Children's speech acquisition

Sharynne McLeod, Ph.D., Charles Sturt University, Australia (smcleod@csu.edu.au)

This compilation of data on typical speech development for English speaking children is designed to be used by speech-language pathologists. It is organised according to children's ages to reflect a typical developmental sequence. However, it should be noted that rates of development vary among typically developing children. Where possible, data from more than one study is presented under each heading at each age to allow for comparison and to encourage consideration of diversity and individuality.

Authors	Year	Country	No. of children	Age of children	Sample type	Data collection method
Anthony, Bogle, Ingram & McIsaac	1971	UK	510	3;0-6;0	SW	Cross-sectional
Arlt & Goodban	1976	USA	240	3;0-5;5	Single word (SW)	Cross-sectional
Chirlian & Sharpley	1982	Australia	1357	2;6-9;0	Single word (SW)	Cross-sectional
Dodd	1995	UK & Australia	5	1;8 – 3;0	Connected speech	Longitudinal
Dodd, Holm, Hua & Crosbie	2003	UK	684	3;0-6;11	SW	Cross-sectional
Donegan	2002	UK & USA	-	-	-	Compilation
Dyson	1988	USA	20	2;0-3;3	CS	Cross-sectional & longitudinal
Flipsen	2006a, b	USA	320	3;1-8;10	CS	Cross-sectional
Grunwell	1987	UK	-	-	-	Compilation
Haelsig & Madison	1986	USA	50	2;10-5;2	SW	Cross-sectional
James	2001	Australia	354	3;0-7;11	SW	Cross-sectional
James, McCormack & Butcher	1999	Australia	240	5;0-7;11	SW	Cross-sectional
James, van Doorn, McLeod	2001	Australia	354	3;0-7;11	SW	Cross-sectional
James, van Doorn, McLeod	2002	Australia	354	3;0-7;11	SW	Cross-sectional
Kehoe	1997	USA	18	1;10 - 2;10	SW	Cross-sectional
Kehoe	2001	USA	-	1;6 – 2;10	-	Compilation
Kilminster & Laird	1978	Australia	1756	3;0-9;0	SW	Cross-sectional
Lowe, Knutson & Monson	1985	USA	1048	2;7 – 4;6	SW	Cross-sectional
McGlaughlin & Grayson	2003	UK	297	0;1-1;0	Crying	Cross-sectional
McLeod, van Doorn & Reed	2001a	Australia	-	-	-	Compilation
McLeod, van Doorn & Reed	2001b	Australia	16	2;0 – 3;4	CS	Longitudinal
McLeod, van Doorn & Reed	2002	Australia	16	2;0 – 3;4	CS	Longitudinal
Oller, Eilers, Neal, Schwartz	1999	USA	3400	0;10-1;0	CS; Parent report	Cross-sectional & longitudinal
Otomo & Stoel-Gammon	1992	USA	6	1;10 – 2;6	SW	Longitudinal
Paynter & Petty	1974	USA	90	2;0-2;6	SW	Cross-sectional
Pollock	2002	USA (Memphis)	162	1;6 – 6;10	SW & CS	Cross-sectional
Pollock & Berni	2003	USA (Memphis)	165	1;6 – 6;10	SW & CS	Cross-sectional
Porter & Hodson	2001	USA	520	2;6-8;0	SW	Cross-sectional
Prather, Hedrick & Kern	1975	USA	147	2;0-4;0	SW	Cross-sectional
Preisser, Hodson & Paden	1988	USA	60	1;6-2;5	SW	Cross-sectional
Robb & Bleile	1994	USA	7	0;8-2;1	CS	Longitudinal
Robb & Gillon	2007	New Zealand & USA	20	3;1-3;5 (NZ) 2;11-3;5 (US)	CS	Cross-sectional
Robbins & Klee	1987	USA	90	2;6-6;11	SW	Cross-sectional
Roberts, Burchinal & Footoo	1990	USA	145	2;6-8;0	SW	Cross-sectional & longitudinal
Roulstone, Loader, Northstone, Beveridge & ALSPAC team	2002	UK	1127	2;1	SW; Parent report	Single age group
Selby, Robb & Gilbert	2000	USA	4	1;3-3;0	CS	Longitudinal
Shriberg	1993	USA	-	-	-	Compilation
Smit	1993b	USA	997	3;0-9;0	SW	Cross-sectional
Smit	1993a	USA	997	3;0-9;0	SW	Cross-sectional
Smit, Hand, Frelinger, Bernthal & Bird	1990	USA	997	3;0-9;0	SW	Cross-sectional
Snow	1994	USA	9	1;0-1;8	CS	Longitudinal
Stoel-Gammon	1985	USA	34	1;3-2;0	CS	Longitudinal
Stoel-Gammon	1987	USA	33	2;0	CS	Cross-sectional
Stokes	2005	USA	40	2;1	CS	Single age group
Templin	1957	USA	480	3;0-8;0	SW	Cross-sectional
Ttofari Eecen, Reilly & Eadie	2007	Australia	1734	1;0	Parent report	Single age group
Waring, Fisher & Aitken	2001	Australia	299	3;5 – 7;11	SW	Cross-sectional
Watson & Scukanec	1997a, b	USA	12	2;0-3;0	CS	Longitudinal
Wells, Peppé & Goulandris	2004	UK	120	5;6 - 13;9	Test of intonation	Cross-sectional

GLOSSARY. **Acquired sounds**: The age at which a certain percentage (often 75%) of children have acquired a phoneme in initial, medial and final position in single words. **Phonetic inventory**: Repertoire of sounds a child can produce, regardless of the adult target. **Syllable shape**: Structure of a syllable within a word. C = consonant; V = vowel

0;0 – 1;0 year

"The interaction between infants and their caregivers lays so many foundations for later learning" (McLaughlin, 1998, p. 192)

ORAL MECHANISM

Infant cf. adults

Oral space is smaller. Lower jaw smaller and retracted. Sucking pads are present, teeth emerge. Tongue large compared to size of oral cavity and therefore has more restricted movement. (Moves with jaw) Nose breather. Epiglottis and soft palate are in approximation as a protective mechanism. Newborns breathe/swallow at same time. Larynx is higher in newborn Eustachian tube lies in horizontal position. (More vertical in adults)

PERCEPTION

"By at least 2 days of age, the neonate has an ability to discriminate language specific acoustic distinctions…The 12 month old human has developed the capacity to categorise only those phonemes which are in its native language" (Ruben, 1997, p. 203)

CRYING

Mean amount of crying /24 hours

1-3 months = 90 mins, mostly in the evening
4-6 months = 64.7 mins, mostly afternoon
7-9 months = 60.5 mins, afternoon/evening
10-12 months = 86.4 mins, mostly evening
Other studies show decrease at 10+ months
(McGlaughlin & Grayson, 2003)

