

# PEPPER GUIDE 7:

## PEPANALYSES

### Overview

As indicated in the PEPPER [flowchart](#), the initial procedural step is to determine if one or more PepAnalyses outputs (i.e., from PepAssess or PepClass) might inform your specific educational, clinical, or research question or need. The focus in this guide is on that determination: which one or more of the dozens of PEPPER outputs might be helpful in your work? Each of the following three sections provides a different perspective on PepAnalyses options.

### Section I

The first section of this guide is a slightly edited copy of Chapter 7 from the original PEPPER (1986) manual. Before approximately 1990, PEPPER did not include outputs that required users to complete prosody-voice coding and/or acoustic analyses. Because the computations in present PepAssess outputs that require only phonetic transcriptions have not changed from their original development, it was efficient to scan the information in this section from the 1986 text, reformat the text to be consistent with the present set of PEPPER Guides, and slightly update the text. Importantly, each of the sample outputs from the PepAssess tab in PepAnalyses can be completed using only broad or narrow phonetic transcription. All reference data (see Section III below) were obtained using narrow phonetic transcription.

### Section II

The second section of this guide includes a table with references to some research that has used PepAssess and PepClass outputs. The reports have used finalized or nearly finalized versions of the Speech Disorders Classification System (Shriberg, Kwiatkowski, & Mabie, 2019). Some of the PepAssess data and all of the PepClass data were obtained from measures that require narrow phonetic transcription, prosody-voice coding, and acoustic analyses.

### Section III

The last section of this guide contains the Tables of Contents from ten Phonology Project Technical Reports. These reports provide standardized reference data for measures in the PepAssess and PepClass outputs. The reference data include statistical information for typical speakers, speakers with idiopathic speech delay, and speakers with speech delay in the context of complex neurodevelopmental disorders. The page numbers in each table of contents should be helpful to locate within each reference, information by measure, age, and sex (see RESEARCH > TECHNICAL REPORTS on the Phonology Project website: <https://phonology.waisman.wisc.edu/publications-and-presentations/technical-reports/>).

**SECTION I:**  
**SOME BASIC PEPASSESS OUTPUTS**

**PEPPER\_PepAnalyses tab:**

**PepAssess > Analyses > Phoneme Analyses: Structural Statistics**

# STRUCTURAL STATISTICS

Filename            Group SPEECHDELAY  
 Study Identification MADSD  
 DOB \*  
 Age at Sampling Date 0 yrs 0 mos

Sampling Date \*  
 Sampling Clinician \*  
 Pepfile Entry Date \*  
 Transcriber \*

TYPE	CANONICAL FORM	INTENDED (Y)		OBTAINED (Z)		OBTAINED=INTENDED	
		n	%	n	%	n	%
1	V	706	9.01	915	11.67	703	99.58
2	CV	1974	25.18	2303	29.38	1913	96.91
3	VC	1035	13.20	934	11.92	879	84.93
4	CVC	2008	25.62	1672	21.33	1561	77.74
5	CnV	119	1.52	89	1.14	71	59.66
6	CnVC	151	1.93	76	0.97	59	39.07
7	VCn	90	1.15	73	0.93	70	77.78
8	C(n)VCn	330	4.21	236	3.01	206	62.42
9	2-Syllable	1176	15.00	1286	16.41	924	78.57
10	3+-Syllable	170	2.17	172	2.19	72	42.35
0	No Vowel	79	1.01	82	1.05	78	98.73
		7838		7838			

Average Words / Utterance	Type-Token Percentage
9014 / 2647 = 3.41	1001 / 6058 = 16.52

Notes: \_\_\_\_\_  
 \_\_\_\_\_  
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## Description

The data in the sample Structural Statistics output and each of the other sample outputs in Section I were obtained from a group of 28 children, 3-6 years of age, with moderate to severe Speech Delay (SD) of unknown (idiopathic) origin ([McSweeney et al., 2012](#)). The Structural Statistics output is based on information in the Y and Z lines of each utterance in a Pepfile. The numbers and percentages of the ten word types (canonical forms) intended by the speaker are taken from the Y line and the numbers and percentages of word types obtained are taken from the Z line. The last two columns in the output are the numbers and percentages of words in which the word types in Y and Z match, i.e. Obtained=Intended. Hence, a child who says [dʌg] for the intended word *dog* produces the same word form (CVC) although the obtained vowel differed from the intended vowel.

## Computational Notes

In all of the PepAssess outputs, it is important to know which words are included in the computations and which are excluded. For the Structural Statistics output, the only words in the Y or Z lines removed from consideration are words represented by or containing one or more asterisks. All other words in Y or Z are included, even those that are questionable, that is, a disregard, either/or, or an unsure in X or an unsure in Z. As long as words are represented entirely-by consonant and vowel/diphthong segments in both the Y and Z lines, their canonical forms will be included in each analysis. The reason all words are included is that the results of these analyses are meant to reflect structural-level speech information. Disregards, either/ors or unsures are removed from the phonetic/phonologic analyses because they may affect reliability and validity. In contrast, the reliability and validity of Structural Statistics requires that computations be based on all words the speaker intended within each utterance. That is why you should always enter a phonetic transcription in Y and Z, reserving asterisks only for completely unintelligible words. Sometimes a Structural Statistics output will include data on the number of words that do not contain at least one vowel or syllabic consonant. This information is printed at the bottom of the word form section of the output.

## Word Types: Intended, Obtained, and Obtained = Intended

A speaker's percentage of occurrence of each Intended word type (Y line) may be interpreted as reflecting two alternative types of information. One interpretation is that the Intended Word Type percentages may indicate whether the speech sample is structurally representative of continuous speech. For example, if a speaker's percentage of CVC words is much higher than the approximately 30% expected (see Section III), perhaps there may be a problem related to the method used for speech sampling. The reference data for word types (see Section III) should provide a general guide to expected percentages. Speaker values above or below one standard deviation from the mean of typical speakers may be suspect. The source of any differences could be traced to a high frequency of occurrence of questionable words of a certain form. Or perhaps a large section of the transcript includes repetitive, non-questionable forms, such as those that occur with repeated use of a proper noun. If the percentages of intended forms do look

too high or too low, it is useful to inspect the transcript to see if the source of the differences can be identified before proceeding to the phonetic or phonologic analyses. Later, in the discussion of the Percentage Consonants Correct (PCC) analysis, we will see that the PCC itself includes helpful quantitative information for decisions about the representativeness of a speech sample (see following discussion of the PCC Word Summary output).

A second interpretation of structural statistics data taken from the Y line is that they accurately reflect phonologic information about the speaker. It is not some lexical bias in a particular speech sample as above, but rather that the speaker is selectively producing or avoiding certain word forms. For example, children who have lowered proportions of multi-syllable words could be avoiding such word forms. Moreover, a comparison of the actual forms used in Z to the intended forms indicated in Y might suggest a pattern of word form substitutions. For example, if the proportion of obtained CVCs to intended CVCs is low when compared to the proportion of obtained versus intended CVs, the speaker may be substituting CV forms for CVCs.

Especially for severely involved children, data on word forms can be informative and useful. Descriptively, such data allow for statements about level or stage of phonologic development. These structural phonologic data also have been used to determine which of the ten word forms should and should not be used in constructing stimuli for management programming. Relevant issues have been discussed in the clinical literature on management of children with phonologic disorders.

#### Average Words per Utterance (AWU)

The Average Words per Utterance section of the Structural Statistics analysis consists of three numbers that describe the Pepfile transcript: total number of words, total number of utterances, and total number of words divided by total number of utterances. Pepfile entries for this section of Structural Statistics are taken exclusively from the Y line. All words entered in the Y line are used, even those represented in part or whole by an asterisk, i.e. unintelligibles. The rationale here is that whether or not the word was intelligible or questionable, it was a word intended by the speaker. In the Percentage of Consonants Correct (PCC) output described later, information is provided that quantifies each of the questionable word categories included as 'words' in the AWU calculation. When computed for a grouped file, the Average Words per Utterance reflects the total of the average values divided by the number of Pepfiles in the group. Hence, each Pepfile contributes equally to the group average.

The AWU provides a measure of average total 'words' per utterance, even if some words were unintelligible to the transcriber. In previous work with this metric, it has correlated highly (high .90's) with Mean Length of Utterance (MLU). However, the high positive relationship between the two indices depends on how frequently AWU includes words that would not be included in an MLU count. As a structural statistic, AWU reflects the sampling context and the nature of the speech sample. For serial study of the same child, for example, you may want to require that samples have comparable AWUs before

proceeding to inspect the results of other analyses. Children with intelligibility problems may deliberately reduce their utterance length to help listeners understand them. Therefore, as with the other structural statistics, AWU may reflect either something about a particular sampling context or something stable about the speaker.

### Type-Token Percentage (TTP)

The Type-Token Percentage (TTP) describes the percentage of word types in the speech sample. Following conventional use of these terms, a word type is a specific lexical item, whereas tokens, including all repetitions of word types, are all words in a sample. The first occurrence of a non-questionable word in the X line is considered a word type, and all non-questionable words are considered word tokens. Note that the program cannot differentiate words on the basis of their constituent morphemes, so *cat* and *cats* would each be considered a word type the first time they occurred in the sample. The program does ignore case, however, so the words *Cat* and *cat* are considered the same word type. A grouped file percentage, as with Average Words per Utterance, is calculated by summing the individual percentages and dividing by the number of Pepfiles in the grouped file. Hence, each Pepfile contributes equally to the group average percentage. As with the other Structural Statistics output, TTP can also be used to qualify a speech sample for further analysis. Does the TTP obtained suggest that the sample is biased--or does it reflect something about the speaker's typical distribution of word types? If the percentage of word types is too low, the sample might be unrepresentative either due to many word repetitions or because the sample continued too long on the same topic. Recall that the "90-70-225 rule" ([PG2](#)) for speech sampling was derived to obtain samples that were neither too short nor too long. In conjunction with the Word Lists output discussed later, you can quickly determine the source of a type-token percentage that appears to be either too low or too high.

**PEPPER\_PepAnalyses tab:**

**PepAssess > Analyses > Phoneme Analyses > Vowel/Diphthong Analyses**

The outputs that comprise the Phoneme Analyses options in PepAssess provide comprehensive summaries of a speaker's speech errors. The error categories are those typically used in describing the articulation of speech sounds with reference to a normative standard. The outputs include separate tabulations for correct sounds by error types, error positions, and phonetic features. Other PepAssess outputs provide word lists aggregated by user interests.

