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# FastBridge Learning

## FAST AUTOreading™ Technical Report



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## Purpose and Use

FAST™ AUTOREading is a suite of eight sub-tests that measure the accuracy and rate of phonological (sound), orthographic (spelling), and semantic (meaning) skills. AUTOREading was developed in response to requests from educators for fully automated assessments of foundational reading skills that can be used and interpreted across all grades, K – 12. Although AUTOREading is available for students in Kindergarten and Grade 1, FAST researchers recommend the FAST earlyReading™ assessment in these grades.

Importantly, earlyReading is individually administered and involves having the student demonstrate each skill for the examiner (i.e., expressive tasks). This format is more ecologically valid with young learners and allows the examiner to observe all facets of the student’s performance. All AUTOREading tasks, on the other hand are completed on a computer or tablet device. This means that the student selects correct answers instead of demonstrating them (i.e., receptive tasks). In addition to the benefits from observing the student complete each skill, it is possible that the motor coordination skills necessary for quick and accurate answer selection have not reached the level needed to perform this task accurately for some young learners. As such, AUTOREading should be used only to supplement earlyReading results for students in Kindergarten and Grade 1.

When used for screening, specific sets of the sub-tests are used together to form the AUTOREading composite score. Table 1 shows the sub-tests included in the AUTOREading composite by grade as well as the total number of items for each sub-test.

When used for progress monitoring, one sub-test is selected to be used. Selection of the best sub-test for progress monitoring should be based on the specific reading skill that the student is learning as part of intervention.

*Table 1. Target grade and item count by sub-test.*

Sub-test	Grade Range		
	K	1-4	5-12
Letter Names	52		
Letter Sounds	28		
Encoding		32	
Word ID		30	30
Vocabulary		30	
Synonym			30
Decoding			30
Morphology			28

## Sub-test Descriptions

Each of the AUTOREADING sub-tests measures a specific reading sub-skill.

### Letter Names

The Letter Names decision task measures whether a student can accurately and automatically identify all upper- and lowercase letter names. Each item consists of a target letter name and two distractors. Most distractors were selected based on similarity of their shape to the target letter. Of the 52 three-letter items (i.e., target letter with two distractors) 70% had similar shapes based on visual characteristics such as rounded or straight lines (Balota, Yap & Cortese, 2006; Carnine, Silbert, Kame'enui, & Tarver, 2010; Mueller & Weidemann, 2012). When similarity in shape was not used, distractors were selected based on type (e.g., all vowels) or case (e.g., presenting both the lower- and upper-case version of the distractor).

### Letter Sounds

The Letter Sounds decision task measures if a student can accurately and automatically identify all letter sounds including dual sounds for "c" and "g". Each item consists of a lower-case target letter sound and two distractors. Only letter sounds *not* similar to the target letter sound were used as distractors in order to reduce potential letter-sound interference (Carnine, et al., 2010; Shankweiler, Liberman, Mark, Fowler & Fisher, 1979; Farrell, 2006). Similarity of letter sounds were determined based on guidelines in the educational literature (Carnine, et al., 2010) and using the International Phonetic Alphabet to determine if letter sounds were similar in voicing as well as in place and manner of articulation.

### Word Decoding

The Word Decoding decision task measures if a student can accurately and automatically read decodable pseudo-words based on decodability levels that represent appropriate developmental progress in word reading (Compton, Appleton & Hosp, 2004; Menton & Hiebert, 1999). Each item consists of a target pseudo-word and two distractor non-words. The pseudo-words are all phonetically regular one- and two-syllable "words" that can be sounded out using phonics skills. Distractor words have the same first letter as the target word and are similar in length and number of syllables.

### Word Identification

The Word Identification decision task measures if a student can accurately and automatically identify frequently occurring words (Zeno, 1995). Each item consists of a target word and two distractor words. Distractor words have the same first letter as the target word and are similar in length and number of syllables.

