

Percentage Consonants Correct – Revised (PCC-R)

$$\frac{\# \text{ C's correct}}{\# \text{ C targets}} \times 100$$

All distortions are considered correct

Percentage Vowels & Diphthongs Correct – Revised (PVC-R)

$$\frac{\# \text{ V's correct}}{\# \text{ V targets}} \times 100$$

All distortions are considered correct

Percentage scores are correlated with severity of speech delay/disorder.

Shriberg, L. D., Austin, D., Lewis, B. A., McSweeney, J. L., & Wilson, D. L. (1997). The Percentage of Consonants Correct (PCC) metric: Extensions and reliability data. *Journal of Speech, Language, and Hearing Research, 40*(4), 708-722.

PCC-R and PVC-R Norms

Age	Normally	Developing	Speech Delayed	
	PCC-R	PVC-R	PCC-R	PVC-R
3;0 – 3;11	94	98	69	92
4;0 – 4;11	93	98	73	95
5;0 – 5;11	94	99	71	94
6;0 – 6;11	95	99	73	92
7;0 – 7;11	97	99	73	93
8;0 – 8;11	97	100	69	97
9;0 – 11;11	98	99	93	96

For more detailed information about the samples and the results, see: Austin, D., & Shriberg, L. D. (1997). *Lifespan reference data for ten measures of articulation competence using the speech disorders classification system (SDCS)*. Madison, WI: Waisman Center, University of Wisconsin-Madison. Available 1/4/05 at <http://www.waisman.wisc.edu/phonology/bib/bib.htm>

Syllable Shapes by Approximate Age

Syllable shapes	Example	Expected by age (months)
C alone	“mmm” (incomplete syllable)	infancy; small % beyond 8-10 months
V alone	“aaahhh” (incomplete syllable)	decreases from 8-12 mos.
CV	“go”	12 months
CVC:		
C harmony (same C)	“pup”	18-24 months
Different C’s	“dog”	24-30 months
VCC	“ant”	36 months
CVCC	“paint”	36
CCV	“play”	36 months
CCVC	“clam”	36 months
CCVCC, CCCVC, etc.		48 months and later

Source: Compiled by Velleman (2003) from Grunwell (1985), Chin and Dinnsen (1992), Smit et al. (1990), and Stoel-Gammon (1987).

Word Shapes/Stress Patterns by Approximate Age of Appearance

Word shapes	Examples	Age (in months)
One syllable	“ma”, “pop”	8-12 months
Two syllables:		
same C’s	“daddy”	8-12 months
different C’s	“bottle”	12–18 months
SW stress	“DAddy”	8-12 months
WS stress	“giRAFFE	36 months
Three syllables:		
SWS stress	“CROcoDILE”	36 months
WSW stress	“baNAna”	36 months
Longer words:		
initial weak syllable	“reFRIGerator”	48 months or later
initial strong syllable	“PEdiaTRician”	48 months or later

S: strong (stressed) syllable
W: weak (unstressed) syllable

from Velleman (2003)

PHONOTACTIC REPERTOIRE: Word and Syllable Shapes

Name:		Age:	
Date:		Examiner:	
Source of sample:		Size of sample:	
Note:	C = consonant	predominant:	60-100%
	V = vowel	frequent:	40-60%
	# = word boundary	occasional:	15-40%

SYLLABLE TYPES

<u>% or √</u>	<u>Frequency Estimate¹: Circle appropriate word.</u>					
<i>INCOMPLETE:</i>						
C alone _____	predominant	frequent	occasional	rare	absent	
V, V?, ?V _____	predominant	frequent	occasional	rare	absent	
<i>OPEN:</i>						
CV _____	predominant	frequent	occasional	rare	absent	
<i>CLOSED:</i>						
VC, ?VC _____	predominant	frequent	occasional	rare	absent	
CVC* _____	predominant	frequent	occasional	rare	absent	

*Includes CCVC, CVCC, etc.