In the following heading and all other headings in this section, we use the current titles found within the PEPPER menu.

Vowel/Diphthong Analyses\_Phonemes

Filename \_\_\_\_\_ Group \_\_\_\_\_ SPEECHDELAY \_\_\_\_\_ Sampling Date \_\_\_\_\_ \*  
 Date of Birth \_\_\_\_\_ \* Sampling Clinician \_\_\_\_\_ \*  
 Age at Sampling Date \_\_\_\_\_ 0 yrs 0 mos Analysis Date \_\_\_\_\_

Sound	Position In Word	Correct N %	Deletion N %	Substitution N %	Distortion N %	Total Sounds
i	Initial	24 100.00				24
	Medial	170 93.92		5 2.76	6 3.31	181
	Final	278 95.53		5 1.72	8 2.75	291
	Total	472 95.16		10 2.02	14 2.82	496
I	Initial	272 93.79	2 0.69	14 4.83	2 0.69	290
	Medial	693 93.15	6 0.81	39 5.24	6 0.81	744
	Final	247 95.74		9 3.49	2 0.78	258
	Total	1212 93.81	8 0.62	62 4.80	10 0.77	1292
e	Initial					
	Medial					
	Final					
	Total					
ɛ	Initial	99 99.00		1 1.00		100
	Medial	401 89.71	1 0.22	40 8.95	5 1.12	447
	Final	8 100.00				8
	Total	508 91.53	1 0.18	41 7.39	5 0.90	555
æ	Initial	230 89.84		26 10.16		256
	Medial	322 92.00		28 8.00		350
	Final	97 97.00			3 3.00	100
	Total	649 91.93		54 7.65	3 0.42	706
3	Initial					
	Medial					
	Final					
	Total					
ʊ	Initial	1 33.33			2 66.67	3
	Medial	19 25.00		17 22.37	40 52.63	76
	Final	14 29.17		9 18.75	25 52.08	48
	Total	34 26.77		26 20.47	67 52.76	127
ə	Initial	231 96.65	3 1.26	4 1.67	1 0.42	239
	Medial	90 90.00	5 5.00	5 5.00		100
	Final	161 95.83		7 4.17		168
	Total	482 95.07	8 1.58	16 3.16	1 0.20	507
ɔ	Initial				1 100.00	1
	Medial	11 20.75	2 3.77	14 26.42	26 49.06	53
	Final	32 18.50	1 0.58	104 60.12	36 20.81	173
	Total	43 18.94	3 1.32	118 51.98	63 27.75	227
ʌ	Initial	59 86.76		7 10.29	2 2.94	68
	Medial	474 92.76	2 0.39	32 6.26	3 0.59	511
	Final	60 96.77		2 3.23		62
	Total	593 92.51	2 0.31	41 6.40	5 0.78	641
a	Initial					
	Medial					
	Final					
	Total					



Filename \_\_\_\_\_ Group \_\_\_\_\_ SPEECHDELAY \_\_\_\_\_ Sampling Date \_\_\_\_\_ \*  
 Date of Birth \_\_\_\_\_ \* Sampling Clinician \_\_\_\_\_ \*  
 Age at Sampling Date \_\_\_\_\_ 0 yrs 0 mos Analysis Date \_\_\_\_\_

Sound	Position In Word	Correct N %	Deletion N %	Substitution N %	Distortion N %	Total Sounds
U	Initial	1 100.00				1
	Medial	112 78.87		29 20.42	1 0.70	142
	Final	201 92.63		8 3.69	8 3.69	217
	Total	314 87.22		37 10.28	9 2.50	360
u	Initial					
	Medial	35 77.78		10 22.22		45
	Final	13 100.00				13
	Total	48 82.76		10 17.24		58
O	Initial	1 100.00				1
	Medial	4 100.00				4
	Final	1 100.00				1
	Total	6 100.00				6
o	Initial	40 88.89		5 11.11		45
	Medial	173 90.10		18 9.38	1 0.52	192
	Final	14 100.00				14
	Total	227 90.44		23 9.16	1 0.40	251
D	Initial					
	Medial					
	Final					
	Total					
d	Initial	71 94.67		3 4.00	1 1.33	75
	Medial	296 93.38		19 5.99	2 0.63	317
	Final	6 100.00				6
	Total	373 93.72		22 5.53	3 0.75	398
aI	Initial	310 93.09		21 6.31	2 0.60	333
	Medial	274 92.57		22 7.43		296
	Final	178 95.19		6 3.21	3 1.60	187
	Total	762 93.38		49 6.00	5 0.61	816
au	Initial	37 84.09		7 15.91		44
	Medial	54 90.00		5 8.33	1 1.67	60
	Final	23 85.19		4 14.81		27
	Total	114 87.02		16 12.21	1 0.76	131
eI	Initial	15 93.75			1 6.25	16
	Medial	124 91.18		12 8.82		136
	Final	130 89.66		12 8.28	3 2.07	145
	Total	269 90.57		24 8.08	4 1.35	297
ou	Initial	52 100.00				52
	Medial	139 95.21		7 4.79		146
	Final	204 90.27	1 0.44	19 8.41	2 0.88	226
	Total	395 93.16	1 0.24	26 6.13	2 0.47	424
oi	Initial					
	Medial	14 93.33		1 6.67		15
	Final	5 55.56		3 33.33	1 11.11	9
	Total	19 79.17		4 16.67	1 4.17	24

Filename \_\_\_\_\_ Group SPEECHDELAY Sampling Date \_\_\_\_\_ \*

Date of Birth \_\_\_\_\_ \* Sampling Clinician \_\_\_\_\_ \*

Age at Sampling Date \_\_\_\_\_ 0 yrs 0 mos Analysis Date \_\_\_\_\_

Sound	Position In Word	Correct N %	Deletion N %	Substitution N %	Distortion N %	Total Sounds
Total Row %	Initial	1443 93.22	5 0.32	88 5.68	12 0.78	1548
	Medial	3405 89.25	16 0.42	303 7.94	91 2.39	3815
	Final	1672 85.61	2 0.10	188 9.63	91 4.66	1953
	Total	6520 89.12	23 0.31	579 7.91	194 2.65	7316
Total Col %	Initial	1443 22.13	5 21.74	88 15.20	12 6.19	1548
	Medial	3405 52.22	16 69.57	303 52.33	91 46.91	3815
	Final	1672 25.64	2 8.70	188 32.47	91 46.91	1953
	Total	6520 100.00	23 100.00	579 100.00	194 100.00	7316
Total Sum %	Initial	1443 19.72	5 0.07	88 1.20	12 0.16	1548
	Medial	3405 46.54	16 0.22	303 4.14	91 1.24	3815
	Final	1672 22.85	2 0.03	188 2.57	91 1.24	1953
	Total	6520 89.12	23 0.31	579 7.91	194 2.65	7316

Notes:

The format for the Phoneme Analysis: Vowels is similar to that for the Phoneme Analysis: Consonants. The twelve vowels are sequenced by place (front, mid, back), with vowel height arranged from high to low within each class. The five diphthongs are not ordered by place. Totals for each vowel and diphthong are given in percentages in the same way as described for consonants. Also, the three summary totals are percentaged by row, by column, and for each row x column cell. Initial and final vowels or diphthongs must be the first and last segment in the word, respectively. All other vowels or diphthongs are medial. Only sounds in non-questionable words are entered into the calculations.

Vowel/Diphthong Analyses\_Features

## FEATURE ANALYSIS: VOWELS

Page: 1

Filename \_\_\_\_\_ Group SPEECHDELAY Sampling Date \_\_\_\_\_ \*  
 Date of Birth \_\_\_\_\_ \* Sampling Clinician \_\_\_\_\_ \*  
 Age at Sampling Date 0 yrs 0 mos Analysis Date \_\_\_\_\_

Feature	Position In Word	Correct N %	Deletion N %	Substitution N %	Distortion N %	Total Sounds
Height	Initial	25 100.00				25
HIGH	Medial	282 87.31		34 10.53	7 2.17	323
	Final	479 94.29		13 2.56	16 3.15	508
	Total	786 91.82		47 5.49	23 2.69	856
MIDDLE	Initial	770 94.48	5 0.61	31 3.80	9 1.10	815
	Medial	2177 88.17	16 0.65	195 7.90	81 3.28	2469
	Final	889 79.02	2 0.18	165 14.67	69 6.13	1125
	Total	3836 87.00	23 0.52	391 8.87	159 3.61	4409
LOW	Initial	648 91.53		57 8.05	3 0.42	708
	Medial	946 92.47		74 7.23	3 0.29	1023
	Final	304 95.00		10 3.13	6 1.88	320
	Total	1898 92.54		141 6.87	12 0.59	2051
Place	Initial	640 93.29	2 0.29	41 5.98	3 0.44	686
FRONT	Medial	1710 92.03	7 0.38	124 6.67	17 0.91	1858
	Final	760 94.76		26 3.24	16 2.00	802
	Total	3110 92.95	9 0.27	191 5.71	36 1.08	3346
CENTRAL	Initial	291 93.57	3 0.96	11 3.54	6 1.93	311
	Medial	594 80.27	9 1.22	68 9.19	69 9.32	740
	Final	267 59.20	1 0.22	122 27.05	61 13.53	451
	Total	1152 76.70	13 0.87	201 13.38	136 9.05	1502
BACK	Initial	512 92.92		36 6.53	3 0.54	551
	Medial	1101 90.47		111 9.12	5 0.41	1217
	Final	645 92.14	1 0.14	40 5.71	14 2.00	700
	Total	2258 91.49	1 0.04	187 7.58	22 0.89	2468

## Substitution Summary (In decreasing percentage of occurrence)

Within- and Across-Class Substitutions			Total Occurrence	Total Possible	Percentage Occurrence
Middle	-> Middle		314	4409	7.12%
Central	-> Back		89	1502	5.93%
High	-> Middle		46	856	5.37%
Low	-> Middle		84	2051	4.10%
Central	-> Central		55	1502	3.66%
Back	-> Back		89	2468	3.61%
Front	-> Front		104	3346	3.11%
Central	-> Front		46	1502	3.06%
Low	-> Low		50	2051	2.44%
Back	-> Central		51	2468	2.07%
Back	-> Front		38	2468	1.54%
Front	-> Central		49	3346	1.46%
Front	-> Back		33	3346	0.99%
Middle	-> Low		39	4409	0.88%
Middle	-> High		21	4409	0.48%
Vowel	-> Synchronic		17	7316	0.23%
Vowel	-> Consonant		8	7316	0.11%

