

Supplemental Material S2. Clinical guide to language sample analysis measures with best accuracy.

Age group	English variety	Measure(s)/model
3 yo	ME	LARSP Model (VP Errors + Stage 1 Utterances + Age + 3-element NP)
4 yo	ME	Finite Verb Morphology Composite (FVMC) Version 1-3 Developmental Sentence Scoring (DSS) Sentence Point
5 yo	ME	Finite Verb Morphology Composite (FVMC) Version 1-3 Developmental Sentence Scoring (DSS) Sentence Point
	SWE	Past Tense: Strategic Scoring
6 yo	ME	Finite Verb Morphology Composite (FVMC) Version 3 SUGAR Model (MLU + Clauses per Sentence) Percent Grammatical C-units (PGCU) Errors per C-Unit Unmarked Verbs + Verb Types
7 yo	ME	Finite Verb Morphology Composite (FVMC) Version 3 SUGAR Model (MLU + Clauses per Sentence) Percent Grammatical Utterances/C-Units
8 yo	ME	Percent Grammatical Utterances (PGU) Errors per C-Unit Proportion “Restricted” Utterances
9 yo	ME	Percent Grammatical Utterances (PGU)
10 yo	ME	Proportion “Restricted” Utterances

Note. ME = Mainstream English; SWE = Southern White English.

Use the table above to identify the language sample measure(s) with the best diagnostic accuracy based on age and dialect. Below, a summary of procedures for each measure is provided, including the age range it can be used for, overall level of diagnostic accuracy (adequate = at least 80% sensitivity/specificity, good = at least 90%), details for eliciting and coding the language sample, and instructions for calculating the measure and interpreting it against the recommended cutoff score. For more detailed descriptions, please see the source article(s) listed with each measure.

LARSP Model

Source: Gavin, W. J., Klee, T., & Membrino, I. (1993). Differentiating specific language impairment from normal language development using grammatical analysis. *Clinical Linguistics & Phonetics*, 7(3), 191–206.

Ages: 2;0-4;2

Accuracy: Good

Elicitation: Conversation/Play (20-minute sample interacting between child and caregiver playing with a set of toys)

Materials: Age-appropriate toys

Sample Length: average 198 utterances (61-377)

Transcription: modified SALT conventions

Coding:

- Total Major Utterances (exclude single word yes/no utterances and 'unanalysed' or 'problematic' utterances)
- 3-element Noun Phrases (count number of occurrences, divide by total major utterances)
 - Determiner + Adjective + Noun (e.g., the big train)
 - Adj + Adjective + Noun (e.g., big red truck)
 - Preposition + Determiner + Noun (e.g., in my pocket)
- Verb Phrase Errors (count number of occurrences, divide by total major utterances)
- Stage 1 Major Utterances (count number of occurrences, divide by total major utterances)
 - 'V' (Command) (e.g., Stop!)
 - 'Q' (Question) (e.g., What?)
 - 'V' (Statement).
 - 'N' (Statement).
 - Other (Statement)
- Input these values into the following formula:
$$-7.58 + .14(\text{Age in months}) + 5.87(\text{Stage 1 Major Utterances}) + 12.96(\text{VP Errors}) - 16.58(3\text{-element NP})$$

Cutoff: <0.025 classified as typical language, >0.025 classified as impaired

Verb Morphology Composite / Finite Verb Morphology Composite

Version 1

Source: Gladfelter, A., & Leonard, L. B. (2013). Alternative tense and agreement morpheme measures for assessing grammatical deficits during the preschool period. *Journal of Speech, Language, and Hearing Research*, 56(2), 542–552.