CLUSTERS

<u>% or √</u>	<u>Frequency Estimate²: Circle appropriate word.</u>					
<i>INITIAL:</i>						
#CC- _____	predominant	frequent	occasional	rare	absent	
#CCC- _____	predominant	frequent	occasional	rare	absent	
<i>FINAL:</i>						
-CC# _____	predominant	frequent	occasional	rare	absent	
-CCC# _____	predominant	frequent	occasional	rare	absent	
<i>MEDIAL:</i>						
-CC- _____	predominant	frequent	occasional	rare	absent	
-CCC- _____	predominant	frequent	occasional	rare	absent	

WORD SHAPES

<u>% or √</u>	<u>Frequency Estimate: Circle appropriate word.</u>					
<i># OF SYLLABLES:</i>						
1 _____	predominant	frequent	occasional	rare	absent	
2 _____	predominant	frequent	occasional	rare	absent	
3 _____	predominant	frequent	occasional	rare	absent	
4+ _____	predominant	frequent	occasional	rare	absent	

MAXIMUM # OF SYLLABLES PRODUCED IN ANY WORD: _____
 From Velleman (1998)

¹Out of all **syllables**

²Out of all words

PHONOTACTIC REPERTOIRE

Reduplication and Harmony

Name:

Age:

Date:

Examiner:

Source of sample:

Size of sample:

Note: C = consonant

V = vowel

Reduplication = Same syllable repeated in word (baba, deedee, gogo, etc.)

Harmony = Same C repeated (**goggie**, **tootie**, etc.) or

same V repeated (**daba**, **boogoo**, etc.)

predominant: 60-100%

frequent: 40-60%

occasional: 15-40%

WORDS OF TWO SYLLABLES OR MORE:

% or √

Frequency Estimate³: Circle appropriate word.

Reduplicated

Syllables _____ predominant frequent occasional rare absent

Harmonized

Vowels _____ predominant frequent occasional rare absent

Harmonized

Consonants _____ predominant frequent occasional rare absent

MONOSYLLABIC CVC WORDS:

% or √

Frequency Estimate⁴: Circle appropriate word.

Harmonized

Consonants _____ predominant frequent occasional rare absent

From Velleman (1998)

³Out of all **multisyllabic** words.

⁴Out of all **monosyllabic** words.

Phonetic versus Phonotactic Repertoire

KEY: C: consonant (), e: emerging
 V: vowel CC: consonant cluster (generic)
 CCC: cluster with three or more C's

Age	Phonotactic Patterns (check if present)	Phonetic Repertoire (circle if occurs 3X)
1;6 - 2;0	<input type="checkbox"/> initial C <input type="checkbox"/> 2-syllable words with: <input type="checkbox"/> reduplication <input type="checkbox"/> C harmony <input type="checkbox"/> V harmony <input type="checkbox"/> syllable reduction from iambs <input type="checkbox"/> CC reduction <input type="checkbox"/> final C deletion	m n p b w h
2;0 - 2;6	<input type="checkbox"/> initial C <input type="checkbox"/> 2-syllable words with no harmony or reduplication <input type="checkbox"/> syllable reduction from iambic words <input type="checkbox"/> CC reduction <input type="checkbox"/> final C deletion or final C harmony	m n ŋ p b t d k g w h
2;6 - 3;0	<input type="checkbox"/> initial C <input type="checkbox"/> 2-syllable words with no harmony or reduplication <input type="checkbox"/> syllable reduction from iambic words <input type="checkbox"/> CC reduction <input type="checkbox"/> final C without C harmony	m n ŋ p b t d k g w j h f
3;0 - 3;6	<input type="checkbox"/> initial C <input type="checkbox"/> 2-syllable words with no harmony or reduplication <input type="checkbox"/> syllable reduction from iambic words longer than 2 syllables <input type="checkbox"/> some stop + glide initial CC <input type="checkbox"/> medial and final CC reduction <input type="checkbox"/> final C without C harmony	m n ŋ p b t d k g w j h f v s ʃ tʃ l ɹ
3;6 - 4;6	<input type="checkbox"/> initial C <input type="checkbox"/> 2-3-syllable words with no harmony, reduplication, or reduction <input type="checkbox"/> stop + glide initial CC <input type="checkbox"/> some medial and final CC <input type="checkbox"/> final C without C harmony	m n ŋ p b t d k g w j h f v s z ʃ tʃ dʒ l (ɹ)
4;6 - 7;0	<input type="checkbox"/> initial C <input type="checkbox"/> 2-3-syllable words with no harmony, reduplication, or reduction <input type="checkbox"/> 4+-syllable words (initially with harmony, reduplication or reduction) <input type="checkbox"/> all CC except θɹ- <input type="checkbox"/> final C without C harmony	m n ŋ p b t d k g w j h f v θ ð s z ʃ (ʒ) tʃ dʒ l ɹ
7;0 - 9;0	<input type="checkbox"/> initial C <input type="checkbox"/> multisyllabic words with no harmony, reduplication or reduction <input type="checkbox"/> all CC including θɹ-, all positions <input type="checkbox"/> CCC in all positions <input type="checkbox"/> final C without C harmony	m n ŋ p b t d k g w j h f v θ ð s z ʃ ʒ tʃ dʒ l ɹ