Filename \_\_\_\_\_ Group **SPEECHDELAY** Sampling Date \_\_\_\_\_ \*

Date of Birth \_\_\_\_\_ \* Sampling Clinician \_\_\_\_\_ \*

Age at Sampling Date \_\_\_\_\_ 0 yrs 0 mos Analysis Date \_\_\_\_\_

		Obtained		
Height		HIGH	MIDDLE	LOW
Intended	HIGH		46 of = % 47 97.87 856 5.37	
	MIDDLE	21 of = % 391 5.37 4409 0.48	314 of = % 391 80.31 4409 7.12	39 of = % 391 9.97 4409 0.88
	LOW		84 of = % 141 59.57 2051 4.10	50 of = % 141 35.46 2051 2.44

		Obtained		
Place		FRONT	CENTRAL	BACK
Intended	FRONT	104 of = % 191 54.45 3346 3.11	49 of = % 191 25.65 3346 1.46	33 of = % 191 17.28 3346 0.99
	CENTRAL	46 of = % 201 22.89 1502 3.06	55 of = % 201 27.36 1502 3.66	89 of = % 201 44.28 1502 5.93
	BACK	38 of = % 187 20.32 2468 1.54	51 of = % 187 27.27 2468 2.07	89 of = % 187 47.59 2468 3.61

		Obtained	
Intended	Other	Conso- nant	Tie
	Vowel	8 of = % 579 1.38 7316 0.11	17 of = % 579 2.94 7316 0.23

The format for the Feature Analyses: Vowel is similar to that used in Feature Analysis: Consonants. As in the Feature Analysis: Consonants, only sound substitution errors are included, with summaries provided for each substitution as tabulated by feature class. Substitutions of diphthongs or vowels are printed to the right of the arrow. Place-height description of the 16 vowels are computed and displayed. The computer program calculates the percentage of occurrence of vowel feature substitutions for all non-questionable sounds and provides a ranked list of all feature substitutions that occurred at least once.

**PEPPER\_PepAnalyses tab:**

**PepAssess > Analyses > Phoneme Analyses > Consonant Analyses**

Percentage Consonants Correct and Percentage of Consonants Correct-Split

PERCENTAGE CONSONANTS CORRECT (PCC)

Child            Group            SPEECHDELAY  
 Study Identification MADSD  
 DOB \*  
 Age at Sampling Date 0 mos  
 Sampling Date \*  
 Sampling Clinician \*  
 Pepfile Entry Date \*

Severity Adjective:

<u>PCC</u>	<u>Adjective</u>
>86%	Mild
66%-85%	Mild-Moderate
50%-65%	Moderate-Severe
<49%	Severe

Key:

+ Correct

- Incorrect

Consonant		Initial		Medial		Final		Consonants		Percentage Consonants	
Class	Sound	+	-	+	-	+	-	Correct	Total	Occurrence	Correct
Nasals	m	398	4	169	9	262	21	829	863	7.93	96.06
	n	339	12	153	41	754	155	1246	1454	13.37	85.69
	ŋ	0	0	11	5	38	16	49	70	0.64	70.00
Glides	w	408	60	20	1	0	0	428	489	4.50	87.53
	j	218	20	2	1	0	0	220	241	2.22	91.29
Stops	p	159	18	40	10	67	5	266	299	2.75	88.96
	b	388	10	77	11	3	0	468	489	4.50	95.71
	t	237	62	134	91	481	340	852	1345	12.36	63.35
	d	235	15	107	38	159	71	501	625	5.75	80.16
	k	150	104	72	57	138	94	360	615	5.65	58.54
	g	162	96	34	14	49	29	245	384	3.53	63.80
Fricatives and Affricates	f	135	20	28	13	25	5	188	226	2.08	83.19
	v	4	3	41	5	71	34	116	158	1.45	73.42
	θ	6	44	11	21	9	39	26	130	1.20	20.00
	ð	108	239	7	31	0	0	115	385	3.54	29.87
	s	137	163	85	77	212	138	434	812	7.46	53.45
	z	2	1	12	18	185	184	199	402	3.70	49.50
	ʃ	2	31	6	15	7	16	15	77	0.71	19.48
	ʒ	0	0	2	1	0	0	2	3	0.03	66.67
	h	226	53	60	0	0	0	286	339	3.12	84.37
	tʃ	6	10	1	11	8	19	15	55	0.51	27.27
Liquids	ɫ	20	56	4	6	1	5	25	92	0.85	27.17
	l	85	196	67	72	83	158	235	661	6.08	35.55
Percent Correct	r	68	246	28	107	51	164	147	664	6.10	22.14
		70.48		64.13		63.55		7267	10878		
								Correct	Total		

Word Coding Summary	N	%
"Words" entered	9014	100.00
"Words" used	6130	68.01
Disregard	1910	21.19
Either/Or	10	0.11
Unsure	262	2.91
Unintelligible	702	7.79
INTELLIGIBILITY INDEX		86.29

66.80

Percentage  
Consonants  
Correct  
(PCC)

Severity Adjective

MILD-MODERATE



PERCENTAGE CONSONANTS CORRECT - SPLIT (PCCS)

Child            Group SPEECHDELAY  
 Study Identification MADSD  
 DOB \*  
 Age at Sampling Date 0 mos  
 Sampling Date \*  
 Sampling Clinician \*  
 Pepfile Entry Date \*

Severity Adjective:

<u>PCC</u>	<u>Adjective</u>
>86%	Mild
66%-85%	Mild-Moderate
50%-65%	Moderate-Severe
<49%	Severe

Key:

+ Correct

- Incorrect

Consonant Class	Consonant Sound	Initial				Medial				Final			
		Single		Cluster		Single		Cluster		Single		Cluster	
		+	-	+	-	+	-	+	-	+	-	+	-
Nasals	m	390	4	8	0	83	4	86	5	223	19	39	2
	n	325	10	14	2	70	22	83	19	618	120	136	35
	ŋ	0	0	0	0	0	0	11	5	18	12	20	4
Glides	w	395	52	13	8	10	1	10	0	0	0	0	0
	j	217	20	1	0	0	0	2	1	0	0	0	0
Stops	p	89	3	70	15	24	3	16	7	56	4	11	1
	b	328	7	60	3	50	3	27	8	3	0	0	0
	t	199	37	38	25	47	30	87	61	352	259	129	81
	d	220	14	15	1	49	14	58	24	112	50	47	21
	k	117	75	33	29	44	14	28	43	98	73	40	21
	g	152	78	10	18	29	9	5	5	45	27	4	2
Fricatives and Affricates	f	113	16	22	4	8	5	20	8	13	5	12	0
	v	4	3	0	0	32	2	9	3	66	33	5	1
	θ	4	18	2	26	5	3	6	18	9	39	0	0
	ð	108	239	0	0	7	31	0	0	0	0	0	0
	s	77	75	60	88	24	19	61	58	119	70	93	68
	z	2	1	0	0	10	7	2	11	122	130	63	54
	ʃ	2	31	0	0	5	13	1	2	7	16	0	0
	ʒ	0	0	0	0	2	1	0	0	0	0	0	0
	h	226	53	0	0	23	0	37	0	0	0	0	0
	tʃ	6	10	0	0	1	11	0	0	5	16	3	3
Liquids	ɫ	20	56	0	0	2	3	2	3	1	5	0	0
	l	55	101	30	95	36	33	31	39	69	122	14	36
	r	21	87	47	159	8	39	20	68	39	126	12	38
Percent Correct		75.62		47.21		68.06		60.81		63.69		63.12	

Consonant Class	Consonant Sound	Number of Consonants Correct		Total Number of Consonants		Percentage Consonants Correct	
		Single	Cluster	Single	Cluster	Single	Cluster
Nasals	m	696	133	723	140	96.27	95.00
	n	1013	233	1165	289	86.95	80.62
	ŋ	18	31	30	40	60.00	77.50
Glides	w	405	23	458	31	88.43	74.19
	j	217	3	237	4	91.56	75.00
Stops	p	169	97	179	120	94.41	80.83
	b	381	87	391	98	97.44	88.78
	t	598	254	924	421	64.72	60.33
	d	381	120	459	166	83.01	72.29
	k	259	101	421	194	61.52	52.06
	g	226	19	340	44	66.47	43.18
Fricatives and Affricates	f	134	54	160	66	83.75	81.82
	v	102	14	140	18	72.86	77.78
	θ	18	8	78	52	23.08	15.38
	ð	115	0	385	0	29.87	*
	s	220	214	384	428	57.29	50.00
	z	134	65	272	130	49.26	50.00
	ʃ	14	1	74	3	18.92	33.33
	ʒ	2	0	3	0	66.67	*
	h	249	37	302	37	82.45	100.00
	tʃ	12	3	49	6	24.49	50.00
	dʒ	23	2	87	5	26.44	40.00
Liquids	l	160	75	416	245	38.46	30.61
	r	68	79	320	344	21.25	22.97
		5614	1653	7997	2881	70.20	57.38

Single   Cluster  
Number of  
Consonants  
Correct

Single   Cluster  
Total Number  
of  
Consonants

Single   Cluster  
Percentage  
Consonants  
Correct  
(PCCS)

Total "words" entered   9014  
Total "words" used   6130  
Percent "words" used   68.01

Single

MILD-MODERATE

Cluster

MODERATE-SEVERE

## MONOSYLLABLE WORDS

	Number of Consonants Correct	Total Number of Consonants	Percentage Consonants Correct
Single	Initial: 2499	Initial: 3311	Initial: 75.48
	Final: 1683	Final: 2626	Final: 64.09
	Total: 4182	Total: 5937	Total: 70.44
Cluster	Initial: 259	Initial: 584	Initial: 44.35
	Final: 500	Final: 765	Final: 65.36
	Total: 759	Total: 1349	Total: 56.26
Total	Initial: 2758	Initial: 3895	Initial: 70.81
	Final: 2183	Final: 3391	Final: 64.38
	Total: 4941	Total: 7286	Total: 67.81

## MULTISYLLABLE WORDS

	Number of Consonants Correct	Total Number of Consonants	Percentage Consonants Correct
Single	Initial: 571	Initial: 749	Initial: 76.23
	Medial: 569	Medial: 836	Medial: 68.06
	Final: 292	Final: 475	Final: 61.47
	Total: 1432	Total: 2060	Total: 69.51
Cluster	Initial: 164	Initial: 312	Initial: 52.56
	Medial: 602	Medial: 990	Medial: 60.81
	Final: 128	Final: 230	Final: 55.65
	Total: 894	Total: 1532	Total: 58.36
Total	Initial: 735	Initial: 1061	Initial: 69.27
	Medial: 1171	Medial: 1826	Medial: 64.13
	Final: 420	Final: 705	Final: 59.57
	Total: 2326	Total: 3592	Total: 64.76

Notes: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

PEPPER Guide 1 includes information on conversational speech sampling for the purposes of PCC and other speech, prosody, and voice analyses. The sample PCC and PCC-Split outputs are two formats that have been used for individual and group PCC data. It is important to keep in mind when formatting a Pepfile for PCC analyses that all Y-Z sound correspondences are inspected, except for sounds that occur in a word that is either questionable in the X line (a disregard or either/or word), or partially questionable in the X line (at least one segment in the word is an unsure or at least one syllable is 'unintelligible'), or sounds in the Z-line that are unsure.