Age: 4;0-4;6, 5;0-5;6

Accuracy: Good

Elicitation: Play (interactions between child and experimenter)

Materials: Age-appropriate toys

Sample length: 152 utterances or more

Transcription Conventions: SALT

Coding:

- Identify obligatory contexts for the morphemes of interest: regular past tense inflections, regular third person singular present inflections, copula and auxiliary BE forms (i.e., am, is, are, was, were in contracted or uncontracted form), and auxiliary DO forms (i.e., do, does, did)
- Mark instances of correct and incorrect (omissions and substitutions) usage (NOTE: overregularized past tense forms (e.g., threw instead of threw) should be scored as an additional obligatory context and credited with an additional instance of past tense –ed)
- Calculate percentage of correct usage: the number of correct productions in the composite divided by the total number of obligatory contexts and multiplied by 100

Cutoff: 4yo = 76%, 5yo = 82.5%

Version 2

Source(s): Souto, S. M., Leonard, L. B., & Deevy, P. (2014). Identifying risk for specific language impairment with narrow and global measures of grammar. *Clinical Linguistics & Phonetics*, 28(10), 741–756.

Ages: 4;0-5;10

Accuracy: Good

Elicitation: Play (interactions between child and experimenter)

Materials: Age-appropriate toys

Sample length: first 50 utterances containing a subject plus verb (100+ elicited)

Transcription Conventions: SALT

Coding:

- NOTE: Code all utterances beginning with the first utterance in the sample to the point at which the 50th utterance containing a subject plus verb
- Identify obligatory contexts for the morphemes of interest: regular past tense inflections, regular third person singular present inflections, and copula and auxiliary BE forms (i.e., am, is, are)
- Mark instances of correct and incorrect (omissions and substitutions) usage

-Calculate percentage of correct usage: the number of correct productions in the composite divided by the total number of obligatory contexts and multiplied by 100

Cutoff: 4yo = 76.95%, 5yo = 83.73%

Version 3

Source(s): Guo, L. Y., & Schneider, P. (2016). Differentiating school-aged children with and without language impairment using tense and grammaticality measures from a narrative task. *Journal of Speech, Language, and Hearing Research*, 59(2), 317–329.

Source: Guo, L. Y., Eisenberg, S., Schneider, P., & Spencer, L. (2020). Finite verb morphology composite between age 4 and age 9 for the Edmonton Narrative Norms Instrument: Reference data and psychometric properties. *Language, Speech, and Hearing Services in Schools*, 51(1), 128-143.

Ages: 4-9yrs

Accuracy: Adequate (6-7yrs) to Good (4-5yrs)

Elicitation: ENNI story generation task¹

Materials: ENNI picture sequences¹

Sample length: average 58-81 utterances (33-181)

Transcription Conventions: SALT

Coding:

-NOTE: Exclude C-units that contained verb forms but no subjects (e.g., Getting the airplane out of the swimming pool)

-Identify obligatory contexts for the morphemes of interest: regular past tense inflections, regular third person singular present inflections, and contracted and uncontracted copula and auxiliary BE forms (i.e., am, is, are, was, were). NOTE: Do not include the infinitive form of be (e.g., The rabbit will be sick), present participle form of be (e.g., The rabbit is being funny), past participle form of be (e.g., He has been trying to get the ball), or gerund form of be (e.g., Being happy is easy) in this calculation.

-Mark instances of correct and incorrect (omissions and substitutions) usage (NOTE: excluded overgeneralization of 3SG –s (e.g., The elephant haves an airplane) or regular past tense –ed (e.g., The elephant just standed there).

-Calculate percentage of correct usage: the number of correct productions in the composite divided by the total number of obligatory contexts and multiplied by 100

Cutoffs: 4yo = 83.77%, 5yo = 93.46%, 6yo = 93.50%, 7yo = 96.64%

¹ Edmonton Narrative Norms Instrument website: <https://www.ualberta.ca/communications-sciences-and-disorders/resources/clinical-supervisors/edmonton-narrative-norms-instrument/index.html>

Developmental Sentence Scoring (DSS) Sentence Point

Source(s): Souto, S. M., Leonard, L. B., & Deevy, P. (2014). Identifying risk for specific language impairment with narrow and global measures of grammar. *Clinical Linguistics & Phonetics*, 28(10), 741–756.