VOCALISATION

0-6 weeks = reflexive vocalisations: cry, fuss
6-16 weeks = coo and laughter: vowel-like
16-30 weeks = syllable-like vocalisations
(Stark, Bernstein, & Demorest, 1983)
0-0;2 = phonation, quasivowels & glottals
0;2-0;3 = primitive articulation stage: gooing
0;4-0;5= expansion stage: full vowels, raspberries, marginal babbling
(Oller, Eilers, Neal & Schwartz, 1999)

BABBLING

"Late onset of canonical babbling may be a predictor of disorders… [ie.] smaller production vocabularies at 18, 24 & 36 months"
(Oller, Eilers, Neal & Schwartz, 1999, p. 223)

31-50 weeks = reduplicated babbling: series of consonant and vowel-like elements
(Mitchell, 1997; Stark, 1979)
0;6+ = canonical stage: well-formed canonical syllables, reduplicated sequences (e.g., [babababa]) (Oller et al., 1999)

"The sounds babbled most frequently are produced more accurately by English-learning 2-year-olds, and appear more often in the languages of the world, than other sounds." (Locke, 2002, p. 249).

PHONETIC INVENTORY

Consonants

Nasal, plosive, fricative, approximant, labial, lingual (Grunwell, 1981)

1;0 = Mean 4.4 consonants; median 4; range 0-16 (Ttofari-Eecen et al., 2007)
1;0 = /m, d, b, n/ most frequently reported consonants in inventory
(Ttofari-Eecen et al., 2007)

0;8 = 5 consonants in initial position (typically / d, t, k, m, h /); 3 consonants in final position (typically / t, m, h/)
0;9 = 5 consonants in initial position (typically / d, m, n, h, w /); 2 consonants in final position (typically / m, h/)
0;10 = 6 consonants in initial position (typically / b, d, t, m, n, h /); 4 consonants in final position (typically t, m, h, s /)
0;11 = 4 consonants in initial position (typically / d, m, n, h /); 2 consonants in final position (typically /m, h/)
1;0 = 5 consonants in initial position (typically / b, d, g, m, h/); 2 consonants in final position (typically /m, h/)(Robb & Bleile, 1994)

Vowels

"Low, non-rounded vowels are favoured in the first year. Front-back vowel differences appear later than height differences"
(Donegan, 2002)

PHONOLOGICAL PROCESSES

Present

All phonological processes (Grunwell, 1987)

SYLLABLE STRUCTURE

Primarily mono-syllabic utterances
(Bauman-Waengler, 2000, p. 99)

PROSODY

0;10 – 1;0 = Begin with falling contour only. Flat or level contour, usually accompanied by variations such as falsettos or variations in duration of loudness (Marcos, 1987 adapted by Bauman-Waengler, 2000)

1;0 – 2;0 years

"…from 18 to 24 months…the largest growth within the phonological system takes place…also…the child's expressive vocabulary has at least tripled" (Bauman-Waengler, 2000, p. 107)

ORAL MECHANISM

Deciduous teeth continue to emerge

INTELLIGIBILITY

2;0 = 26-50% intelligible (Weiss, 1982)

ACQUIRED SOUNDS

Consonants (females)
2;0 = /m, n, h, g/ (Chirlian & Sharpley, 1982)
Consonants (males)
2;0 = /m, n/ (Chirlian & Sharpley, 1982)
Consonants (all children)
2;0 = / h, w/ (Paynter & Petty, 1974)
2;0 = /m, n, ŋ, h, p/ (Prather, Hedrick, & Kern, 1975)
Consonant clusters
?
Vowels
?

PERCENT CORRECT

Consonants
2;0 = 69.2 (range 53-91) (Watson & Scukanec, 1997b)
Consonant clusters
?
Vowels (USA -nonrhotic)
1;6-1;11 = 82% (range = 69-96) (Pollock & Berni, 2003)

COMMON MISMATCHES

Consonants
?
Consonant clusters
?

PHONOLOGICAL PROCESSES

Present
Final consonant deletion, cluster reduction, fronting of velars, stopping, gliding, context sensitive voicing (Grunwell, 1987)

Declining
Reduplication, consonant harmony (Grunwell, 1987)

PHONETIC INVENTORY

"First words show individual variation in consonants used; phonetic variability in pronunciations" (Grunwell, 1987)
Consonants
/m, p, b, w, n, t, d/ (Grunwell, 1987)
1;0 = 5 consonants in initial position (typically / b, d, g, m, h/); 2 consonants in final position (typically /m, h/)
1;6 = 6 consonants in initial position (typically / b, d, m, n, h, w /); 3 consonants in final position (typically / t, h, s /)
2;0 = 10 consonants in initial position (typically / b, d, p, t, k, m, n, h, s, w /); 4 consonants in final position (typically / t, k, n, s/) (Robb & Bleile, 1994)
1;0 – Mean = 4.4 consonants; median = 4; range 0-16
1;0 – /m, d, b, n/ most frequently reported consonants in inventory (Ttofari-Eecen et al., 2007)
Vowels (USA)
1;3 = /ɪ, ʊ, ʌ, ɑ/
1;6 = /i, u, ʊ, ʌ, ɔ, ɑ, æ/
1;9 = /i,ɪ , u, ɛ, o, ʌ, ɔ, ɑ/
2;0 = /i, ɪ, u, ɛ, e, o, ɔ, ɑ, æ/ (Selby, Robb & Gilbert, 2000)

SYLLABLE STRUCTURE

?

PROSODY

Young children acquire skills that control intonation earlier than final syllable timing skills (Snow, 1994).
1;1 – 1;3 = Rising contour. High falling contour that begins with a high pitch and drops to a lower one
prior to 1;6 = high rising and high rising-falling contour
around 1;6 = falling-rising contour. Rising-falling contour (Marcos, 1987 adapted by Bauman-Waengler, 2000)

METALINGUISTIC SKILLS

1;6-2;0 = monitor own utterances: repair spontaneously, adjust speech to different listeners, practice sounds, words, sentences (Clark, adapted by Owens, 1996, p. 386)

2;0 – 3;0 years

"Unlike toddlers, preschoolers develop more freedom of movement and therefore, soon become trailblazers in every sense of the word" (McLaughlin, 1998, p. 271

ORAL MECHANISM

During first 3 years of life:
Oral space enlarges. Growth of lower jaw + other bony structures. Disappearance of sucking pads. Increased muscle tone and "skilled" tongue movement. (Tongue movement become dissociated from jaw movement. Important for feeding & speech) Lowering & more sophisticated movement of larynx. Separation of epiglottis & soft palate.