The PCC output provides a Word Coding Summary, including an Intelligibility Index at the bottom of the form. The Intelligibility Index results from the following steps: (1) subtract from the total number of 'words' in the sample, all disregard words in the X line, (2) subtract from this result, the total of all either/or, unsure, and unintelligible words, and (3) divide (2) by (1) and multiply by 100. Essentially, the Intelligibility Index is based on the percentage of intelligible words, with disregards (fillers, false starts, repeated words, etc.) removed from both the numerator and the denominator.

The three-page output for the PCC-Split provides more detail than provided in the PCC analyses. Percentage of Consonants Correct information is tabled separately for each sound as it occurs as a singleton or as part of a cluster, by word position, and by monosyllable and multi-syllable words.

Consonant Analyses\_Phonemes

Filename \_\_\_\_\_ Group \_\_\_\_\_ SPEECHDELAY \_\_\_\_\_ Sampling Date \_\_\_\_\_ \*  
 Date of Birth \_\_\_\_\_ \* Sampling Clinician \_\_\_\_\_ \*  
 Age at Sampling Date \_\_\_\_\_ 0 yrs 0 mos Analysis Date \_\_\_\_\_

Sound	Position In Word	Correct N %	Deletion N %	Substitution N %	Distortion N %	Total Sounds
m	Initial	398 99.00	1 0.25	2 0.50	1 0.25	402
	Medial	169 94.94	1 0.56	7 3.93	1 0.56	178
	Final	262 92.58	6 2.12	9 3.18	6 2.12	283
	Total	829 96.06	8 0.93	18 2.09	8 0.93	863
n	Initial	339 96.58	1 0.28	8 2.28	3 0.85	351
	Medial	153 78.87	32 16.49	8 4.12	1 0.52	194
	Final	754 82.95	109 11.99	39 4.29	7 0.77	909
	Total	1246 85.69	142 9.77	55 3.78	11 0.76	1454
ŋ	Initial					
	Medial	11 68.75	3 18.75	2 12.50		16
	Final	38 70.37	11 20.37	5 9.26		54
	Total	49 70.00	14 20.00	7 10.00		70
w	Initial	408 87.18	11 2.35	18 3.85	31 6.62	468
	Medial	20 95.24		1 4.76		21
	Final					
	Total	428 87.53	11 2.25	19 3.89	31 6.34	489
j	Initial	218 91.60	5 2.10	10 4.20	5 2.10	238
	Medial	2 66.67	1 33.33			3
	Final					
	Total	220 91.29	6 2.49	10 4.15	5 2.07	241
p	Initial	159 89.83	3 1.69	5 2.82	10 5.65	177
	Medial	40 80.00	4 8.00	5 10.00	1 2.00	50
	Final	67 93.06	2 2.78	3 4.17		72
	Total	266 88.96	9 3.01	13 4.35	11 3.68	299
b	Initial	388 97.49	3 0.75	5 1.26	2 0.50	398
	Medial	77 87.50	2 2.27	8 9.09	1 1.14	88
	Final	3 100.00				3
	Total	468 95.71	5 1.02	13 2.66	3 0.61	489
t	Initial	237 79.26	18 6.02	24 8.03	20 6.69	299
	Medial	134 59.56	53 23.56	35 15.56	3 1.33	225
	Final	481 58.59	227 27.65	111 13.52	2 0.24	821
	Total	852 63.35	298 22.16	170 12.64	25 1.86	1345
d	Initial	235 94.00	5 2.00	10 4.00		250
	Medial	107 73.79	19 13.10	19 13.10		145
	Final	159 69.13	44 19.13	26 11.30	1 0.43	230
	Total	501 80.16	68 10.88	55 8.80	1 0.16	625
k	Initial	150 59.06	7 2.76	94 37.01	3 1.18	254
	Medial	72 55.81	18 13.95	38 29.46	1 0.78	129
	Final	138 59.48	41 17.67	52 22.41	1 0.43	232
	Total	360 58.54	66 10.73	184 29.92	5 0.81	615
g	Initial	162 62.79	9 3.49	85 32.95	2 0.78	258
	Medial	34 70.83	4 8.33	10 20.83		48
	Final	49 62.82	10 12.82	18 23.08	1 1.28	78
	Total	245 63.80	23 5.99	113 29.43	3 0.78	384

Filename \_\_\_\_\_ Group \_\_\_\_\_ SPEECHDELAY \_\_\_\_\_ Sampling Date \_\_\_\_\_ \*  
 Date of Birth \_\_\_\_\_ \* Sampling Clinician \_\_\_\_\_ \*  
 Age at Sampling Date \_\_\_\_\_ 0 yrs 0 mos Analysis Date \_\_\_\_\_

Sound	Position In Word	Correct N %	Deletion N %	Substitution N %	Distortion N %	Total Sounds
f	Initial	135 87.10		18 11.61	2 1.29	155
	Medial	28 68.29	2 4.88	11 26.83		41
	Final	25 83.33		5 16.67		30
	Total	188 83.19	2 0.88	34 15.04	2 0.88	226
v	Initial	4 57.14		3 42.86		7
	Medial	41 89.13		5 10.87		46
	Final	71 67.62	26 24.76	8 7.62		105
	Total	116 73.42	26 16.46	16 10.13		158
θ	Initial	6 12.00	5 10.00	39 78.00		50
	Medial	11 34.38	3 9.38	17 53.13	1 3.13	32
	Final	9 18.75	7 14.58	32 66.67		48
	Total	26 20.00	15 11.54	88 67.69	1 0.77	130
ð	Initial	108 31.12	11 3.17	224 64.55	4 1.15	347
	Medial	7 18.42	4 10.53	24 63.16	3 7.89	38
	Final					
	Total	115 29.87	15 3.90	248 64.42	7 1.82	385
s	Initial	137 45.67	47 15.67	62 20.67	54 18.00	300
	Medial	85 52.47	14 8.64	32 19.75	31 19.14	162
	Final	212 60.57	19 5.43	36 10.29	83 23.71	350
	Total	434 53.45	80 9.85	130 16.01	168 20.69	812
z	Initial	2 66.67		1 33.33		3
	Medial	12 40.00	5 16.67	6 20.00	7 23.33	30
	Final	185 50.14	17 4.61	69 18.70	98 26.56	369
	Total	199 49.50	22 5.47	76 18.91	105 26.12	402
ʃ	Initial	2 6.06	4 12.12	24 72.73	3 9.09	33
	Medial	6 28.57		12 57.14	3 14.29	21
	Final	7 30.43	1 4.35	13 56.52	2 8.70	23
	Total	15 19.48	5 6.49	49 63.64	8 10.39	77
ʒ	Initial					
	Medial	2 66.67		1 33.33		3
	Final					
	Total	2 66.67		1 33.33		3
h	Initial	226 81.00	44 15.77	4 1.43	5 1.79	279
	Medial	60 100.00				60
	Final					
	Total	286 84.37	44 12.98	4 1.18	5 1.47	339
tʃ	Initial	6 37.50		10 62.50		16
	Medial	1 8.33		9 75.00	2 16.67	12
	Final	8 29.63		19 70.37		27
	Total	15 27.27		38 69.09	2 3.64	55
dʒ	Initial	20 26.32	5 6.58	51 67.11		76
	Medial	4 40.00		6 60.00		10
	Final	1 16.67		5 83.33		6
	Total	25 27.17	5 5.43	62 67.39		92

Filename
Group
SPEECHDELAY
Sampling Date
\*
  
Date of Birth
\*
Sampling Clinician
\*
  
Age at Sampling Date
0 yrs 0 mos
Analysis Date

Sound	Position In Word	Correct N %	Deletion N %	Substitution N %	Distortion N %	Total Sounds
l	Initial	85 30.25	55 19.57	98 34.88	43 15.30	281
	Medial	67 48.20	24 17.27	31 22.30	17 12.23	139
	Final	83 34.44	49 20.33	97 40.25	12 4.98	241
	Total	235 35.55	128 19.36	226 34.19	72 10.89	661
r	Initial	68 21.66	88 28.03	30 9.55	128 40.76	314
	Medial	28 20.74	31 22.96	16 11.85	60 44.44	135
	Final	51 23.72	52 24.19	49 22.79	63 29.30	215
	Total	147 22.14	171 25.75	95 14.31	251 37.80	664
Total Row %	Initial	3493 70.48	322 6.50	825 16.65	316 6.38	4956
	Medial	1171 64.13	220 12.05	303 16.59	132 7.23	1826
	Final	2603 63.55	621 15.16	596 14.55	276 6.74	4096
	Total	7267 66.80	1163 10.69	1724 15.85	724 6.66	10878
Total Col %	Initial	3493 48.07	322 27.69	825 47.85	316 43.65	4956
	Medial	1171 16.11	220 18.92	303 17.58	132 18.23	1826
	Final	2603 35.82	621 53.40	596 34.57	276 38.12	4096
	Total	7267 100.00	1163 100.00	1724 100.00	724 100.00	10878
Total Sum %	Initial	3493 32.11	322 2.96	825 7.58	316 2.90	4956
	Medial	1171 10.76	220 2.02	303 2.79	132 1.21	1826
	Final	2603 23.93	621 5.71	596 5.48	276 2.54	4096
	Total	7267 66.80	1163 10.69	1724 15.85	724 6.66	10878

Notes:

The sample analysis output titled Phoneme Analysis: Consonants can be run on any type of speech behavior. It is perfectly appropriate to run Arctic Test analyses on speech samples consisting of syllables, phrases, sentences or utterances from continuous speech. The only restriction for the analysis to be computed is that each 'word' must contain a vowel. The four columns in the output provide number and percentage data for correct and incorrect segments. The 24 consonants are classified by manner, with place features within each class progressing anterior to posterior in the vocal tract, that is, from the lips to the glottis. The order of manner classes is consistent with most normative data on consonant acquisition. Summary percentages are given for consonants across each row. The three summary total areas are percentaged in three alternatives ways: by row, by column, and for each row x column cell. Only those sounds occurring in non-questionable words are entered into the computations.