### Word Encoding

The Word Encoding decision task measures if a student can accurately and automatically identify the appropriate spelling for a given word based on appropriate sound-spelling correspondence. All words are phonetically regular English words. Each item consists of a target word and two distractor pseudo-homophones.

## Vocabulary

The Vocabulary Definitions task measures how well students know the definitions words that are used in multiple contexts but may require some vocabulary instruction to help children learn them (Beck, McKeown, & Kucan, 2002). Careful attention was given to avoid words that could have negative connotations with respect to religion, culture, race, and ethnicity.

## Matching Synonyms

The Matching Synonyms task assesses students' accuracy and speed in matching words that are similar in meaning. Half of the words have high imageability, which are words that can easily be seen. The other half are low-imageability items, or abstract for which mental images are difficult (Paivio, Yuille, & Madigan, 1968). Distractors are as close as possible to the target word in length, imageability, and frequency (Zeno, 1995), and part of speech (i.e., noun v. verb). Additionally, distractors are relatively similar semantically to the target word (i.e., "boat" and "sand" are semantically similar whereas; "boat" and "leaf" are not).

## Morphology

The Word Morphology decision task measures if a student can accurately and automatically identify word structures and relationships based on appropriate use of morphemes, roots, and affixes. The examinee determines whether the meaning of the word changes as a result of adding or removing morpheme roots or affixes. For example, the student responds "yes" when presented with "quick" and "quickly" and responds "no" when presented "moth" and "mother". Each item (N = 30) consists of two words. The second word of the two stimuli consists of words that are morphologically related or unrelated to the first word. All words appear on the list of the 5,000 most frequent words in print according to the Corpus of Contemporary American English (COCA).

## Administration

All AUTOreading sub-tests are computer administered. They can be launched by a Group Proctor, or by setting up Student Login Access so the students can log in themselves to take the assessments.

AUTOreading items were designed to provide efficient and valid assessment of foundational reading skills. Each item is presented in a simple multiple-choice format that is developmentally appropriate for young learners with little formal exposure to computer-based assessment and equally appropriate for older students. Although there is not a total testing time limit, each item has a 6-second time limit. If the student responds before the time is up, he or she continues to the next item. If the student does not respond within 6 seconds, the item is scored as incorrect (coded as "no response") and the test automatically advances to the next item. Students should complete the tests quickly, but carefully.

Items are presented with color coding that alerts the student to the time limit. Each item begins with a green border around each answer choice. The border color changes to yellow and finally red. The student can select an answer at any point when the choices are displayed. The green border displays for 3 seconds, the yellow for 2 seconds, and the red for 1 second. After the total elapsed 6 seconds the choices disappear, and a new item is displayed.

Prior to each sub-test the student hears instructions and is presented with two practice items with correct/incorrect feedback. The student is next prompted to begin the test. Prior to each sub-test item, a "+" symbol appears for one second at the center of the screen to orient the student to where the stimuli will be presented; this symbol disappears automatically, and the next item is presented. Each AUTOreading sub-test takes between 45 to 120 seconds to complete.

All administrations begin with a practice sub-test (e.g., warmup) that includes pictures that the student identifies by clicking on them. The task is very easy, even for most Kindergarten students. It is intended to familiarize the student with the timing feedback (e.g., green, yellow, and red borders) and accuracy feedback, and to prime students to respond accurately and quickly as they need to on the actual test items.

## AUTOreading Scores

AUTOreading reports a composite score and sub-test scores. The composite is used for universal screening because it provides the most robust and accurate assessment of reading deficits. Sub-test scores are used for progress monitoring to enable educators the ability to monitor individual skills which often improve at different rates especially when instruction is targeted to subskills.