DDK (2;6 – 2;11)
/pʌ/= 3.7 per second; /tʌ/ = 3.7 per second
/kʌ/ = 3.65 per second; patticake = 1.26/sec
(Robbins & Klee, 1987)

Maximum phonation time
2;6 – 2;11 = 5.55sec (Robbins & Klee, 1987)

INTELLIGIBILITY

2;1 = "…children were mostly intelligible to their parents with 12.7% parents finding their child difficult to understand and only 2.1% of parents reporting that they could rarely understand their child"
(Roulstone et al., 2002, p. 264)

3;0 = 95.68% (88.89–100.00)
% of words that could be reliably understood by the transcriber (Flipsen, 2006b)

2;0 = 26-50% intelligible
2;6 = 51-70% intelligible
3;0 = 71-80% intelligible (Weiss, 1982)

3;0 = 73% (50-80%) intelligible judged by three unfamiliar listeners. The children who used more complex sentences were more difficult to understand (Vihman, 1988)

ACQUIRED SOUNDS

Consonants (females)
≤3;0 = /m, n, h, w, p, b, t, d, k, g, f/
3;0 = + / s/ (Smit, et al., 1990)

2;0 = /m, n, h, g/
2;6 = + / p, ŋ, w, t, d, k/
3;0 = + / j, f/ (Chirlian & Sharpley, 1982)

3;0 = /h, ŋ, p, m, w, b, n, d, t, k, ʒ, f/
(Kilminster & Laird, 1978)

Consonants (males)
≤3;0 & 3;0 = /m, n, h, w, p, b, t, d, k, g/
(Smit, et al., 1990)

2;0 = /m, n/
2;6 = + / ŋ, d/
3;0 = + / p, b, h, w, k, g/ (Chirlian & Sharpley, 1982)

3;0 = /h, ŋ, p, m, w, b, n, d, j, g, ʒ/
(Kilminster & Laird, 1978)

Consonants (all children)
2;0 = /h, w/
2;6 = + /p, b, t, m/ (Paynter & Petty, 1974)

2;0 = /m, n, ŋ, h, p/
2;4 = +/ j, d, k, f/
2;8 = +/ w, b, t/
3;0 = +/g, s/
(Prather, Hedrick, & Kern, 1975)

3;0 = / p, b, t, d, k, g, m, n, ŋ, h, f, w /
(Arlt & Goodban, 1976)

3;0 = / p, b, t, d, k, g, m, n, ŋ, f, v, s, z, h, w, l, j / (Dodd et al., 2003)

Consonant clusters
"Two-year-old children can produce consonant clusters, but these may not be of the same form as the ambient language"
(McLeod, van Doorn & Reed, 2001a)

Vowels
"The literature on vowel development suggests that vowels are acquired early, both in production and perception. There is considerable variability in their production, but most studies suggest that vowel production is reasonably accurate by age 3, although some studies call this into question." (Donegan, 2002, p. 2)

1;10-2;6= /i, ɑ/ mastered early, /e, æ/ next, /ɪ, ɛ/ least accurate
(Otomo & Stoel-Gammon, 1992)

PERCENT CORRECT

Consonants
PCC = 70% (Stoel-Gammon, 1987)

2;0 = 69.2% (range 53-91)
2;3 = 69.9% (range 51-91)
2;6 = 75.1% (range 61-94)
2;9 = 82.1% (range 63-96)
3;0 = 86.2% (range 73-99)
(Watson & Scukanec, 1997b)

3;0-3;11 = 82.11% (Dodd et al., 2003)

Consonant clusters
2;0-3;4 = 29.5% (mean); 0.0 - 79.1% (range) in conversational speech
(McLeod, van Doorn & Reed, 2001b)

Vowels (UK)
3;0-3;11 = 97.39% (Dodd et al., 2003)

Vowels (USA - nonrhotic)
2;0-2;5 = 92.4% (range = 78-100)
2;6-2;11 = 93.9% (range = 78-100)
(Pollock, 2002; Pollock & Berni, 2003)

Vowels (USA - rhotic)
2;0-2;5 = 37.5% (range = 0-87)
2;6-2;11 = 62.5% (range = 0-100)
(Pollock, 2002)

PERCENT ERROR

Consonants
2;7 = mean error rate for velars = 31%
2;7 = mean error rate for fricatives = 38%
2;7 = mean error rate for liquids = 57%
(Roulstone et al., 2002)

Consonant clusters
2;7 = mean error rate 72% (Roulstone et al., 2002)

COMMON MISMATCHES

Consonants (>15%)
ŋ → n; j→ ø; l→ w; r→ w; v→b; θ→f; ð→ d; s→ dentalised; z→d; ʃ→ s; tʃ→ t/d; ʒ→d (Smit, 1993a)

Consonant clusters (>15%)
pr→p, pw; br→b, bw; tr→t, tw; dr→d, dw; kr→k, kw; gr→g, gw; fr→f, fw; θr→f, θw; sw→w; sm→m; sn→n; sp→p, b; st→t, d; sk→k, skw→k, t, kw, gw; spl→p, b, pl, pw; spr→p, pw, pr, sp; str→t, d, st, tw, sw; skr→k, w, kw, gw, fw (Smit, 1993b)

PHONOLOGICAL PROCESSES

Present
Cluster reduction, fronting of velars, fronting /ʃ/, stopping /v, θ, ð, tʃ, dʒ/, gliding, context sensitive voicing (Grunwell, 1987)

Most prevalent = cluster reduction & liquid deviations (gliding) (Preisser et al., 1988)

2;0 = final consonant deletion, liquid simplification, later stopping, cluster reduction, vowelisation
3;0 = later stopping, cluster simplification
(Watson & Scukanec, 1997b)

2;7-3;0 = 23% fronting
(Lowe, Knutson & Monson, 1985)

Declining

Final consonant deletion (Grunwell, 1987)

Affrication, depalatisation, gliding, meathesis, prevocalic voicing, vowel changes (James, 2001)

PHONETIC INVENTORY

Consonants (word-initial)

9-10 consonants (Stoel-Gammon, 1987)

2;0 = /p, b, t, d, k, m, n, s, f, h, w, j/

2;3 = /p, b, t, d, k, g, m, n, s, f, h, w, j, l/

2;6 = /p, b, t, d, k, g, m, n, s, f, h, tʃ, w, j, l/

2;9 = /p, b, t, d, k, g, m, n, s, f, h, tʃ, w, j, l/

3;0 = /p, b, t, d, k, g, m, n, s, f, h, tʃ, ð, w, j, l/
(Watson & Scukanec, 1997b)

/m, p, b, w, n, t, d, (ŋ), (k), (g), h/
(Grunwell, 1987)

2;0, 2;5, 2;9 = /p, b, t, d, k, g, f, s, h, m, n, w, j, l/ (Dyson, 1988)

Consonants (word-final)

5-6 final consonants (Stoel-Gammon, 1987)

2;0 = /p, t, k, m, n, s, z/

2;3 = /p, t, d, m, n, s, z/

2;6, 2;9, 3;0 = /p, t, d, k, m, n, s, z, l, r/
(Watson & Scukanec, 1997b)