Velleman, S. L. (2003). *Childhood apraxia of speech resource guide*. Clifton Park, NY: Delmar/Thomson/Singular.

Phonological Mean Length of Utterance (Ingram 2002)

Item in child's production	Points
Each consonant or vowel produced (but not more than in target)	1 point each
Each correct consonant (matches target)	1 additional point

The Index of Phonetic Complexity		
Category	0 points	1 point each
consonant by place	labials coronals (alv., pal.)	dorsals (velars)
consonant by manner	stops, nasals, glides	fricatives, affricates, liquids
vowel	monophthongs diphthongs	rhotics
contiguous consonants	no clusters	at least 1 cluster
cluster type	homorganic (same place)	heterorganic
word length	monosyllables disyllables	three ± syllables

Examples of word complexity ratings:

"mommy" = 0 points
 "coat" = 1 point
 "horse" = 3 points
 "pizza" = 2 points
 "school" = 5 points

Average values of complexity ratings on words produced

Complexity rating	14-18 mos. (4 subj.) % of all values	22-26 mos. (same 4 subj.) % of all values	34 mos. (2 new sub.) % of all values
0	32	17	14
1	32	33	30
2	21	19	24
3	4	10	13
4	7	10	12
5	4	6	5
6	1	4	2
7	0	1	<1
8	0	<1	1
9	n/a	n/a	n/a
10	n/a	n/a	n/a
11	0	<1	<1
Average mean	1.37	2.05	2.095

Jakielski, K. J. (2000). *Quantifying phonetic complexity in words: An experimental index*. Paper presented at the International Child Phonology Conference, University of Northern Iowa.

STRESS PATTERNS: INDEPENDENT ANALYSIS

Name:

Age:

Date:

Examiner:

Source of sample:

Size of sample:

S: strong syllable

W: weak syllable

For each stress pattern, list words which the child produces with that pattern, whether correct or not. Examples in parentheses are intended to facilitate the speech-language pathologist's recognition of varied stress patterns only. The child should not necessarily be required to attempt these words.

TARGET STRESS PATTERN	— EXAMPLES — (from child)
SW (ex: mónkey)	
WS (ex: giráffe)	
S W [̀] (ex: téléphòne)	
SWW/S [̀] W (ex: hámburger)	
WSW (ex: spaghétti)	
WWS/ [̀] WS (ex: kàngaróo)	
S W [̀] W (ex: cáterpillar)	
WS W [̀] / [̀] SS W W (ex: rhinóceròs)	
WWSW/ [̀] WS W (ex: dìsappóinted)	
OTHER 4 SYLL. (SWWS, WWSW, WSSW)	

5+ SYLLABLES	
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from Velleman (1998)

Consistency Index (Tyler 2002)

Target phoneme	Substitutions (including Ø□□□□□□□ □□□□□□ □□□□□□□□ □□)			Total # of different substitutions for that phoneme
	Initial substitutions	Medial substitutions	Final substitutions	

Total number of substitutions ÷ Total number of phonemes attempted = Consistency Average

The smaller the Consistency Average, the more consistent the child's speech patterns. For example, a child who averages only one substitution per phoneme (Consistency Average = 1.0) is very consistent; a child who averages three substitutions per phoneme (Consistency Average = 3.0) is not.