#### Consonant Analyses\_Features



FEATURE ANALYSIS: CONSONANTS

Page: 1

Filename \_\_\_\_\_ Group \_\_\_\_\_ SPEECHDELAY \_\_\_\_\_ Sampling Date \_\_\_\_\_ \*  
 Date of Birth \_\_\_\_\_ \* Sampling Clinician \_\_\_\_\_ \*  
 Age at Sampling Date \_\_\_\_\_ 0 yrs 0 mos Analysis Date \_\_\_\_\_

Feature	Position In Word	Correct N %	Deletion N %	Substitution N %	Distortion N %	Total Sounds
Class	Initial	1516 73.81	161 7.84	166 8.08	211 10.27	2054
Sonor- ant	Medial	450 65.60	92 13.41	65 9.48	79 11.52	686
	Final	1188 69.80	227 13.34	199 11.69	88 5.17	1702
	Total	3154 71.00	480 10.81	430 9.68	378 8.51	4442
Obstru- ent	Initial	1977 68.13	161 5.55	659 22.71	105 3.62	2902
	Medial	721 63.25	128 11.23	238 20.88	53 4.65	1140
	Final	1415 59.11	394 16.46	397 16.58	188 7.85	2394
	Total	4113 63.91	683 10.61	1294 20.11	346 5.38	6436
Voice	Initial	2435 71.77	194 5.72	545 16.06	219 6.45	3393
Voiced	Medial	734 67.09	126 11.52	144 13.16	90 8.23	1094
	Final	1656 66.43	324 13.00	325 13.04	188 7.54	2493
	Total	4825 69.13	644 9.23	1014 14.53	497 7.12	6980
Voice- less	Initial	1058 67.69	128 8.19	280 17.91	97 6.21	1563
	Medial	437 59.70	94 12.84	159 21.72	42 5.74	732
	Final	947 59.08	297 18.53	271 16.91	88 5.49	1603
	Total	2442 62.65	519 13.31	710 18.21	227 5.82	3898
Manner	Initial	737 97.88	2 0.27	10 1.33	4 0.53	753
Nasal	Medial	333 85.82	36 9.28	17 4.38	2 0.52	388
	Final	1054 84.59	126 10.11	53 4.25	13 1.04	1246
	Total	2124 88.98	164 6.87	80 3.35	19 0.80	2387
Glide	Initial	626 88.67	16 2.27	28 3.97	36 5.10	706
	Medial	22 91.67	1 4.17	1 4.17		24
	Final					
	Total	648 88.77	17 2.33	29 3.97	36 4.93	730
Stop	Initial	1331 81.36	45 2.75	223 13.63	37 2.26	1636
	Medial	464 67.74	100 14.60	115 16.79	6 0.88	685
	Final	897 62.47	324 22.56	210 14.62	5 0.35	1436
	Total	2692 71.65	469 12.48	548 14.59	48 1.28	3757
Frica- tive	Initial	620 52.81	111 9.45	375 31.94	68 5.79	1174
	Medial	252 58.20	28 6.47	108 24.94	45 10.39	433
	Final	509 55.03	70 7.57	163 17.62	183 19.78	925
	Total	1381 54.54	209 8.25	646 25.51	296 11.69	2532
Affri- cate	Initial	26 28.26	5 5.43	61 66.30		92
	Medial	5 22.73		15 68.18	2 9.09	22
	Final	9 27.27		24 72.73		33
	Total	40 27.21	5 3.40	100 68.03	2 1.36	147
Liquid	Initial	153 25.71	143 24.03	128 21.51	171 28.74	595
	Medial	95 34.67	55 20.07	47 17.15	77 28.10	274
	Final	134 29.39	101 22.15	146 32.02	75 16.45	456
	Total	382 28.83	299 22.57	321 24.23	323 24.38	1325

Filename \_\_\_\_\_ Group \_\_\_\_\_ SPEECHDELAY \_\_\_\_\_ Sampling Date \_\_\_\_\_ \*  
 Date of Birth \_\_\_\_\_ \* Sampling Clinician \_\_\_\_\_ \*  
 Age at Sampling Date \_\_\_\_\_ 0 yrs 0 mos Analysis Date \_\_\_\_\_

Feature	Position In Word	Correct N %	Deletion N %	Substitution N %	Distortion N %	Total Sounds
Place	Initial	1353 93.63	18 1.25	30 2.08	44 3.04	1445
Bilabi- al	Medial	306 90.80	7 2.08	21 6.23	3 0.89	337
	Final	332 92.74	8 2.23	12 3.35	6 1.68	358
	Total	1991 93.04	33 1.54	63 2.94	53 2.48	2140
Labio- dental	Initial	139 85.80		21 12.96	2 1.23	162
	Medial	69 79.31	2 2.30	16 18.39		87
	Final	96 71.11	26 19.26	13 9.63		135
	Total	304 79.17	28 7.29	50 13.02	2 0.52	384
Dental	Initial	114 28.72	16 4.03	263 66.25	4 1.01	397
	Medial	18 25.71	7 10.00	41 58.57	4 5.71	70
	Final	9 18.75	7 14.58	32 66.67		48
	Total	141 27.38	30 5.83	336 65.24	8 1.55	515
Alveo- lar	Initial	1035 69.74	126 8.49	203 13.68	120 8.09	1484
	Medial	558 62.35	147 16.42	131 14.64	59 6.59	895
	Final	1874 64.18	465 15.92	378 12.95	203 6.95	2920
	Total	3467 65.43	738 13.93	712 13.44	382 7.21	5299
Palatal	Initial	314 46.38	102 15.07	125 18.46	136 20.09	677
	Medial	43 23.37	32 17.39	44 23.91	65 35.33	184
	Final	67 24.72	53 19.56	86 31.73	65 23.99	271
	Total	424 37.46	187 16.52	255 22.53	266 23.50	1132
Velar	Initial	312 60.94	16 3.13	179 34.96	5 0.98	512
	Medial	117 60.62	25 12.95	50 25.91	1 0.52	193
	Final	225 61.81	62 17.03	75 20.60	2 0.55	364
	Total	654 61.18	103 9.64	304 28.44	8 0.75	1069
Glottal	Initial	226 81.00	44 15.77	4 1.43	5 1.79	279
	Medial	60 100.00				60
	Final					
	Total	286 84.37	44 12.98	4 1.18	5 1.47	339

## Substitution Summary (In decreasing percentage of occurrence)

Within- and Across- Class Substitutions	Total Occurrence	Total Possible	Percentage Occurrence
Dental -> Alveolar	267	515	51.84%
Affricative -> Stop	55	147	37.41%
Velar -> Alveolar	263	1069	24.60%
Obstruent -> Obstruent	1199	6436	18.63%
Unvoiced -> Unvoiced	559	3898	14.34%
Affricative -> Fricative	21	147	14.29%
Fricative -> Stop	353	2532	13.94%
Stop -> Stop	451	3757	12.00%
Voiced -> Voiced	718	6980	10.29%
Fricative -> Fricative	252	2532	9.95%
Palatal -> Alveolar	112	1132	9.89%
Liquid -> Glide	128	1325	9.66%
Dental -> Labiodental	44	515	8.54%

Filename	Group	SPEECHDELAY	Sampling Date	*
Date of Birth	*		Sampling Clinician	*
Age at Sampling Date	0 yrs 0 mos		Analysis Date	

## Substitution Summary (In decreasing percentage of occurrence)

Within- and Across-Class Substitutions	Total Occurrence	Total Possible	Percentage Occurrence
Labiodental -> Bilabial	21	384	5.47%
Sonorant -> Sonorant	213	4442	4.80%
Labiodental -> Alveolar	15	384	3.91%
Alveolar -> Alveolar	179	5299	3.38%
Palatal -> Bilabial	34	1132	3.00%
Unvoiced -> Voiced	114	3898	2.92%
Alveolar -> Bilabial	123	5299	2.32%
Alveolar -> Glottal	111	5299	2.09%
Nasal -> Nasal	50	2387	2.09%
Glide -> Liquid	14	730	1.92%
Labiodental -> Labiodental	7	384	1.82%
Voiced -> Unvoiced	110	6980	1.58%
Dental -> Glottal	8	515	1.55%
Dental -> Bilabial	8	515	1.55%
Consonant -> Pure Vowel	151	10878	1.39%
Stop -> Fricative	51	3757	1.36%
Alveolar -> Velar	66	5299	1.25%
Dental -> Velar	6	515	1.17%
Velar -> Glottal	12	1069	1.12%
Velar -> Velar	12	1069	1.12%
Sonorant -> Obstruent	46	4442	1.04%
Alveolar -> Dental	54	5299	1.02%
Palatal -> Palatal	10	1132	0.88%
Nasal -> Stop	20	2387	0.84%
Liquid -> Stop	11	1325	0.83%
Bilabial -> Bilabial	17	2140	0.79%
Labiodental -> Palatal	3	384	0.78%
Liquid -> Liquid	10	1325	0.75%
Liquid -> Fricative	9	1325	0.68%
Obstruent -> Sonorant	43	6436	0.67%
Alveolar -> Palatal	35	5299	0.66%
Fricative -> Glide	15	2532	0.59%
Glottal -> Glottal	2	339	0.59%
Dental -> Palatal	3	515	0.58%
Consonant -> Synchronic	61	10878	0.56%
Bilabial -> Alveolar	12	2140	0.56%
Glide -> Nasal	4	730	0.55%
Palatal -> Glottal	6	1132	0.53%
Palatal -> Dental	6	1132	0.53%
Labiodental -> Dental	2	384	0.52%
Bilabial -> Labiodental	10	2140	0.47%
Liquid -> Nasal	6	1325	0.45%
Palatal -> Velar	5	1132	0.44%