### Composite Scores

AUTOreading composite score is a scaled score that uses the same scale as the FAST aReading assessment, and ranges from 350 – 750. It is derived from the calibration of all test items using the Graded Response IRT model (GRM). This method combines item scores and response times to generate item difficulty thresholds. Response times for each item in the AUTOreading sub-tests (e.g., Letter Names, Letter Sounds, and Encoding) were transformed from milliseconds to seconds by dividing the original response time values by 1000. Then, a logarithmic transformation was applied to the response times (in seconds) to eliminate the skewness in the response time distribution and obtain a normal distribution. Using the log versions of the response times, the 25<sup>th</sup> and 70<sup>th</sup> percentiles were identified as the cut-off values for response time-based scoring, and items were recoded as

- 0 for incorrect
- 1 for correct and slow response time (bottom quartile)
- 2 for correct and moderate response time (25<sup>th</sup> – 70<sup>th</sup> percentile)
- 3 for correct and fast response time (71 – 99<sup>th</sup> percentile)

Items were calibrated separately by grade ranges within item sets using the following item sets.

- Set A items: Letter Names & Letter Sounds
- Set B items: Encoding, Word ID, & Vocabulary
- Set C items: Word ID, Synonym, Decoding, & Morphology

The number of students by grade in each block is shown in Table 2.

*Table 2. Number of unique AUTOreading scores by grade and set.*

Grade	Set A	Set B	Set C
KG	7,215		
1		10,567	
2		14,109	
3		13,470	
4		14,076	
5			11,236
6			11,876
7			8,560
8			8,387

The AUTOreading composite includes national norm percentiles ranging from 1 – 99, benchmarks (high risk, some risk, and advanced), and seasonal growth norms to assist with interpretation of student performance and growth across time. Because the AUTOreading composite scores uses the aReading scale the norms and benchmarks for AUTOreading are the same as those for aReading.

### **Sub-test Scores**

Sub-tests are scored on items correct per minute and result in a rate-based score. Rate-based scoring of individual sub-tests is important because research indicates that readers need to be both accurate and fast when recognizing specific word features. Accuracy and automaticity (i.e., fluency) are strong predictors of both how much text a student can read as well as how much of the text information is understood (i.e., comprehension). Both benchmarks and norms for all sub-tests are available in the Benchmarks and Norms section of the FastBridge website.

## Validity, Reliability, and Decision Accuracy

The quality and utility of the AUTOREading composite score as a reading risk indicator are summarized in this section using internal consistency reliability, the correlation among sub-tests and with general reading ability and using classification accuracy.

The table below reports summary statistics for the AUTOREading composite test by grade using data from the calibration sample described above. As indicated above, the AUTOREading composite score is reported as a scaled score on the aReading scale, which has a mean of 500 and a standard deviation of 50. The mean AUTOREading composite score shows the expected increase with grade. Beginning in Grade 1 average increase is about 10 scaled score points per grade through Grade 5 and decreases to 5 points from Grade 7 to Grade 8. The averages were derived from scores collected during the fall and winter screening window with about 70% of the scores from the fall. These samples are not representative of the total population; thus, the means and SDs will differ from those reported in the national norms tables.

*Table 3. Rescaled AUTOREading summary statistics by grade.*

Grade	N	Mean	SD	Median	Min	Max
KG	6,426	395.93	28.50	396.22	324.82	529.37
1	2,648	480.10	17.70	479.26	402.92	568.29
2	8,549	488.04	18.06	488.05	410.52	572.22
3	9,760	496.78	19.91	497.55	401.70	572.83
4	10,528	506.69	19.27	507.71	416.66	580.67
5	7,739	517.86	16.77	518.18	446.72	589.91
6	7,099	524.73	18.90	524.73	447.15	599.41
7	5,048	530.25	20.92	530.12	444.07	599.41
8	7,788	535.19	21.75	535.35	455.49	599.41

### Validity

The inter-relationship among the AUTOREading sub-test scores that measure distinct skills represents an aspect of validity. Table 4 shows the correlations for the AUTOREading sub-tests and the composite by grade. The values in the first column indicate that each sub-test correlates strongly with the overall composite. This is expected in part because each sub-test contributes to the overall composite. The correlation coefficients among the sub-tests range from about 0.60 to 0.85. These levels indicate that the sub-tests measure distinct but related skills. The speed/automaticity aspect of item performance may make these correlations somewhat stronger than if they were based solely on accuracy.