*Note: Substitutions that occur in multiple word positions only count once. For example, if a child substitutes [t] for /k/ in initial, medial, and final positions, only one substitution is counted in the rightmost column, because that one substitution is consistent across all word positions. Substitutions (or omissions) that occur within consonant clusters are counted in the same manner as singleton consonants.

Transcript for Practice (Peter, age 5)

- | | |
|--------------------|-----------------------|
| 1. [bʌs] | 26. [ptə kʌ dɪtʰ] |
| 2. [fʃ] | 27. [ˈʌmʌ bʌ] |
| 3. [kɑ] | 28. [dʌn] |
| 4. [ɑt] | 29. [nɛt ˈnɑdo bʌs] |
| 5. [ˈʌwʌ tʌ fɑm] | 30. [ˈbʌpʌ] |
| 6. [hɒ] | 31. [pæ] |
| 7. [nɑ] | 32. [ˈʌmʌ tsɑ] |
| 8. [ˈpʌtʌ ɪt] | 33. [ʌbd wʌ] |
| 9. [tʌ] | 34. [ɑb wʌ ˈwɛdə] |
| 10. [ˈnɑkənɑɪ] | 35. [lɑt] |
| 11. [bɑ] | 36. [ˈʌwʌ tɪ] |
| 12. [bɑ: ɬ] | 37. [nɑ? ˈdɪtɪ] |
| 13. [ˈʌwʌ dʌ ftʰ] | 38. [ˈʌwʌtʰ fɑ] |
| 14. [ˈʌwʌ sɪ] | 39. [wʌtʰ ˈvɑvɑ] |
| 15. [wɑ] | 40. [ˈgɑbʊ] |
| 16. [ˈpʌtʌ wɑ] | 41. [ɪ gɑʊ gɒ] |
| 17. [nɑs] | 42. [ɪ pkə] |
| 18. [nɑ bɑ ˈtɪʊfʊ] | 43. [ˈʌmʌ ˈkʌdɪ] |
| 19. [ˈɑnɑs] | 44. [ɑ m] |
| 20. [kʌ] | 45. [ˈʌmʌ ˈkʊkʊkɒ] |
| 21. [ɪgʌ] | 46. [ˈɒfə bkə ɪ ˈɒfə] |
| 22. [ɪm: æ] | 47. [nɒ ftʰsə] |
| 23. [bɑ hʊ bɑkʰ] | 48. [mɑ ptɪ nɑʊ] |
| 24. [bɑ hu nɒ] | 49. [ˈwɛdə tʰ] |
| 25. [bɑʊ hu] | 50. [sɪ ɑ ɪtʰ] |