2;0 = /p, t, d, k, tʃ, ʔ, f, s, ʃ, m, n/

2;5 = /p, t, d, k, tʃ, ʔ, f, s, ʃ, m, n, ŋ, ɚ/

2;9 = /p, t, k, ʔ, f, s, ʃ, m, n, ɚ/ (Dyson, 1988)

Consonant clusters

"A few clusters" (Stoel-Gammon, 1987)

2;6 = /pw, bw, -nd, -ts/

2;9 = /pw, bw, bl, -nd, -ts, -nt, -nz/

3;0 = /st, sp, pl, -nd, -ts, -nt, -nz, -st, -ŋk/
(Watson & Scukanec, 1997b)

2;0 = /fw, -ts (-ŋk)/

2;5 = /(fw), (bw), -ts, (-ps), (ntʃ), (ŋk)//

2;9 = /(fw), (kw), (-ps), (-ts), (-nts), (-ŋk)/
(Dyson, 1988)

2;0 = predominantly word-initial consonant clusters containing /w/ (e.g., [bw, kw])

3;0 = range of word-initial clusters predominantly containing /l/, /w/ or /s/. Common word-final clusters contained nasals (e.g., [-nd, -nt, -ŋk]).
(McLeod, van Doorn & Reed, 2001b)

Vowels

2;0 = /i, ɪ, u, ɛ, e, o, ɔ, ɑ, æ/

3;0 = /i, ɪ, u, ʊ, ɛ, e, o, ʌ, ɔ, ɜ, ɑ, æ/
(Selby, Robb & Gilbert, 2000)

SYLLABLE STRUCTURE

Syllable shapes

CV, CVC, CVCV, CVCVC
(Stoel-Gammon, 1987)

CV, VC, CVC, 2-syllable (Shriberg, 1993)

Monosyllabic words - V, CV, VC, CVC, CCVC, CVCC, CCVCC, CCVCCC, CCCCVC

Polysyllabic words - V, CV, VC, CVC, CCVC
(Dodd, 1995; Watson & Skucanec, 1997)

PROSODY

"Significantly greater number of stress errors in SWS words (S = strong; W = weak). Tendency for greater number of stress errors in SWSW words. Stress errors were more frequent in imitated than spontaneous productions." (Kehoe, 1997)

"An analysis of children's truncation error syllable deletion patterns revealed the following robust findings:

(a) Stressed and word-final unstressed syllables are preserved more frequently than nonfinal unstressed syllables,

(b) word-internal unstressed syllables with obstruent onsets are preserved more frequently than word-internal syllables with sonorant onsets,

(c) unstressed syllables with non-reduced vowels are preserved more frequently than unstressed syllables with reduced vowels,

(d) right-sided stressed syllables are preserved more frequently than left-sided stressed syllables.

An analysis of children's stress patterns revealed that children made greater numbers of stress errors in target words with irregular stress." (Kehoe, 2001, p. 284)

METALINGUISTIC SKILLS

1;6-2;0 = monitor own utterances: repair spontaneously, adjust speech to different listeners, practice sounds, words, sentences (Clark, adapted by Owens, 1996, p. 386)

3;0 – 4;0 years

"A client 3 years of age or older who is unintelligible is a candidate for treatment" (Bernthal & Bankson, 1998, p. 272)

ORAL MECHANISM

3 yrs = adult-like swallow

DDK (3;0 – 3;5/ 3;6 – 3;11)

/pʌ/= 4.66/ 4.81 per second

/tʌ/ = 4.56/ 4.78 per second

/kʌ/ = 3.82/ 4.83 per second

patticake = 1.36/ 1.75 per second

(Robbins & Klee, 1987)

Maximum phonation time

/a/ = 5.51/ 7.79sec (Robbins & Klee, 1987)

INTELLIGIBILITY

3;0 = 95.68% (88.89–100.00)

4;0 = 96.82% (88.42–100.00)

% of words that could be reliably understood by the transcriber (Flipsen, 2006b)

3;0 = 71-80% intelligible (Weiss, 1982)

3;0 = 73% (50-80%) intelligible judged by three unfamiliar listeners (Vihman, 1988)

"A client 3 years of age or older who is unintelligible is a candidate for treatment" (Bernthal & Bankson, 1998, p. 272)

ACQUIRED SOUNDS

"3-year-olds had acquired all major phoneme classes, except liquids…sibilant lisps were still common until the age of 7 years" (Porter & Hodson, 2001, p.165)

Consonants (females)

3;0 = /m, n, h, w, p, b, t, d, k, g, f, s/

3;6 = + / j /

4;0 = +/ v, ð, ʃ, tʃ/ (Smit, et al., 1990)

3;0 = / m, n, h, g, p, ŋ, w, t, d, k, j, f/

3;6 = + / b, ʃ, tʃ, s/

4;0 = + /l, ʒ, dʒ/ (Chirlian & Sharpley, 1982)

3;0 = /h, ŋ, p, m, w, b, n, d, t, k, ʒ, f/

3;6 = +/ j, g, l /

4;0 = + / ʃ, tʃ, dʒ / (Kilminster & Laird, 1978)

Consonants (males)

3;0 = /m, n, h, w, p, b, t, d, k, g/

3;6 = + / j, f /

4;0 = +/ dʒ / (Smit, et al., 1990)

3;0 = / m, n, ŋ, d, p, b, h, w, k, g/

3;6 = + /j, t, f, l, ʃ, tʃ, dʒ/

4;0 = + /s/ (Chirlian & Sharpley, 1982)

3;0 = /h, ŋ, p, m, w, b, n, d, j, g, ʒ/

3;6 = + / k, f /

4;0 = as above (Kilminster & Laird, 1978)

Consonants (all children)

3;0 = / p, b, t, d, k, g, m, n, ŋ, h, f, w /

3;6 = + /v/

4;0 = + / s, z, ʒ, tʃ, dʒ, l/ (Arlt & Goodban, 1976)

3;0 = /m, n, ŋ, h, p, j, d, k, f, w, b, t, g, s/

3;4 = +/l, r/

3;8 = +/ʃ, tʃ/

4;0 = +/ð, ʒ/ (Prather, Hedrick, & Kern, 1975)

3;0 = / p, b, t, d, k, g, m, n, ŋ, f, v, s, z, h, w, l, j /

3;6 = +/tʃ/

4;0 = +/ʒ, dʒ/ (Dodd et al., 2003)

Consonant clusters

3;6 (males & females)= /tw, kw/

4;0 (females) = /tw, kw, pl, bl, kl/

4;0 (males) = /tw, kw/ (Smit, et al., 1990)

4;0 = /tw, kw, sp, st, sk, sm, sn, pl, bl, kl, gl, pr, br, tr, dr, kr, gr/ (Templin, 1957)

4;0 = /kw/ (Anthony et al., 1971)