Filename Group SPEECHDELAY Sampling Date \*  
 Date of Birth \* Sampling Clinician \*  
 Age at Sampling Date 0 yrs 0 mos Analysis Date

Class		Obtained	
		Sonor- ant	Obstru- ent
Intended	Sonor- ant	213 of = % 430 49.53 4442 4.80	46 of = % 430 10.70 4442 1.04
Intended	Obstru- ent	43 of = % 1294 3.32 6436 0.67	1199 of = % 1294 92.66 6436 18.63

Voice		Obtained	
		Voiced	Voice- less
Intended	Voiced	718 of = % 1014 70.81 6980 10.29	110 of = % 1014 10.85 6980 1.58
Intended	Voice- less	114 of = % 710 16.06 3898 2.92	559 of = % 710 78.73 3898 14.34

Manner		Obtained					
		Nasal	Glide	Stop	Frica- tive	Affri- cate	Liquid
Intended	Nasal	50 of = % 80 62.50 2387 2.09	1 of = % 80 1.25 2387 0.04	20 of = % 80 25.00 2387 0.84	2 of = % 80 2.50 2387 0.08		
	Glide	4 of = % 29 13.79 730 0.55		1 of = % 29 3.45 730 0.14	3 of = % 29 10.34 730 0.41		14 of = % 29 48.28 730 1.92
Intended	Stop	12 of = % 548 2.19 3757 0.32	5 of = % 548 0.91 3757 0.13	451 of = % 548 82.30 3757 12.00	51 of = % 548 9.31 3757 1.36	10 of = % 548 1.82 3757 0.27	1 of = % 548 0.18 3757 0.03
	Frica- tive	4 of = % 646 0.62 2532 0.16	15 of = % 646 2.32 2532 0.59	353 of = % 646 54.64 2532 13.94	252 of = % 646 39.01 2532 9.95	6 of = % 646 0.93 2532 0.24	6 of = % 646 0.93 2532 0.24
Intended	Affri- cate			55 of = % 100 55.00 147 37.41	21 of = % 100 21.00 147 14.29		
	Liquid	6 of = % 321 1.87 1325 0.45	128 of = % 321 39.88 1325 9.66	11 of = % 321 3.43 1325 0.83	9 of = % 321 2.80 1325 0.68		10 of = % 321 3.12 1325 0.75

Place		Obtained						
		Bilabi- al	Labio- dental	Dental	Alveo- lar	Palatal	Velar	Glottal
Intended	Bilabi- al	17 of = % 63 26.98 2140 0.79	10 of = % 63 15.87 2140 0.47		12 of = % 63 19.05 2140 0.56	9 of = % 63 14.29 2140 0.42	4 of = % 63 6.35 2140 0.19	3 of = % 63 4.76 2140 0.14
	Labio- dental	21 of = % 50 42.00 384 5.47	7 of = % 50 14.00 384 1.82	2 of = % 50 4.00 384 0.52	15 of = % 50 30.00 384 3.91	3 of = % 50 6.00 384 0.78	1 of = % 50 2.00 384 0.26	1 of = % 50 2.00 384 0.26
	Dental	8 of = % 336 2.38 515 1.55	44 of = % 336 13.10 515 8.54		267 of = % 336 79.46 515 51.84	3 of = % 336 0.89 515 0.58	6 of = % 336 1.79 515 1.17	8 of = % 336 2.38 515 1.55
Intended	Alveo- lar	123 of = % 712 17.28 5299 2.32	13 of = % 712 1.83 5299 0.25	54 of = % 712 7.58 5299 1.02	179 of = % 712 25.14 5299 3.38	35 of = % 712 4.92 5299 0.66	66 of = % 712 9.27 5299 1.25	111 of = % 712 15.59 5299 2.09
	Palatal	34 of = % 255 13.33 1132 3.00	4 of = % 255 1.57 1132 0.35	6 of = % 255 2.35 1132 0.53	112 of = % 255 43.92 1132 9.89	10 of = % 255 3.92 1132 0.88	5 of = % 255 1.96 1132 0.44	6 of = % 255 2.35 1132 0.53
	Velar	4 of = % 304 1.32 1069 0.37	1 of = % 304 0.33 1069 0.09	4 of = % 304 1.32 1069 0.37	263 of = % 304 86.51 1069 24.60	2 of = % 304 0.66 1069 0.19	12 of = % 304 3.95 1069 1.12	12 of = % 304 3.95 1069 1.12
Intended	Glottal	1 of = % 4 25.00 339 0.29					1 of = % 4 25.00 339 0.29	2 of = % 4 50.00 339 0.59

Other		Obtained		
		Pure Vowel	Diph- thong	Tie
Intended	Conso- nant	151 of = % 1724 8.76 10878 1.39	11 of = % 1724 0.64 10878 0.10	61 of = % 1724 3.54 10878 0.56

The format for the feature analyses is generally similar to that used for the analysis of individual phonemes. The phonetic feature system selected to classify the consonant phonemes of English consists of the traditional six manner features (nasals, stops, fricatives, affricates, glides and liquids) and the six place features (bilabial, labiodental, lingua-alveolar, palatal, velar, and glottal). Sounds are also categorized by the higher-order linguistic concepts of obstruents (stops, fricatives, affricates) versus sonorants (nasals, glides, liquids) and by voiced versus voiceless. Summary formats for each feature category and a summary category are provided. Feature Analysis: Consonants also computes and presents, in ranked order, a Substitution Summary by features. The features corresponding to sound substitutions are computed, rank ordered, and arranged on the second section of the output for visual inspection. The computer program looks at the features for non-questionable sounds (main characters) in the Z line and calculates the percentage of occurrence of feature changes from those intended for the corresponding sounds (main characters) in the Y line. The summary ranked list includes all feature changes that occurred at least once in the speech sample. If the substituted sound is not another consonant, the program prints "other" to the right of the arrow.

**PEPPER\_PepAnalyses tab:**

**PepAsses > Analyses > Phoneme Analyses > Natural Process Analysis (NPA)**

PEPPER's extensive series of natural process analyses have been retained in PepAssess primarily for their possible value for some contemporary educational, clinical, or research question.

## SECTION II:

### SOME ADDITIONAL PEPASSESS AND SOME PEPCLASS OUTPUTS

The second section of this guide includes a table with some references to research that has used PepAssess and PepClass outputs. The reports have used finalized ([Shriberg, Kwiatkowski, & Mabie, 2019](#)) or nearly finalized versions of the Speech Disorders Classification System.

**Phonology Project Articles: Tables and Figures with PEPPER-related content.**

Reference <sup>a</sup>	PepAnalyses		Domain or Measure <sup>b</sup>	Location			Output(s)
	PepAssess	PepClass		Figure	Table	No.	
Shriberg, Kwiatkowski, and Mabie (2019)	X	X	Consonants		X	1	<b>PCC</b> raw values ( <i>M, SD</i> ) for 415 participants with idiopathic Speech Delay
	X	X	Vowels & Consonants				<b>II</b> raw values ( <i>M, SD</i> ) for 415 participants with idiopathic Speech Delay
		X	Multiple		X	4	<b>DSI</b> percentile scores for 14 participants classified as CD from a group of 415 children with idiopathic Speech Delay.
		X	Multiple		X	5	<b>Prevalence estimates of Motor Speech Disorders</b> in 415 children with idiopathic Speech Delay
		X	Multiple	X		2	<b>SDCSS</b> for individual and Down syndrome group
		X	Multiple	X		3	<b>SDCSS</b> for group of 415 children with idiopathic Speech Delay
Shriberg, Strand, Jakielski, and Mabie (2019)		X	Multiple		X	3	<b>DI</b> and 5 <b>DSI</b> percentages for seven groups with Complex Neurodevelopmental Disorders
		X	Multiple	X		3	<b>SDCSS</b> for individual and group with Childhood Apraxia of Speech
		X	Multiple	X		4	<b>SDCSS</b> for participants in eight Complex Neurodevelopmental groups
		X	Multiple	X		5	<b>SDCSS</b> graphed findings of <b>three speech classification</b> percentages for participants in eight Complex Neurodevelopmental groups
		X	Multiple	X		6	<b>SDCSS</b> graphed findings of <b>five motor speech classification</b> percentages for participants in eight Complex Neurodevelopmental groups
Shriberg, Campbell, Mabie, and McGlothlin (2019)	X	X	Consonants		X	1	<b>PCC</b> raw values ( <i>M, SD</i> ) for 415 participants with idiopathic Speech Delay by Motor Speech classification status
	X	X	Vowels & Consonants				<b>II</b> raw values ( <i>M, SD</i> ) for 415 participants with idiopathic Speech Delay by Motor Speech classification status



Reference <sup>a</sup>	PepAnalyses		Domain or Measure <sup>b</sup>	Location			Output(s)
	PepAssess	PepClass		Figure	Table	No.	
	X	X	Consonants		X	2	<b>PCC</b> raw values ( <i>M, SD</i> ) for 14 longitudinal participants with idiopathic Speech Delay from the earliest available conversational sample
	X	X	Vowels & Consonants				<b>II</b> raw values ( <i>M, SD</i> ) for 14 longitudinal participants with idiopathic Speech Delay from the earliest available conversational sample
	X		Vowels		X	3	<b>PVC</b> raw values and z-scores ( <i>M, SD</i> ) for participant samples of idiopathic Speech Delay with high (Sample 1) and low (Sample 2) prevalence of Speech Motor Delay (SMD)
	X	X	Consonants				<b>PCC</b> raw values and z-scores ( <i>M, SD</i> ) for participant samples of idiopathic Speech Delay with high (Sample 1) and low (Sample 2) prevalence of Speech Motor Delay (SMD)
	X	X	Consonants - SRT				<b>SRT Performance, Encoding, and Memory</b> z-scores for participant samples of idiopathic Speech Delay with high (Sample 1) and low (Sample 2) prevalence of Speech Motor Delay (SMD)
	X	X	Vowels & Consonants				<b>II</b> raw values and z-scores ( <i>M, SD</i> ) for participant samples of idiopathic Speech Delay with high (Sample 1) and low (Sample 2) prevalence of Speech Motor Delay (SMD)
	X	X	Vowels & Consonants				<b>OII % Lowered Intelligibility</b> for participant samples of idiopathic Speech Delay with high (Sample 1) and low (Sample 2) prevalence of Speech Motor Delay (SMD)
	X		Phrasing				<b>Average Words/Utterance</b> z-scores for participant samples of idiopathic Speech Delay with high (Sample 1) and low (Sample 2) prevalence of Speech Motor Delay (SMD)
		X	PSI		X	4	Ten most frequent earliest available <b>PSI signs</b> for participant samples of idiopathic Speech Delay with