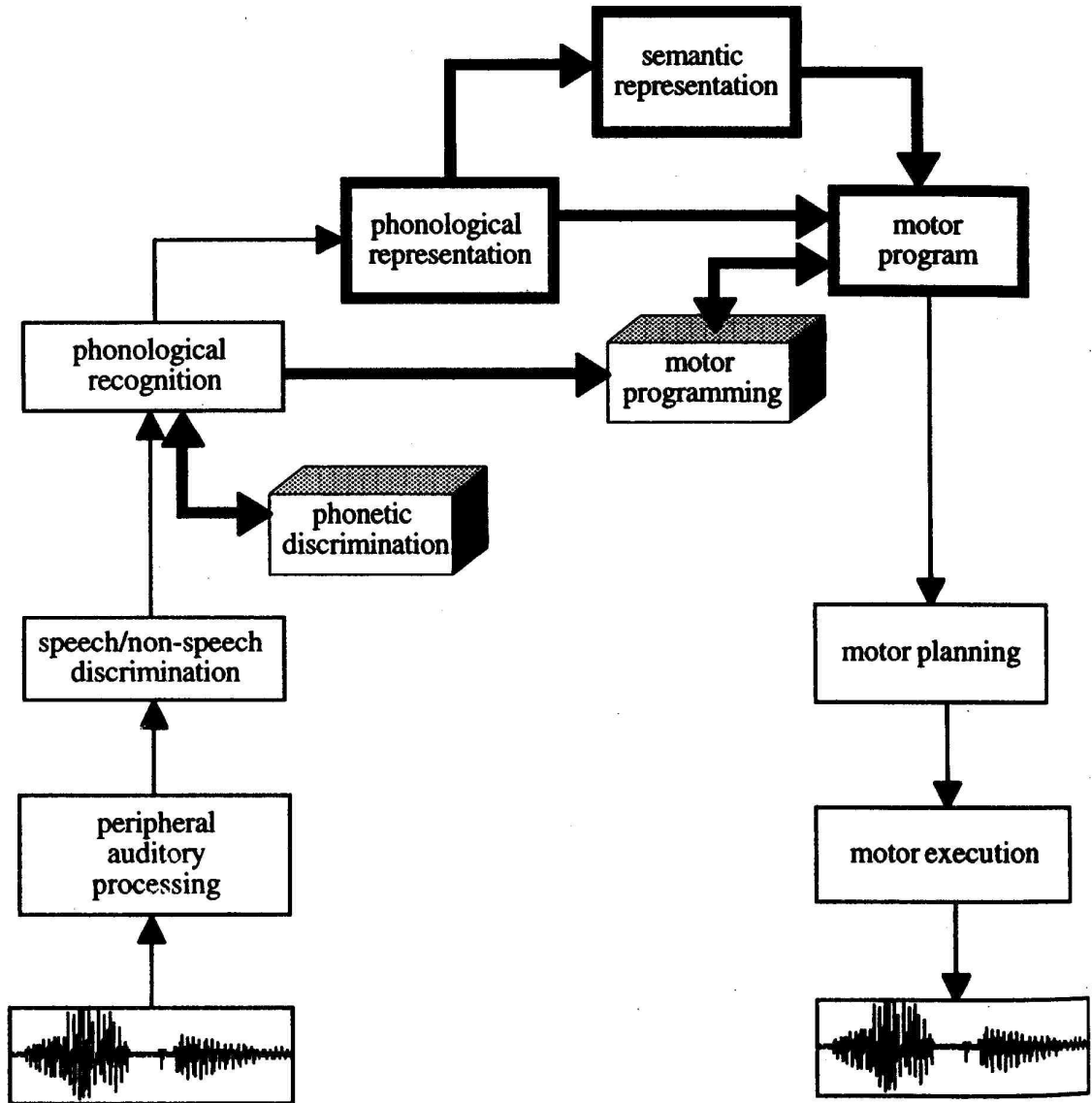
Key:

ˈ indicates stressed syllable (after mark) [ʰ] indicates aspiration (strong release)

[ɬ] is a voiceless lateral fricative

- Use these data to fill out independent analysis forms in the worksheets packet: Word & Syllable Shapes, Reduplication & Harmony, Phonetic vs. Phonotactic Repertoire, Index of Phonetic Complexity, Stress Patterns.
- Answer the following questions:
 - What are Peter's phonological strengths?
 - What are his phonological weaknesses?
 - What aspects of his speech are likely to interfere the most with intelligibility?
 - What aspects of his speech are disordered vs. delayed?
 - What aspects of his speech are or are not indicative of CAS?

SPEECH PROCESSING MODEL



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Symptom	Common patterns	CAS differences	Typical goals
Limited C, V repertoire	Simplification substitution processes	“Complexification” substitutions e.g., affrication of stops	More complete C, V repertoire
Omissions	Simplification phonotactic processes	“Complexification” i.e., epenthesis	More complete phonotactic (syllable and word shape) repertoire Accurate production of target structures
Vowel errors	Rare in children who don’t have CAS	Much more common; persistent	More complete V repertoire Accurate production of V’s
Altered suprasegmentals	Weak syllable deletion	Excess equal stress	Weak syllables Differentiation of strong vs. weak syllables
Increased errors with increased length/complexity	Processes more frequent in complex contexts	More marked increase in difficulty in more complex contexts	Generalization of new sounds and structures to more difficult contexts
Use of simple syllable & word shapes	Weak syllable deletion, initial & final C deletion, cluster reduction reduplication, C, V harmony	More pervasive, persistent Phonotactic repertoire may lag behind phonetic repertoire	More complete phonotactic repertoire More syllable variety Accurate production of target structures

BEHAVIORAL OBJECTIVES WORKSHEET (Based on Kirkpatrick, Stohr & Kimbrough 1990)

I. Movement Pattern Categories: Choose **one** block in **either** the place **or** manner movement charts for each objective. Date blocks as they are completed.