Vowels

Paradigmatic production (ie production of individual vowels) is generally mastered by 3 years. However, syntagmatic production (production of vowels in context such as polysyllabic words) takes up to at least 6 years (James, van Doorn & McLeod, 2001)

PERCENT CORRECT

Consonants

3;0-3;11 = 76.77% in monosyllabic words

3;0-3;11 = 76.41% in polysyllabic words (James, van Doorn & McLeod, 2002)

3;5-3;11 = 85.2% (Waring, Fisher, Atkin, 2001)

3;0-3;11 = 82.11% (Dodd et al., 2003)

Consonant clusters

3;5-3;11 = 86.4%(Waring, Fisher, Atkin, 2001)

Vowels (Australian)

3;0-3;11 = 94.9% in monosyllabic words

3;0-3;11 = 88.28% in polysyllabic words (James, van Doorn & McLeod, 2001)

Vowels (UK)

3;0-3;11 = 97.39% (Dodd et al., 2003)

Vowels (USA - nonrhotic)

3;0-3;5 = 97.3% (range = 89-100)

3;6-3;11 = 97.2% (range = 91-100) (Pollock, 2002; Pollock & Berni, 2003)

Vowels (USA - rhotic)

3;0-3;5 = 79.2% (range = 4-100)

3;6-3;11 = 76.5% (range = 4-100) (Pollock, 2002)

COMMON MISMATCHES

Consonants (>15%)

ŋ→ n; r→ w; v→b; θ→f; ð→ d; s→ dentalised (Smit, 1993a)

Consonant clusters (>15%)

pr→pw; br→bw; tr→tw; dr→dw; kr→kw; gr→gw; fr→fw; θr→fr; st→θt; skw→θkw; spl→ θpl, spw; spr→ θpr, spw; str→ θtr, stw; skr→ θkr, skw (Smit, 1993b)

PHONOLOGICAL PROCESSES

Present

Stopping /v, θ, ð/, fronting /ʃ, tʃ, dʒ/, gliding, (Grunwell, 1987)

3;0-3;6 Gliding of liquids, weak syllable deletion, glottal replacement, alveolar & labial assimilation, cluster reduction, stopping, vocalization, final consonant deletion (Haelsig & Madison, 1986)

3;0-3;11 gliding, deaffrication, cluster reduction, fronting, weak syllable deletion, (stopping – only used by 3;0-3;5) (Dodd et al., 2003)

Declining

Cluster reduction (Grunwell, 1987)

Backing, cluster reduction, deaffrication, final consonant deletion, final devoicing, initial consonant deletion, labial assimilation, palatalisation, stopping, unstressed syllable deletion, fricative simplification (James, 2001)

PHONETIC INVENTORY

Consonants

/m, p, b, w, n, t, d, ŋ, k, g, h, f, w, s, (l), j, h/ (Grunwell, 1987)

initial = /p, b, t, d, k, g, f, s, h, m, n, w, j, l, r/;
final = /p, t, d, k, ʔ, f, v, s, z, ʃ, m, n, ŋ, r, ɚ/

(Dyson, 1988)

Consonant clusters

3;3 = /-ts, (fw), (kw), (tr), (sp), (st), (sn), (sl), (bw), (-ps), (-ns), (-ntʃ), (-ŋk)/ (Dyson, 1988)

Obstruent + approximant used, /s/ clusters may occur (Grunwell, 1987)

3;0 = range of word-initial clusters predominantly containing /l/, /w/ or /s/. Common word-final clusters contained nasals (e.g., [-nd, -nt, -ŋk]).

(McLeod, van Doorn & Reed, 2001b)

Vowels

N.Zealand /i, e, u, o, ɒ, ɪ, ɛ, æ, ə, ʌ, ɔ, ʊ/

USA /i, e, u, o, ɒ, ɪ, ɛ, æ, ə, ʌ, ɔ, ʊ, ɜ˞, ə˞/

(Robb & Gillon, 2007)

SYLLABLE STRUCTURE

CV, VC, CVC, Cn_ or _Cn, 2-syllable (Shriberg, 1993)

Average number of syllables/words

3;0 = 1.26

4;0 = 1.27 (Flipsen, 2006a)

PROSODY

Speaking rate

New Zealand = 182 syllables per minute; 7.15 phones per second

USA = 208 syllables per minute; 8.17 phones per second (Robb & Gillon, 2007)

Stress

"…after 2 years of age, deletion of stressed syllables is relatively infrequent, and after 3 years of age, deletion of unstressed syllables is less frequent" (Kehoe, 2001,291)

PHONOLOGICAL AWARENESS

Emerging skills (Dodd & Gillon, 2001)

"The majority of 4-year-old children… will not exhibit phonological awareness other than syllable segmentation and the emergence of rhyme awareness" (Dodd & Gillon, 2001,142)

4;0 – 5;0 years

"Five-year-old children are producing long, complex sentences…and maintaining a topic for several turns. In a few short years, children move much closer to the adult level of linguistic and communicative competence." (James, 1990, p. 74)

ORAL MECHANISM

DDK (4;0 – 4;5/ 4;6 – 4;11)
/pʌ/= 4.89/ 4.64 per second
/tʌ/ = 4.77/ 4.46 per second
/kʌ/ = 4.58/ 4.29 per second
patticake = 1.56/ 1.33 per second
(Robbins & Klee, 1987)

Maximum phonation time
/a/ = 8.01/ 9.22sec (Robbins & Klee, 1987)

INTELLIGIBILITY

"A client 3 years of age or older who is unintelligible is a candidate for treatment"
(Bernthal & Bankson, 1998, p. 272)

3;0 = 95.68% (88.89–100.00)
4;0 = 96.82% (88.42–100.00)
5;0 = 98.05% (89.84–100.00)
% of words reliably understood by the transcriber (Flipsen, 2006b)

4;0 = 93% (73-100%) intelligible in conversational speech with unfamiliar listeners (Gordon-Brannan, 1993 cited in Gordon-Brannan, 1994).