Ages: 4:0-5:10

Accuracy: Good

Elicitation: Play (interactions between child and experimenter)

Materials: Age-appropriate toys

Sample length: first 50 utterances containing a subject plus verb (100+ elicited)

Transcription Conventions: SALT

Coding:

- NOTE: Code all utterances beginning with the first utterance in the sample to the point at which the 50th utterance containing a subject plus verb

- Score each utterance: give one sentence point if and only if the sentence was fully grammatical, regardless of whether it uses simple or complex morphosyntax, and give zero points for any grammatical error (e.g., a sentence point should be withheld for sentences such as “Her broke the window” (personal pronoun error), “Dad built new birdhouse and Mom ate two apple” (grammatical errors on articles and noun plural inflections)

- Calculate Sentence Point Score: add the total number of sentence points earned and divide by 50 (i.e., total number of utterances)

Cutoffs: 4yo = .755, 5yo = .815

SUGAR Model

Source: Pavelko, S. L., & Owens, R. E. (2019). Diagnostic accuracy of the sampling utterances and grammatical analysis revised (SUGAR) measures for identifying children with language impairment. *Language, Speech, and Hearing Services in Schools*, 50(2), 211–223

Ages: 3;0-7;0

Accuracy: Adequate

Elicitation: SUGAR Conversation protocol²

Sample length: 50 utterances

Transcription Conventions: SUGAR

Coding:

- Mean Length of Utterance (SUGAR): the total number of morphemes divided by 50. Per the rules in Pavelko and Owens (2017), count all free morphemes, five grammatical morphemes, 18 derivational morphemes, and each word in a proper name as one morpheme; all contractions and the words *hafta*, *wanna*, and *gotta* as two morphemes; and the word *gonna* as three morphemes.
- Clauses Per Sentence (CPS): the total number of clauses divided by the number of sentences

Cutoffs: Both measures below the cutoff indicates impairment

Measure	3;0-3;5	3;6-3;11	4;0-4;5	4;6-4;11	5;0-5;11	6;0-6;11	7;0-7;11
MLU	2.87	4.13	4.26	4.86	5.31	6	6.87
CPS	0.90	0.99	1.0	1.05	1.1	1.15	1.18

² For conversation elicitation protocol, see Pavelko, S. L., & Owens Jr, R. E. (2017). Sampling Utterances and Grammatical Analysis Revised (SUGAR): New normative values for language sample analysis measures. *Language, Speech, and Hearing Services in Schools*, 48(3), 197-215.

Percent Grammatical Utterances/C-Units

Source(s): Guo, L. Y., & Schneider, P. (2016). Differentiating school-aged children with and without language impairment using tense and grammaticality measures from a narrative task. *Journal of Speech, Language, and Hearing Research*, 59(2), 317–329.

Guo, L. Y., Eisenberg, S., Schneider, P., & Spencer, L. (2019). Percent grammatical utterances between 4 and 9 years of age for the Edmonton Narrative Norms Instrument: Reference data and psychometric properties. *American Journal of Speech-Language Pathology*, 28(4), 1448-1462.

Ages: 4-9yrs

Accuracy: Acceptable (4-8) to Good (9yrs)

Elicitation: ENNI story generation task³

Sample length: average 58-81 utterances (33-181)

Transcription Conventions: SALT

Coding:

- Identify errors: errors in tense marking, incorrect pronoun use, omission or incorrect use of grammatical morphemes, inconsistent argument structure (i.e., omission of a required constituent, other syntactic errors that were not included in the previous categories (e.g., semantic irregularities).
- Percent grammatical utterances/C-units (PGU/PGCU): 1) calculate the total number of utterances/C-units containing at least 1 error, then subtract from the total number of utterances/C-units. Divide by the total number of C-units.

Cutoff: 4 yrs = 54.04%, 5 yrs = 79.10%, 6 = 83.00%, 7 yrs = 85.40%, 8 yrs = 91.50%, 9 yrs = 88.42%

³ Edmonton Narrative Norms Instrument website: <https://www.ualberta.ca/communications-sciences-and-disorders/resources/clinical-supervisors/edmonton-narrative-norms-instrument/index.html>

Errors per C-unit

Source: Guo, L. Y., & Schneider, P. (2016). Differentiating school-aged children with and without language impairment using tense and grammaticality measures from a narrative task. *Journal of Speech, Language, and Hearing Research*, 59(2), 317–329.

