1
25,000 – 34,999	116	4
35,000-49,999	819	30
50,000-74,999	862	31
75,000-99,999	649	24
Over 100,000	289	11

[1] Income estimate based on median per ZIP code

Source: 2010-2014 American Community Survey 5-Year Estimates; and Environics Analytics of Canada

Normative Scores

Three types of normative scores are available for each subtest of the GTCS: percentiles, standard scores, and age-equivalents.

Percentile Rank (%tile)
Percentile rank is based on the location of the student's score compared to same-age students in the sample. It is the point in the distribution of scores that is at or below the scores of where a percentage of students fall. For example, a percentile rank of 83 means that the student scored as well as or better than 83% of the other students of the same age in the sample. Percentiles range from 1 to 99. It is important to note that the percentile rank is not the same as the percentage of items the student answered correctly. Percent correct is not a score option for the GTCS.

Standard Scores (SS)
The standard score (SS) is based on a distribution of scores from 50 to 150 with a mean of 100 and a standard deviation of 15. The standard score is determined from the percentile score using a standard psychometric conversion table. For example, if a seven-year old student obtained a percentile rank of 50 on the word attack subtest, the student's standard score would be 100. Standard scores are the best metrics to use in statistical analysis because these scores are on an interval scale.

Age-Equivalents (AE)
An age-equivalent is an age that corresponds to the student's raw score. It is determined by calculating the mean scores of all students in each age group and plotting them on a graph to visually evaluate their correlations. It is important to note that the use of age-equivalents should be approached with caution. Because they are determined through manual smoothing, interpolation, and extrapolation, they are not as reliable as standard scores and percentiles.

The development and validation process for the Gibson Test of Cognitive Skills (Version 2, CBT) aligned with the *Standards for Educational and Psychological Testing* and the Standard Protocol for Evaluating Response to Intervention Tools. The test framework was guided by the Cattell-Horn-Carroll (CHC) theory of intelligence, and the measurement of the broad CHC factors. The evaluation of the technical properties of the test included content validation by subject matter experts, item analysis, differential item functioning, and examination of coefficient alpha for internal consistency reliability, test-retest and split-half reliability coefficients, and analysis of concurrent validity with Woodcock-Johnson III-Tests of Cognitive Abilities subtests. Comprehensive evidence of validity and reliability is presented in the GTCS V2 Technical Manual (Moore & Miller, in press).

Technical Properties

Sources of Reliability Evidence

Coefficient Alpha

Coefficient alpha represents the internal consistency reliability of the test, or how well the test items correlate with each other. A desired reliability coefficient approximates or exceeds .80. Using item analysis, coefficient alphas were calculated for a sub-sample of students from the norming group. Overall coefficient alphas range from .87 to .98.

Table 4. Overall Coefficient Alphas for GTCS2 Tests

Test	Statistic	Overall
Long-Term Memory	*n*	2619
	M	23.2
	SD	12.2
	α	.93
	SEM	3.2
Working Memory	*n*	2081
	M	38.9
	SD	11.5
	α	.88
	SEM	3.9
Visual Processing	*n*	2237
	M	33.0
	SD	19.4
	α	.98
	SEM	3.0
Auditory Processing	*n*	2239
	M	12.8
	SD	5.5
	α	.90
	SEM	1.7
Logic & Reasoning	*n*	2122
	M	14
	SD	4.7
	α	.87
	SEM	1.7
Processing Speed	*n*	2115
	M	32.2
	SD	6.3
	α	.88
	SEM	2.1
Word Attack	*n*	2066
	M	16.9
	SD	6.4
	α	.93
	SEM	1.7

Split-Half

Split-half reliability is the estimation of test reliability determined by correlating the scores on two halves of the test. This method is frequently used when retesting the same students is not practical, or when practice effects are a possible threat. To calculate the split-half reliability estimate, the sum of the even numbered items was correlated with the sum of the odd numbered items. A Spearman-Brown formula was applied to the Pearson correlation for each subtest to predict the overall reliability of the test. Split-half reliability coefficients ranged from .90 -.99 (Table 5).