Reference <sup>a</sup>	PepAnalyses		Domain or Measure <sup>b</sup>	Location			Output(s)
	PepAssess	PepClass		Figure	Table	No.	
							Speech Motor Delay (SMD) and No Motor Speech Disorder (No MSD)
	X		Vowels		X	5	<b>PVC</b> raw values and z-scores ( <i>M, SD</i> ) for participant samples of idiopathic Speech Delay with Speech Motor Delay (SMD) and No Motor Speech Disorder (No MSD)
	X	X	Consonants				<b>PCC</b> raw values and z-scores ( <i>M, SD</i> ) for participant samples of idiopathic Speech Delay with Speech Motor Delay (SMD) and No Motor Speech Disorder (No MSD)
	X	X	Consonants - SRT				<b>SRT Performance, Encoding, and Memory</b> z-scores for participant samples of idiopathic Speech Delay with Speech Motor Delay (SMD) and No Motor Speech Disorder (No MSD)
	X	X	Vowels & Consonants				<b>II</b> raw values and z-scores ( <i>M, SD</i> ) for participant samples of idiopathic Speech Delay with Speech Motor Delay (SMD) and No Motor Speech Disorder (No MSD)
	X	X	Vowels & Consonants				<b>OII % Lowered Intelligibility</b> for participant samples of idiopathic Speech Delay with Speech Motor Delay (SMD) and No Motor Speech Disorder (No MSD)
	X		Phrasing				<b>Average Words/Utterance</b> z-scores for participant samples of idiopathic Speech Delay with Speech Motor Delay (SMD) and No Motor Speech Disorder (No MSD)
	X		Vowels		X	6	<b>PVC</b> raw values and z-scores ( <i>M, SD</i> ) for 11 participants with concurrent Speech Delay and normalized Speech Motor Delay (SMD) by 9 years of age and 3 participants with concurrent Speech Delay and persistent SMD after 9 years of age
	X	X	Consonants				<b>PCC</b> raw values and z-scores ( <i>M, SD</i> ) for 11 participants with concurrent Speech Delay and

Reference <sup>a</sup>	PepAnalyses		Domain or Measure <sup>b</sup>	Location			Output(s)
	PepAssess	PepClass		Figure	Table	No.	
							normalized Speech Motor Delay (SMD) by 9 years of age and 3 participants with concurrent Speech Delay and persistent SMD after 9 years of age
	X	X	Consonants				<b>PCCR</b> raw values and z-scores ( <i>M, SD</i> ) for 11 participants with concurrent Speech Delay and normalized Speech Motor Delay (SMD) by 9 years of age and 3 participants with concurrent Speech Delay and persistent SMD after 9 years of age
	X	X	Vowels & Consonants				<b>II</b> raw values and z-scores ( <i>M, SD</i> ) for 11 participants with concurrent Speech Delay and normalized Speech Motor Delay (SMD) by 9 years of age and 3 participants with concurrent Speech Delay and persistent SMD after 9 years of age
	X	X	Vowels & Consonants				<b>OII % Lowered Intelligibility</b> for 11 participants with concurrent Speech Delay and normalized Speech Motor Delay (SMD) by 9 years of age and 3 participants with concurrent Speech Delay and persistent SMD after 9 years of age
		X	PSI	X		1	Scatterplot of persistence of Speech Motor Delay (SMD) based on the <b>PSI</b> in 14 participants treated for idiopathic Speech Delay (SD).
Shriberg and Wren (2019)	X		Vowels		X	1	<b>PVC</b> raw values ( <i>M, SD</i> ) for three groups of speakers (i.e., two groups with idiopathic Speech Delay from the USA and England and a group with Complex Neurodevelopmental Disorders) with Speech Motor Delay (SMD) and No Motor Speech Disorder (No MSD) in two of the three groups
	X	X	Consonants				<b>PCC</b> raw values ( <i>M, SD</i> ) for three groups of speakers (i.e., two groups with idiopathic Speech Delay from the USA and England and a group with Complex Neurodevelopmental Disorders) with Speech Motor Delay (SMD) and No Motor Speech Disorder (No MSD) in two of the three groups

Reference <sup>a</sup>	PepAnalyses		Domain or Measure <sup>b</sup>	Location			Output(s)
	PepAssess	PepClass		Figure	Table	No.	
		X	PSI		X	2	<b>PSI</b> Sign No. 5 findings for participants in the USA and Complex Neurodevelopmental Disorder (CND) groups with idiopathic Speech Delay and Speech Motor Delay (SMD) compared to control participants with idiopathic Speech Delay and No Motor Speech Disorder (No MSD) in two speech tasks.
		X	PSI	X		1	<b>The Precision-Stability Index (PSI): Individual output</b>
		X	PSI	X		2	The 19 <b>PSI</b> acoustic signs of Speech Motor Delay in two groups with idiopathic Speech Delay from the USA and England and a group with Complex Neurodevelopmental Disorders
	X	X	Vowels & PSI	X		3	Average duration (ms) of the 11 phonemes in <b>PSI 5: Increased Duration of Mid-Vowels and Diphthongs</b> in the continuous speech tasks from participants with idiopathic Speech Delay and Speech Motor Delay compared to durations of these phonemes from the continuous speech of participants with SD and No Motor Speech Disorder
Wilson, Abbeduto, Camarata, and Shriberg (2019a)	X		Vowels		X	2	<b>PVC</b> raw values ( <i>M</i> , <i>SD</i> , Range) for DS group
	X	X	Consonants				<b>PCC</b> raw values ( <i>M</i> , <i>SD</i> , Range) for DS group
	X	X	Vowels & Consonants				<b>II</b> raw values ( <i>M</i> , <i>SD</i> , Range) for DS group
	X		Phrasing				<b>Average Words/Utterance</b> raw scores ( <i>M</i> , <i>SD</i> , Range) for 45 participants with Down syndrome (DS)
		X	Multiple	X		1	<b>SDCSS</b> for Down syndrome group
		X	Multiple	X		2	<b>5 DSI</b> subtype percentages and percentiles for participants with Down syndrome (DS)

Reference <sup>a</sup>	PepAnalyses		Domain or Measure <sup>b</sup>	Location			Output(s)
	PepAssess	PepClass		Figure	Table	No.	
Wilson, Abbeduto, Camarata, and Shriberg (2019b)	X		Phrasing		X	1	<b>Average Words/Utterance</b> raw scores ( <i>M</i> , <i>SD</i> ) for participants with Down syndrome by Ordinal Intelligibility Index classification
		X	Vowels & Consonants		X	2	<b>Ordinal Intelligibility Index</b> findings for a Down syndrome group classified by their speech and motor speech status.
		X	Vowels & Consonants		X	3	<b>Ordinal Intelligibility Index</b> findings for a Down syndrome group classified by their motor speech status.
	X	X	Vowels & Consonants	X		1	<b>Intelligibility Index</b> scores and <b>Ordinal Intelligibility Index</b> classification findings for a Down syndrome group.
		X	Multiple	X		2	Bar graphs of 5 <b>DSI</b> subtype percentages and percentiles for participants with Down syndrome by High and Low Ordinal Intelligibility Index classification
		X	Multiple	X		3	Bar graphs of <b>Motor Speech Classification</b> percentages from the <b>SDCSS</b> for three participants groups (Down syndrome, Complex Neurodevelopmental Disorders, and Idiopathic Speech Delay) by <b>Ordinal Intelligibility Index</b> classification (High, Moderate, and Low)
	X	X	Vowels & Consonants	X		4	Four measures of consonant and vowel production in Conversational Speech in a Down syndrome group by High and Low <b>Ordinal Intelligibility Index</b> classification
	X	X	Consonants	X		5	Sibilant distortions in Conversational Speech in a Down syndrome group by High and Low <b>Ordinal Intelligibility Index</b> classification
	X	X	Prosody & Voice	X		6	Inappropriate prosody and voice in Conversational Speech in a Down syndrome group by High and Low <b>Ordinal Intelligibility Index</b> classification

Reference <sup>a</sup>	PepAnalyses		Domain or Measure <sup>b</sup>	Location			Output(s)
	PepAssess	PepClass		Figure	Table	No.	
Baylis and Shriberg (2018)	X		Vowels		X	1	<b>PVC</b> raw values and z-scores ( <i>M</i> , <i>SD</i> , Range)
	X	X	Consonants				<b>PCC</b> raw values and z-scores ( <i>M</i> , <i>SD</i> , Range)
	X	X	Vowels & Consonants				<b>II</b> raw values and z-scores ( <i>M</i> , <i>SD</i> , Range)
		X	Multiple		X	2	<b>SDCS</b> speech and motor speech classifications described
	X	X	Multiple		X	3	Transcription, <b>PVSP</b> , and acoustic analyses reliability estimates
		X	Multiple	X		1	<b>SDCSS</b> (22q and DS)
		X	Multiple	X		2	<b>SDCSS</b> (FXS and GALT)
		X	Multiple	X		3	Bar graphs for speech and motor speech classifications percentage of participants (22q, DS, FXS, GALT)
Shriberg et al. (2017a)		X	Multiple		X	3	<b>SDCS</b> speech and motor speech classifications described
		X	Multiple		X	4	<b>DI</b> and 5 <b>DSI</b> defined and described
		X	Multiple		X	6	8 subtypes of inappropriate pauses descriptions
		X	Multiple	X		1	<b>SDCS</b>
		X	Multiple	X		2	<b>SDCSS</b> for individual
Shriberg et al. (2017b)	X	X	Multiple		X	2	17 MSAP tasks
	X		Vowels		X	3	<b>PVC</b> raw values ( <i>M</i> , <i>SD</i> , Range) for CAS groups
	X	X	Consonants		X	3	<b>PCC</b> raw values ( <i>M</i> , <i>SD</i> , Range) for CAS groups
		X	Pauses		X	3	Opportunities; Inappropriate Type I; <b>PM</b> score for CAS groups
	X	X	SPMS		X	3	Rate, Stress, Transcoding data for CAS groups
	X		Vowels		X	4	<b>PVC</b> raw values ( <i>M</i> , <i>SD</i> , Range) for AAS groups
	X	X	Consonants		X	4	<b>PCC</b> raw values ( <i>M</i> , <i>SD</i> , Range) for AAS groups
		X	Pauses		X	4	Opportunities; Inappropriate Type I; <b>PM</b> score for AAS groups
	X	X	SPMS		X	4	Rate, Stress, Transcoding data for AAS groups
	X		Vowels		X	5	<b>PVC</b> raw values ( <i>M</i> , <i>SD</i> , Range) for PM+/PM- groups
	X	X	Consonants		X	5	<b>PCC</b> raw values ( <i>M</i> , <i>SD</i> , Range) for PM+/PM- groups