A. Place

1st C 2nd C → ↓	Bilabial [p,b,m,w]	Dental [f,v,θ,ð]	Alveolar [t,d,n,s,z,l]	Palatal [j,ʃ,ʒ,tʃ,dʒ,r]	Velar [k,g,ŋ,h]
Bilabial [p, b, m, w]					
Dental [f, v, θ, ð]					
Alveolar [t, d, n, s, z, l]					
Palatal [j, ʃ, ʒ, tʃ, dʒ, r]					
Velar [k, g, ŋ, h]					

B. Manner

1st C 2nd C → ↓	stop [p, t, k, b, d, g]	nasal [m, n, ŋ]	glide [w, j]	fricative [f, v, θ, ð, s, z, ʃ, ʒ, h]	affricate [tʃ, dʒ]	liquid [l, r]
stop [p, t, k, b, d, g]						
nasal [m, n, ŋ]						
glide [w, j]						
fricative [f, v, θ, ð, s, z, ʃ, ʒ, h]						
affricate [tʃ, dʒ]						
liquid [l, r]						

II. Syllable Level, Type, and Position

Each new number of syllables per word or new syllable shape (open vs. closed) is a new skill level and therefore a new objective for the child.

# of syll. # of C → ↓	1	2	3	4
1	open (CV)	closed (CVC)		
2		open (CVCV)	closed (CVCVC)	
3			open (CVCVCV)	closed (CVCVCVC)

A blank version of this chart could be used to track progress as the child masters new phonotactic possibilities.

# of syll. # of C → ↓	1	2	3	4
1				
2				
3				

III. Cueing Levels

- 1: Names without model
- 2: Verbal imitation
- 3. Visual and/or tactile cue
 - V3: visual
 - T3: tactile
- 4: Unable to produce, no response

IV. Objective Levels: **One** new variable per objective

	Movement Category	Syllable Category	Cueing Level
New			
Old			

EXAMPLE:

A young child is able to produce "ba" (for "bottle"), "ma" (for "mommy"), and "wa" (for "water") with visual and tactile cues both provided. Thus, "bilabial", "open syllable" (CV), and "V3 + T3" are all "old" skills for her. The following objective could now be targeted:

	Movement Category	Syllable Category	Cueing Level
New		two syllables	
Old	bilabial - bilabial	open (CVCV)	maximum (3) (V3 + T3)

E.g.: mama/mommy, bye-bye, baby, boobo, bubble, puppy, mopping, mowing, wiper, woman, etc.

Note that, because place (bilabial) is the target, manner errors should be ignored (although of course accurate productions are modeled by the clinician).

When this objective had been achieved, "two syllables" would become an "old" variable, and the next objective would incorporate **one** change from the above. Some possible next objectives are given here:

	Movement Category	Syllable Category	Cueing Level
New	bilabial - alveolar (new place pattern)		
Old		two syllables, open	maximum (3) (V3 + T3)

E.g.: buddy, money, bunny, motor, Peter, panda, etc.

OR

	Movement Category	Syllable Category	Cueing Level
New		closed (CVC)	
Old	bilabial - bilabial	one syllable	maximum (3) (V3 + T3)

E.g., pop, mom, Pam, map, wham, weep, bomb, etc.

OR

	Movement Category	Syllable Category	Cueing Level
New	stop - fricative (new manner pattern)		
Old	bilabial - bilabial (old place pattern)	two syllables, open	maximum (3) (V3 + T3)

E.g., puffy, kisses, fishing, diver, cashew, etc.

OR

	Movement Category	Syllable Category	Cueing Level
New			V3 only
Old	bilabial - bilabial	two syllables, open	

E.g.: Same words as for first objective, but no tactile cues would be provided.