Table 5. Split-Half Correlation Coefficients for GTCS2

Test	Overall
Long-Term Memory	.95
Working Memory	.90
Visual Processing	.99
Auditory Processing	.93
Logic & Reasoning	.90
Processing Speed	n/a*
Word Attack	.94

[1]Split-half correlation is not an appropriate analysis for a speeded test

Test-Retest (Delayed Administration)

Test-retest reliability is the estimation of test reliability determined by correlating the scores on two different administrations of the test to the same sample of test takers. We administered the test two times one week apart to a sub-sample of the norming group (n = 56). The test-retest reliability coefficients ranged from .60 - .87 (Table 6).

Table 6. Test-Retest Correlation Coefficients for GTCS2

Test	Overall
Long-Term Memory	.68
Working Memory	.78
Visual Processing	.87
Auditory Processing	.60
Logic & Reasoning	.74
Processing Speed	.65
Word Attack	.61

Sources of Validity Evidence

Content Validity

Each GTCS test was developed following an extensive review of the literature and two decades of applied research on cognitive skills that are necessary for learning: memory, attention, processing speed, auditory processing and phonological awareness (segmenting, dropping, and blending), visual processing, logic & reasoning, and word attack skills. The tests were selected after extensive field use of similar tasks by clinicians using the Visual Information Processing (VIP) program and the Processing and Cognitive Enhancement (PACE) program. Subject matter experts were consulted during each phase of development and field testing to ensure that the content of each test adequately represented the skill it aimed to measure. A formal content validation review by three experts was conducted prior to field testing. Inter-rater reliability coefficients ranged from .97 to .99 for all items.

Construct Validity

The individual GTCS tests were developed in alignment with intelligence factors identified by the Cattell-Horn-Carroll (CHC) theory of cognitive abilities (Table 7).

Table 7. Construct Alignment of GTCS2 Tests and CHC Theory

GTCS2 Subtest	Skill Measured	CHC Factor
Processing Speed	Processing Speed	Processing Speed (Gs)
Working Memory	Working/Short-Term Memory	Short-Term Memory (Gsm)
Visual Processing	Visual Processing	Visual-Spatial Thinking (Gv)
Auditory Processing	Auditory Processing	Auditory Processing (Ga)
Logic & Reasoning	Reasoning	Fluid Reasoning (Gf)
Word Attack	Basic Reading Skills	Reading-Writing Ability (Grw)[1]
Long-Term Memory	Long-Term Memory	Long-Term Retrieval (Glr)

[1] Grw is a broad ability identified in the Cattell-Horn-Carroll *Gf-Gc* Model

Criterion - Concurrent Validity

Each test on the GTCS2 was correlated with other measures of the same skills to determine if the GTCS measures the skills as well as other standardized measures. Scores were collected from students in the first two phases of the norming group. The sample sizes are not consistent across criterion correlations because not all students were administered all tests. Correlation coefficients were attenuated based on reliability coefficients of the individual criterion tests, and corrected for possible range effects. The resulting correlations range from .44 to .92, indicating strong to very strong relationships between the GTCS and other standardized criterion tests (Table 8).

Table 8. Concurrent Validity between the GTCS2 and the Woodcock-Johnson III

GTCS2 Test	Traditional Cognitive Test	Correlation (r)
Long-Term Memory	Woodcock-Johnson III – Tests of Cognitive Abilities: Visual Auditory Learning	.44
Working Memory	Woodcock-Johnson III – Tests of Cognitive Abilities: Numbers Reversed	.75
Visual Processing	Woodcock-Johnson III – Tests of Cognitive Abilities: Spatial Relations	.74
Auditory Processing	Woodcock-Johnson III – Tests of Achievement: Sound Awareness	.73
	Woodcock-Johnson III – Tests of Cognitive Abilities: Sound Blending	.92
Logic & Reasoning	Woodcock-Johnson III – Tests of Cognitive Abilities: Concept Formation	.80
Processing Speed	Woodcock-Johnson III – Tests of Cognitive Abilities: Visual Matching	.85
Word Attack	Woodcock-Johnson III – Tests of Achievement: Spelling Sounds	.82

Summary and Ordering

The Gibson Test of Cognitive Skills (V2) is a web-based screening tool that informs clinicians, teachers, and parents about performance on tasks that measure 1) working memory, 2) long-term memory, 3) processing speed, 4) auditory processing, 5) visual processing, 6) logic & reasoning, and 7) word attack skills. To purchase the test, visit the website at www.gcstest.com or call LearningRx at (719) 264-8808.

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