Ages: 6yrs and 8yrs

Accuracy: Acceptable

Elicitation: ENNI story generation task³

Materials: ENNI picture sequences³

Sample length: average 58-81 utterances (33-181)

Transcription Conventions: SALT

Coding:

- Identify errors: errors in tense marking, incorrect pronoun use, omission or incorrect use of grammatical morphemes, inconsistent argument structure (i.e., omission of a required constituent, other syntactic errors that were not included in the previous categories (e.g., semantic irregularities).
- Number of errors per C-unit (Errors/CU): total number of errors divided by total number of C-units that were included for analysis

Cutoff: 6yo = .14, 8yo = .09

Proportion “Restricted” Utterances

Source: Hoffman, L. M. (2009). The utility of school-age narrative microstructure indices: INMIS and the proportion of restricted utterances. *Language, Speech, and Hearing Services in Schools*, 40(4), 365-375.

Ages: 8-10 yrs

Accuracy: Acceptable

Elicitation: Narrative generation

Materials: *Frog Where Are You?* by Mercer Mayer

Sample length: average 38 utterances (22-72)

Transcription Conventions: SALT

Coding:

- Segment utterances into T-units
- Code restricted utterances: mark T-units as “restricted” if they have 1) a complete clause with a subject and predicate, and 2) contain any number of grammatical errors (including verb inflections or clausal structure) and/or semantic errors (i.e., inaccurate references or meanings, such as pronoun reversals or substituting “door” for *window*)
- Proportion “restricted” utterances: total number of utterances marked as “restricted” divided by total number of complete & intelligible utterances

Cutoff: 14% or higher indicates impairment

Unmarked Verbs + Verb Types

Source: Fletcher, P., & Peters, J. (1984). Characterizing language impairment in children. *Language Testing*, 1(1), 33–49.

Ages: 3;4-6;11

Accuracy: Acceptable

Elicitation: 1 hour session of 4 activities: free play with a familiar adult, narrative generation, board game play, narrative retell

Materials: Toys, board game, wordless picture book (generation), picture sequence (retell)

Sample length: 200 or more (50 per task)

Transcription Conventions: N/A

Coding:

- Code unmarked verbs: total number of verbs that are not marked by an auxiliary or inflection
- Code verb types: total number of unique verbs
- Input these values into the following formula:

$$-0.87710 + -0.2770(\text{Unmarked Verbs}) + 0.10354(\text{Verb Types})$$

Cutoff: .19 or below indicates impairment

Past Tense (Strategic Scoring)

Source: Oetting, J. B., Rivière, A. M., Berry, J. R., Gregory, K. D., Villa, T. M., & McDonald, J. (2021). Marking of tense and agreement in language samples by children with and without specific language impairment in African American English and Southern White English: Evaluation of scoring approaches and cut scores across structures. *Journal of Speech, Language, and Hearing Research*, 64(2), 491–509.

Ages: 5 yrs

Accuracy: Acceptable

Elicitation: Play (20-30 minutes), narrative generation

Materials: Toys (gas station set, picnic/park set, baby doll set), 3 action pictures⁴ (a child at a doctor’s office getting a shot and a family fishing, grocery shopping, or washing a car)

Sample length: average 237 utterances

Transcription Conventions: SALT, except for utterance segmentation rules

Coding:

- Segment utterances into C-units, but allow two conjoined independent clauses to remain in the same utterance
- Code past tense on main verbs only (not participles, auxiliaries, or non-changing forms such as *cut*)
- Code mainstream overt (MO): past tense marked with forms that are consistent with standard English (e.g., *jumped*, *ate*)
- Code nonmainstream overt (NMO): past tense marked with dialect-specific patterns (e.g., *drunk*)
- Code nonmainstream zero form (NMZ): no acoustically perceptible marking
- Code other forms (O): more than one tense/agreement form marked within a predicate (e.g., *where did this went?*)
- Calculate percentage of overt marking: dividing the total mainstream and nonmainstream overt forms divided by total overt and zero forms (MO+NMO/MO+NMO+NMZ). Do not include forms coded as “other.”

Cutoff: 91-93% or lower indicates impairment

⁴ Arwood, E. L. (1985). *Apricot I language kit*. Apricot.