ACQUIRED SOUNDS

Consonants (females)
4;0 = /m, n, h, w, p, b, t, d, k, g, f, s, j, v, ð, ʃ, tʃ/
4;6 = + /dʒ, l/ 5;0 = + /z/ (Smit, et al., 1990)

4;0 = / m, n, h, g, p, ŋ, w, t, d, k, j, f, b, ʃ, tʃ, s, l, ʒ, dʒ/
5;0 = + /r, v / (Chirlian & Sharpley, 1982)

4;0 = /h, ŋ, p, m, w, b, n, d, t, k, ʒ, f, j, g, l, ʃ, tʃ, dʒ/
4;6 = + /s, z/ 5;0 = + /r/ (Kilminster & Laird, 1978)

Consonants (males)
4;0 = /m, n, h, w, p, b, t, d, k, g, j, f , dʒ/
4;6 = + v, z/ 5;0 =+ /s, ʃ, tʃ/ (Smit, et al., 1990)

4;0 = / m, n, ŋ, d, p, b, h, w, k, g, j, t, f, l, ʃ, tʃ, dʒ, s/
4;6 = + /ʒ/ 5;0 = + /r/ (Chirlian & Sharpley, 1982)

4;0 = /h, ŋ, p, m, w, b, n, d, j, g, ʒ, k, f /
4;6 = /t, l, ʃ, tʃ, dʒ/
5;0 = /r/ (Kilminster & Laird, 1978)

Consonants (all children)
4;0 = / p, b, t, d, k, g, m, n, ŋ, h, f, w, v, s, z, ʒ, tʃ, dʒ, l/
4;6 = + /ʃ/
5;0 = + /θ, ð, r / (Arlt & Goodban, 1976)

4;0 = /m, n, ŋ, h, p, j, d, k, f, w, b, t, g, s, l, r, ʃ, tʃ, ð, ʒ/
>4;0 = +/v, θ, z, dʒ/
(Prather, Hedrick, & Kern, 1975)

4;0 = / p, b, t, d, k, g, m, n, ŋ, f, v, s, z, h, w, l, j, tʃ, ʒ, dʒ/
5;0 = +/ʃ/ (Dodd et al., 2003)

Consonant clusters (all children)
4;0 = /tw, kw, sp, st, sk, sm, sn, pl, bl, kl, gl, pr, br, tr, dr, kr/
4;6 = /tw, kw, sp, st, sk, sm, sn, pl, bl, kl, gl, pr, br, tr, dr, kr, gr, fr/
5;0 = /tw, kw, sp, st, sk, sm, sn, pl, bl, kl, gl, fl, pr, br, tr, dr, kr, gr, fr, str/ (Templin, 1957)

4;0 = /kw/
4;6 = +/kr, fl/
5;0 = +/gl, tr, kl, br/ (Anthony et al., 1971)

Consonant clusters (females)
4;0 = /tw, kw, pl, bl, kl/
4;6 = /tw, kw, sp, st, sk, sw, pl, bl, kl, gl, fl, kr, skw/
5;0 = same as for 4;6 (Smit, et al., 1990)

Consonant clusters (males)
4;0 = /tw, kw/
4;6 = /tw, kw, gl/
5;0 = /tw, kw, sp, st, sn, bl, gl, dr/
(Smit et al., 1990)

Vowels
Paradigmatic production (ie production of individual vowels) is generally mastered by 3 years. However syntagmatic production (production of vowels in context such as polysyllabic words) takes up to at least 6 years of age.
(James, van Doorn & McLeod, 2001)

PERCENT CORRECT

Consonants
4;0-4;11 = 83.97% in monosyllabic words
4;0-4;11 = 82.45% in polysyllabic words
(James van Doorn & McLeod, 2002)
4;0-4;11 = 88.5% (Waring, Fisher, Atkin, 2001)
4;0-5;5 = 90.37% (Dodd et al., 2003)

Consonant clusters
4;0-4;11 = 88.1% (Waring, Fisher, Atkin, 2001)

Vowels (UK)
4;0-5;5 = 98.93% (Dodd et al., 2003)

Vowels (Australian)
4;0-4;11 = 95.2% in monosyllabic words
4;0-4;11 = 92.08% in polysyllabic words
(James van Doorn & McLeod, 2001)

Vowels (USA - nonrhotic)
4;0-4;5 = 98% (range = 91-100)
4;6-4;11 = 99% (range = 94-100)
(Pollock, 2002; Pollock & Berni, 2003)

Vowels (USA - rhotic)
4;0-4;5 = 90.1% (range = 37-100)
4;6-4;11 = 86.8% (0-100) (Pollock, 2002)

COMMON MISMATCHES

Consonants (>15%)
θ→f; s→ dentalised (Smit, 1993a)

Consonant clusters (>15%)
pr→pw; br→bw; tr→tw; dr→dw; kr→kw; gr→gw; fr→fw; θr→fr; st→θt; skw→θkw; spl→ θpl, spw; spr→ θpr, spw; str→ θtr, stw; skr→ θkr, skw (Smit, 1993b)

PHONOLOGICAL PROCESSES

Present
/θ/ -> [ŋ], /ð/ -> [d, v], palatisation of /ʃ, tʃ, dʒ/, gliding (Grunwell, 1987)
4;0-4;6 Weak syllable deletion, vocalization, gliding of liquids (20% criterion)
(Haelsig & Madison, 1986)

4;0-4;11 Gliding, deaffrication, cluster reduction (3 element clusters only)
(Dodd et al., 2003)

Declining
Cluster reduction (Grunwell, 1987)
Depalatalisation, gliding, glottal replacement
(James, 2001)

PHONETIC INVENTORY

Consonants
/m, p, b, w, n, t, d, ŋ, k, g, h, f, v, w, s, z, ʃ, tʃ, dʒ, l, r, j, h/ (Grunwell, 1987)

Consonant clusters
obstruent + approximant; /s/ clusters (may be "immature") (Grunwell, 1987)

SYLLABLE STRUCTURE

CV, VC, CVC, Cn_, _Cn, Cn_Cn, 2-syllable, 3-syllable (Shriberg, 1993)

Average number of syllables/words
4;0 = 1.27; 5;0 = 1.29 (Flipsen, 2006a)

5;0 – 6;0 years

"By the time children enter school, their phonological development has progressed considerably" (Bauman-Waengler, 2000, p. 118)

ORAL MECHANISM

DDK (5;0 – 5;5/ 5;6 – 5;11)
/pʌ/= 4.76/ 5.09 per second
/tʌ/ = 4.82/ 5.22 per second
/kʌ/ = 4.56/ 4.91 per second
patticake = 1.58/ 1.65 per second
(Robbins & Klee, 1987)

Maximum phonation time
/a/ = 8.06/ 9.42sec (Robbins & Klee, 1987)

INTELLIGIBILITY

5;0 = 98.05% (89.84–100.00)
6;0 = 98.43% (91.67–100.00)
% of words that could be reliably understood by the transcriber (Flipsen, 2006b)

Intelligible (Gordon-Brannan, 1994)

ACQUIRED SOUNDS

Consonants
"By age 5, /l/ was acquired (93.4%) and /r/ was almost at criterion (84.8%). By age 6, all of the phonological deviation means, including liquids, were less than 5%."
(Porter & Hodson, 2001, p. 169)

Consonants (females)
5;0 = /m, n, h, w, p, b, t, d, k, g, f, s, j, v, ð, ʃ, tʃ, dʒ, l , z/
5;6 = + /ŋ, θ/
6;0 = + /r/ (Smit, et al., 1990)