Table 4. AUTOreading sub-test and composite correlation by set.

	Comp.	LN	LS	Enc	WID	Voc	Dec	MS	Morph
<b>Set A</b>									
Composite	1.00								
Letter names	0.97	1.00							
Letter Sounds	0.85	0.72	1.00						
<b>Set B</b>									
Composite	1.00								
Encoding	0.94			1.00					
Word ID	0.93			0.80	1.00				
Vocabulary	0.89			0.76	0.77	1.00			
<b>Set C</b>									
Composite	1.00								
Word ID	0.92				1.00				
Decoding	0.86				0.74		1.00		
Matching Synonyms	0.86				0.71		0.68	1.00	
Morphology	0.79				0.60		0.60	0.60	1.00

Table 5 reports the correlation of the AUTOreading composite scores with two other FAST reading assessments, including the aReading scale scores and CBMreading words per minute scores. The correlations with aReading were derived from the sample described in Table 3. Because this sample was used for post-calibration equating, the mean and SD in Table 3 are identical for aReading. As the summary statistics indicate, this sample spans a broad range of reading ability.

The correlations with CBMreading are strong and demonstrate why the AUTOreading scale score, which also combines accuracy and automaticity, has many of the same attributes as CBMreading. The correlations with aReading are, as expected, not as strong. Even so, the strength of the association between AUTOreading and aReading demonstrates the important role that automaticity plays in foundational reading skills and vocabulary in general reading proficiency.

Table 5. AUTOreading correlation with aReading and CBMreading.

Grade	aReading		CBMreading			
	N	Cor.	N	Cor.	Mean	SD
KG	6,426	0.51				
1	2,648	0.58	1,292	0.80	42.2	37.2
2	8,549	0.64	3,023	0.82	78.4	45.1
3	9,760	0.67	2,864	0.75	97.8	45.5
4	10,528	0.65	2,775	0.74	115.8	46.7
5	7,739	0.63	2,279	0.76	129.7	45.6
6	7,099	0.60	1,205	0.70	134.6	40.9
7	5,048	0.62	656	0.74	140.9	46.0
8-12	7,788	0.61	695	0.73	135.4	46.9

## Reliability

Table 5 reports IRT model-based reliability coefficients by grade. These coefficients are all very high and similar to those for CBMreading, a FAST measure with documented reliability.

Table 6. IRT model-based reliability coefficients by grade.

Grade	N	reliability
KG	7,215	0.97
1	2,651	0.94
2	8,576	0.94
3	9,808	0.95
4	10,574	0.95
5	7,743	0.95
6	7,110	0.96
7	5,073	0.97
8	7,838	0.97

## Decisions Accuracy

Decision accuracy was assessed using the aReading some risk benchmark as the criterion. In the FAST system, scores at some risk fall between the 15<sup>th</sup> and 40<sup>th</sup> national FAST percentiles. aReading was selected as the criterion measure because it measures general reading proficiency, including reading comprehension. For this analysis, fall AUTOreading scores were used to predict winter aReading scores. Table 6 reports results for Grades 2 through 8. Area under the curve (AUC) values are in the mid- to upper-0.70s and correspond with acceptable values for decision accuracy. The AUTOreading cut scores are derived from *Youden's J* index. This is the point on the ROC curve that optimizes sensitivity and specificity.

Table 7. Decision accuracy predicting some risk on aReading by grade.

<b>AUTOreading</b>				
<b>Grade</b>	<b>AUC</b>	<b>Cut Score</b>	<b>Sensitivity</b>	<b>Specificity</b>
2	0.75	480.61	0.72	0.67
3	0.81	491.82	0.80	0.68
4	0.78	502.93	0.76	0.64
5	0.79	516.88	0.70	0.75
6	0.77	524.70	0.64	0.79
7	0.78	522.65	0.84	0.63
8	0.73	530.40	0.74	0.64

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