Reference <sup>a</sup>	PepAnalyses		Domain or Measure <sup>b</sup>	Location			Output(s)
	PepAssess	PepClass		Figure	Table	No.	
		X	Pauses		X	5	Opportunities; Inappropriate Type I; <b>PM</b> score for PM+/PM- groups
	X	X	SPMS		X	5	Rate, Stress, Transcoding data for PM+/PM- groups
Shriberg et al. (2017c)	X	X	Consonants		X	2	<b>PCC</b> raw values ( <i>M</i> , <i>SD</i> , Range) for CAS, PPAOS, and SD groups
	X	X	Consonants - SRT		X	3	Performance, Encoding, Memory, and Transcoding raw and z-scores for CAS, AAS, and SD groups
	X	X	Pauses, PVSP		X	4	Groping, Repetition/revision pauses, and <b>PVSP</b> repetition/revision raw and z-scores for CAS, AAS, and SD groups
		X	PSI, DMI		X	5	<b>PSI</b> and <b>DMI</b> (place/duration/addition changes) raw and z-scores for CAS, AAS, and SD groups
	X		Rate		X	6	Speaking and articulation rate raw and z-scores for CAS, AAS, and SD groups
	X		Stress			6	Sentential stress raw and z-scores for CAS, AAS, and SD groups
		X	Multiple	X		1	<b>SDCS</b>
		X	Pauses	X		2	Bar graphs for Appropriate and Inappropriate Abrupt pauses for SD, CAS&CND, and AAS groups
Shriberg et al. (2017d)		X	PM		X	1	<b>PM</b> Non-marginal and Marginal counts for CAS, CND, AAS, Longitudinal participants, and SD groups
	X	X	Consonants		X	1	<b>PCC</b> raw values ( <i>M</i> , <i>SD</i> , Range) for CAS, CND, AAS, Longitudinal participants, and SD groups
		X	SCI		X	2	Pearson r correlation coefficients for CAS and AAS participants with nonmarginal PM+ scores by CPSA and Transcription/PVSP/Acoustic methods of data reduction
		X	PSI		X	2	
	X	X	Multiple		X	2	
	X	X	SPMS		X	3	<b>SPMS</b> Signs scores and classification for Longitudinal participants
		X	PM			3	<b>PM</b> scores and classification for Longitudinal participants
		X	PM	X		1	<b>PM</b> scores plotted low to high for participants with CAS, DS, GALT, CNDs, AOS, and PPAOS

Reference <sup>a</sup>	PepAnalyses		Domain or Measure <sup>b</sup>	Location			Output(s)
	PepAssess	PepClass		Figure	Table	No.	
		X	PMI	X		3	Bar graphs of <b>PMI</b> categories for participants with CAS, CND, and AAS
	X	X	PVSP	X		4	<b>PVSP</b> Profiles for CAS participants by PMI category
	X	X	PVSP	X		5	<b>PVSP</b> Profiles for CND participants by PMI category
	X	X	PVSP	X		6	<b>PVSP</b> Profiles for AAS participants by PMI category
Carrigg et al. (2016)	X	X	SRT		X	5	Median and range scores on the <b>SRT</b> for Persistent and Resolved SSD groups
Vick et al. (2014)		X	Multiple	X		1	<b>SDCS</b>
Shriberg et al. (2012)	X	X	TLDA		X	2	<b>TLDA</b> signs for classification of CAS and DYS.
	X		Vowels		X	3	<b>PVC</b> raw values for participants with typical speech, SD, typical language, LI, and CAS
	X	X	Consonants		X	3	<b>PCC</b> raw values for participants with typical speech, SD, typical language, LI, and CAS
	X	X	Vowels & Consonants		X	3	<b>PPC</b> and <b>II</b> raw values for participants with typical speech, SD, typical language, LI, and CAS
	X	X	Phrasing		X	3	% Appropriate Phrasing raw values for participants with typical speech, SD, typical language, LI, and CAS
	X	X	Rate		X	3	% Appropriate Rate raw values for participants with typical speech, SD, typical language, LI, and CAS
	X	X	Stress		X	3	% Appropriate Stress raw values for participants with typical speech, SD, typical language, LI, and CAS
	X	X	Loudness		X	3	% Appropriate Loudness raw values for participants with typical speech, SD, typical language, LI, and CAS
	X	X	Pitch		X	3	% Appropriate Pitch raw values for participants with typical speech, SD, typical language, LI, and CAS
	X	X	Laryngeal quality		X	3	% Appropriate LQ raw values for participants with typical speech, SD, typical language, LI, and CAS
	X	X	Resonance quality		X	3	% Appropriate RQ raw values for participants with typical speech, SD, typical language, LI, and CAS
	X	X	SRT		X	4	Correlations for SRT Encoding, Memory, Transcoding, and Competence scores for participants



Reference <sup>a</sup>	PepAnalyses		Domain or Measure <sup>b</sup>	Location			Output(s)
	PepAssess	PepClass		Figure	Table	No.	
							with typical speech, SD, typical language, LI, and CAS
	X	X	Multiple and SRT		X	5	Correlations for SRT Encoding, Memory, Transcoding, and Competence scores with speech-prosody measures (PVC, PCC, II, Phrasing, Rate, Stress) for participants with typical speech, SD, typical language, LI, and CAS
	X	X	SRT		X	5	Pair-wise comparisons for SRT Encoding, Memory, Transcoding, and Competence scores for participants with typical speech, SD, typical language, LI, and CAS
		X	Multiple	X		1	<b>SDCS</b>
	X	X	SRT	X		2	Box plots for percentage of Encoding, Memory, Transcoding, and Competence for participants with typical speech, SD, typical language, LI, and CAS
Shriberg, Paul et al. (2011)	X	X	PVSP	X		2	<b>PVSP</b> Profiles for participants with ASD, Typical Development, SD, and CAS.
Shriberg (2010)		X	Multiple	X		1-2	<b>SDCS</b>
	X		Consonants	X		1-7	<b>PCCR</b> Profiles for two OME study groups

<sup>a</sup> See **REFERENCES** section.

<sup>b</sup> Ten Linguistic Domains (Shriberg et al., 2010).

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### **SECTION III:**

#### **SOME REFERENCE DATA FOR PEPANALYSES OUTPUTS**

The last section of this guide includes Tables of Contents from ten Phonology Project Technical Reports. These reports provide standardized reference data for measures in the PepAssess and PepClass outputs. The reference data include statistical information for typical speakers, speakers with idiopathic speech delay, and speakers with speech delay in the context of complex neurodevelopmental disorders. The page numbers in each table of contents should be helpful to locate within each reference, information by measure, age, and sex (see RESEARCH > TECHNICAL REPORTS on the Phonology Project website:

<https://phonology.waisman.wisc.edu/publications-and-presentations/technical-reports/>).

**REFERENCE DATA FOR  
THE SYLLABLE REPETITION TASK (SRT)**

**Technical Report No. 17**

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**Revised November 2011**

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**Development of the Syllable Repetition Task (SRT) and preparation of this technical report was supported by research grant DC00496 from the National Institute on Deafness and Other Communication Disorders, National Institutes of Health (Lawrence D. Shriberg, Principal Investigator) and the Australian Research Council Discovery Grant (DP0773978). We thank the following colleagues for their contributions to the development and validation of the SRT and/or for their contribution of reference data obtained in the context of collaborative research: Richard Boada, Roger Brown, Thomas Campbell, Christine Dollaghan, Lisa Freebairn, Jordan Green, Linda J. Harrison, Christine Hollar, Joan Kwiatkowski, Barbara Lewis, Lindy McAllister, Jane McCormack, Sharynne McLeod, Jane McSweeny, Christopher Moore, Bruce Pennington, Steven Pittelko, Heather Leavy Rusiewicz, Christine Tilkens, Sonja Wilson, and David Wilson.**

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**Reference Data for the Madison Speech Assessment Protocol (MSAP):  
A Database of 150 Participants 3-to-18 Years of Age with Typical Speech**

**Technical Report No. 18**

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**Reference Data for the Madison Speech Assessment Protocol (MSAP):  
A Database of 28 Participants, 3-to-6 Years of Age, with Speech Delay**

**Technical Report No. 19**

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**Reference Data for the Madison Speech Assessment Protocol (MSAP):  
A Database of Fifty 20-to-80 Year Participants with Typical Speech**

**Technical Report No. 20**

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# **Conversational Speech Reference Data for Children with Speech Delay:**

## **A Database of 180 Participants, 3-to-5 Years of Age**

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5. Reduced Vowel Space: /i, æ, ɑ/ Distance from Center VSD3	
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1. Percentage of Consonants in Inventory
2. Percentage of Consonants Correct
3. Percentage of Consonants Correct-Revised
4. Relative Omission Index
5. Relative Substitution Index
6. Relative Distortion Index

### B. Precision

1. Nasal Emissions
2. Reduced Percentage of Glides Correct
3. Increased Percentage of /j/ Deletions in Clusters
4. Lowered Sibilant Centroids: M1 at Midpoint
5. Lowered Sibilant Centroids: Maximum M1
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**A Diagnostic Marker to Discriminate Childhood Apraxia of Speech (CAS)  
from Speech Delay (SD): The Pause Marker**

**Technical Report No. 22**

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**Speech and Motor Speech Measures and Reference Data  
for the Speech Disorders Classification System (SDCS)**

**Technical Report No. 23**

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**Speech and Motor Speech Assessment Findings  
In Eight Complex Neurodevelopmental Disorders**

**Technical Report No. 24**

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**December, 2017**

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**Speech and Motor Speech Characteristics  
of a Consensus Group of 28 Children  
with Childhood Apraxia of Speech**

**Technical Report No. 25**

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**February, 2018**

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**Reference Data for Children with Idiopathic Speech Delay**  
**With and Without Concurrent Speech Motor Delay**

**Technical Report No. 26**

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