5;0 = / m, n, h, g, p, ŋ, w, t, d, k, j, f, b, ʃ, tʃ, s, l, ʒ, dʒ r, v/
No more at 5;6 or 6;0 (Chirlian & Sharpley, 1982)

5;0 = /h, ŋ, p, m, w, b, n, d, t, k, ʒ, f, j, g, l, ʃ, tʃ, dʒ, s, z, r/
5;6 = + / v/ (Kilminster & Laird, 1978)

Consonants (males)
5;0 = /m, n, h, w, p, b, t, d, k, g, j, f , dʒ, v, z, s, ʃ, tʃ/
5;6 = /ð, r/
6;0 = /ŋ, θ, z, l/ (Smit, et al., 1990)

5;0 = / m, n, ŋ, d, p, b, h, w, k, g, j, t, f, l, ʃ, tʃ, dʒ, s, ʒ , r/
No more at 5;6 or 6;0 (Chirlian & Sharpley, 1982)

5;0 = /h, ŋ, p, m, w, b, n, d, j, g, ʒ, k, f, t, l, ʃ, tʃ, dʒ, r/
No more 5;6 or 6;0 (Kilminster & Laird, 1978)

Consonants (all children)
5;0 = / p, b, t, d, k, g, m, n, ŋ, h, f, w, v, s, z, ʒ, tʃ, dʒ, l, ʃ, θ, ð, r /(Arlt & Goodban, 1976)

5;0 = / p, b, t, d, k, g, m, n, ŋ, f, v, s, z, h, w, l, j, tʃ, ʒ, dʒ, ʃ/
6;0 = +/r/ (Dodd et al., 2003)

Consonant clusters (all children)
5;0 = /tw, kw, sp, st, sk, sm, sn, pl, bl, kl, gl, fl, pr, br, tr, dr, kr, gr, fr, str/
6;0 = /tw, kw, sp, st, sk, sm, sn, pl, bl, kl, gl, fl, pr, br, tr, dr, kr, gr, fr, skw, str/
(Templin, 1957)

5;0 = /kw, kr, fl, gl, tr, kl, br/
5;6 = +/sl/
>5;6 = +/θr, sm, st, str, sp/
(Anthony et al., 1971)

Consonant clusters (females)
5;0 = /tw, kw, sp, st, sk, sw, pl, bl, kl, gl, fl, kr, skw/
5;6 = /tw, kw, sp, st, sk, sm, sn, sw, pl, bl, kl, gl, fl, kr, skw/
6;0 = /tw, kw, sp, st, sk, sm, sn, sw, sl, pl, bl, kl, gl, fl, pr, br, tr, dr, kr, gr, fr, skw, spl/
(Smit, et al., 1990)

Consonant clusters (males)
5;0 = /tw, kw, sp, st, sn, bl, gl, dr/
5;6 = /tw, kw, sp, st, sn, pl, bl, kl, gl, fl, pr, tr, kr, gr, fr, dr/
6;0 = /tw, kw, sp, st, sk, sn, sw, pl, bl, kl, gl, fl, pr, br, tr, kr, gr, fr, dr/ (Smit, et al., 1990)

Vowels
Paradigmatic production (ie production of individual vowels) is generally mastered by 3 years. However syntagmatic production (production of vowels in context such as polysyllabic words) takes up to at least 6 years of age. (James et al., 2001)

PERCENT CORRECT

Consonants
5;0-5;11 = 89.54% in monosyllabic words
5;0-5;11 = 88.36% in polysyllabic words
(James van Doorn & McLeod, 2002)

5;0-5;11 = 93.4% (Waring, Fisher, Atkin, 2001)

4;0-5;5 = 90.37%
5;6-7;0 = 95.86% (Dodd et al., 2003)

Consonant clusters
5;0-5;11 = 94.9% (Waring, Fisher, Atkin, 2001)

Vowels (UK)
4;0-5;5 = 98.93% (Dodd et al., 2003)
5;6-7;0 = 99.19% (Dodd et al., 2003)

Vowels (Australian)
5;0-5;11 = 94.8% in monosyllabic words
5;0-5;11 = 94.3% in polysyllabic words
(James van Doorn & McLeod, 2001)

Vowels (USA -nonrhotic)
5;0-5;5 = 99% (range = 98-100)
5;6-5;11 = 99% (range = 98-100)
(Pollock, 2002; Pollock & Berni, 2003)

Vowels (USA - rhotic)
5;0-5;5 = 88.2% (range = 0-100)
5;6-5;11 = 80.31% (range = 0-100)
(Pollock, 2002)

COMMON MISMATCHES

Consonants (>15%)
Nil (Smit, 1993a)

Consonant clusters (>15%)
> 5;6 = pr→pw; br→bw; tr→tw; dr→dw; kr→kw; gr→gw; skw→θkw; spl→ θpl, spw; spr→ θpr, spw; str→ θtr, stw; skr→ θkr, skw (Smit, 1993b)

PHONOLOGICAL PROCESSES

Declining
Deaffrication, epenthesis, metathesis, fricative simplification (v/ð) (James, 2001)

5;0-5;11 Gliding (Dodd et al., 2003)

SYLLABLE STRUCTURE

CV, VC, CVC, Cn_, _Cn, Cv_Cn, 2 syllable, 3+ syllable (Shriberg, 1993)

Average number of syllables/words
5;0 = 1.29
6;0 = 1.30 (Flipsen, 2006a)

PHONETIC INVENTORY

Consonants
/m, p, b, w, n, t, d, ŋ, k, g, h, f, v, θ, ð, w, s, z, ʃ, ʒ, tʃ, dʒ, l, r, j, h/ (Grunwell, 1987)

PROSODY

"The ability to produce intonation functionally is largely established in five-year-olds though some specific functional contrasts are not mastered until C.A. 8;7"
(Wells, Peppé & Goulandris, 2004, p. 749)

PHONOLOGICAL AWARENESS

5;0 – 5;5 = syllable segmentation, rhyme awareness, alliteration awareness, phoneme isolation (+ letter knowledge, UK)
5;6 – 5;11 = phoneme segmentation (Dodd & Gillon, 2001)

6;0+ years

"As time goes on, it becomes more difficult to clearly number the individual developments. Major changes may be less specific…" (McLaughlin, 1998, p. 353)

ORAL MECHANISM

6 yrs = skull reaches adult size
6 yrs = permanent teeth emerge
7-10yrs = lower face "growth spurt"
9-13 = tongue and lips "growth spurt"
Mandible + tongue + lips continue to grow until 16 yrs (girls) and 18 yrs (boys) (Bauman-Waengler, 2000)

DDK (6;0 – 6;5/ 6;6 – 6;11)
/pʌ/= 5.36/ 5.51 / sec /tʌ/ = 5.32/ 5.37 /sec
/kʌ/ = 4.94/ 4.85 /sec patticake = 1.61/ 1.64
(Robbins & Klee, 1987)

Maximum phonation time
/a/ = 10.99/11.47sec (Robbins & Klee, 1987)

INTELLIGIBILITY

6;0 = 98.43% (91.67–100.00)
7;0 = 99.51% (97.36–100.00)
8;0 = 99.01% (197.07–100.00)
% of words that could be reliably understood by the transcriber (Flipsen, 2006b)

Intelligible (Gordon-Brannan, 1994).

ACQUIRED SOUNDS

Consonants (females)
6;0 = ALL = /m, n, h, w, p, b, t, d, k, g, f, s, j, v, ð, ʃ, tʃ, dʒ, l , z, ŋ, θ, r/ (Smit, et al., 1990)

6;0 = / m, n, h, g, p, ŋ, w, t, d, k, j, f, b, ʃ, tʃ, s, l, ʒ, dʒ r, v/
7;6 = + /θ, ð/ (Chirlian & Sharpley, 1982)

6;0 = /h, ŋ, p, m, w, b, n, d, t, k, ʒ, f, j, g, l, ʃ, tʃ, dʒ, s, z, r, v/
7;6 = + /θ, ð/ (Kilminster & Laird, 1978)

Consonants (males)
6;0 = / m, n, ŋ, d, p, b, h, w, k, g, j, t, f, l, ʃ, tʃ, dʒ, s, ʒ , r/
7;6 = +/ð/ 8;0 = + /θ/
9;0 = + /v/ (/z/ not achieved)
(Chirlian & Sharpley, 1982)

6;0 = ALL = /m, n, h, w, p, b, t, d, k, g, j, f , dʒ, v, z, s, ʃ, tʃ, ð, r, ŋ, θ, z, l/
(Smit, et al., 1990)

6;0 = /h, ŋ, p, m, w, b, n, d, j, g, ʒ, k, f, t, l, ʃ, tʃ, dʒ, r/
6;6 = + /s, z, v/ (/θ, ð/ not achieved by 9;0)
(Kilminster & Laird, 1978)

Consonants (all children)
6;0 = / p, b, t, d, k, g, m, n, ŋ, f, v, s, z, h, w, l, j, tʃ, ʒ, dʒ, ʃ, r/
>6;6 = +/θ, ð/ (Dodd et al., 2003)

Consonant clusters (all children)
6;0 = /tw, kw, sp, st, sk, sm, sn, pl, bl, kl, gl, fl, pr, br, tr, dr, kr, gr, fr, skw, str/
7;0 = /tw, kw, sp, st, sk, sm, sn, sw, sl, pl, bl, kl, gl, fl, pr, br, tr, dr, kr, gr, fr, θr, skw, spl, spr, str, skr/ (Templin, 1957)

6;0 = / p, b, t, d, k, g, m, n, ŋ, f, v, s, z, h, w, l, j, tʃ, ʒ, dʒ, ʃ, r/
>6;6 = +/θ, ð/ (Dodd et al., 2003)

Consonant clusters (females)
6;0 = /tw, kw, sp, st, sk, sm, sn, sw, sl, pl, bl, kl, gl, fl, pr, br, tr, dr, kr, gr, fr, skw, spl/
7;0 = /tw, kw, sp, st, sk, sm, sn, sw, sl, pl, bl, kl, gl, fl, pr, br, tr, dr, kr, gr, fr, θr, skw, spl/
8;0 = /tw, kw, sp, st, sk, sm, sn, sw, sl, pl, bl, kl, gl, fl, pr, br, tr, dr, kr, gr, fr, θr, skw, spl, spr, str, skr/ (Smit, et al., 1990)

Consonant clusters (males)
6;0 = /tw, kw, sp, st, sk, sn, sw, pl, bl, kl, gl, fl, pr, br, tr, kr, gr, fr, dr/
7;0 = + / sm, sl, θr, skw, spl/
8;0 = + / spr, str, skr/ (Smit, et al., 1990)

Vowels
Paradigmatic production (ie production of individual vowels) is generally mastered by 3 years. However syntagmatic production (production of vowels in context such as polysyllabic words) takes up to at least 6 years of age. (James et al., 2001)

PERCENT CORRECT

Consonants
6;0-6;11 = 93.74% in monosyllabic words
6;0-6;11 = 90.76% in polysyllabic words
7;0-7;11 = 93.93% in monosyllabic words
7;0-7;11 = 90.99% in polysyllabic words
(James van Doorn & McLeod, 2002)

6;0-6;11 = 95.1%
7;0-7;11 = 98.4% (Waring, Fisher, Atkin, 2001)

5;6-7;0 = 95.86% (Dodd et al., 2003)

Consonant clusters
6;0-6;11 = 96.6%
7;0-7;11 = 98.3% (Waring, Fisher, Atkin, 2001)

Vowels (UK)
5;6-7;0 = 99.19% (Dodd et al., 2003)

Vowels (Australian)
6;0-6;11 = 95.39% in monosyllabic words
6;0-6;11 = 94.86% in polysyllabic words
7;0-7;11 = 95.10% in monosyllabic words
7;0-7;11 = 95.44% in polysyllabic words
(James van Doorn & McLeod, 2001)

Vowels (USA - nonrhotic)
6;0-6;5 = 98.5% (range = 94-100)
6;6-6;10 = 99.2% (range = n/a)
(Pollock, 2002; Pollock & Berni, 2003)

Vowels (USA - rhotic)
6;0-6;5 = 80.3% (range = 0-100)
6;6-6;10 = 77.2% (range = 2-100)
(Pollock, 2002)

COMMON MISMATCHES

Consonants (>15%)
Nil (Smit, 1993a)

Consonant clusters (>15%)
tr→tw; skw→θkw; spl→θpl; spr→θpr, spw; str→θtr, stw; skr→θkr, skw
(Smit, 1993b)

SYLLABLE STRUCTURE

All (Shriberg, 1993)

Average number of syllables/words
6;0 = 1.30. 7;0 = 1.32. 8;0 = 1.33 (Flipsen, 2006a)

PHONETIC INVENTORY

ALL - /m, p, b, w, n, t, d, ŋ, k, g, h, f, v, θ, ð, w, s, z, ʃ, ʒ, tʃ, dʒ, l, r, j, h/ (Grunwell,1987)

PROSODY

Intonation production continues to be mastered until 8;7. Intonation comprehension continues to develop up to 10;10 (Wells, Peppé & Goulandris, 2004)

PHONOLOGICAL AWARENESS

Established skills (Australia)
6;0 – 6;5 = syllable segmentation, rhyme awareness, alliteration awareness, phoneme isolation
6;6 – 6;11 = phoneme segmentation
(Dodd & Gillon, 2001)

Established skills (UK)
6;0 – 6;11 = syllable segmentation, rhyme awareness, alliteration awareness, phoneme isolation, letter knowledge, phoneme segmentation (Dodd & Gillon, 2001)