Supplemental File 1: Granada Spanish Word List and Transcriptions for PPD301 (male, 3;1)

Singleton Mismatches: Target of reduplication (R), Assimilation (A), Migration/Metathesis (M). **Bold** = **whole word match (14.4%: 13/90)**

Orthography (I=Imitated)	Adult pronunciations (Optional deletion) Variants {~}	PPD301 pronunciation(s)	# syl/ wd.	WI stress: S=stressed, u=unstressed	WI C	WM syllable: stress, position in word (final syllable: F; Internal syllable: Int)	WM C
aire	ˈaiɾe	ˈaðe	2			WM u F	ɾ
azul	**aˈ{s~θ}u(l~ɾ)**	**aˈsuː**	**2**			**WM S F**	**s**
bailando	{b~β}aiˈlan̪do	_eˈβan̪do (M)	3	WI u	b~β	WM S Int	l, no CC
bañera	{b~β}aˈɲeɾa		3	WI u	b~β	WM S Int, WM u F	ɲ, ɾ
baño	ˈ{b~β}aɲo	ˈmaɲo ˈmaɲo (A)	2	WI S	b~β	WM u F	ɲ
barco	ˈ{b~β}aɾko	ˈpakːo (A)	2	WI S	b~β	No CC	
bloque(s)	{b~β}lok{e~ɛ}(s~h)	ˈboʔkɛ	2	No CC in study		WM u F	k
boca	ˈ{b~β}oca	ˈpoka (A)	2	WI S	b~β	WM u F	k
brazo	ˈ{b~β}raso	ˈpas̪o (A)	2	No CC		WM u F	s
bruja	ˈ{b~β}ru{x/h}a	ˈpuxa (A)	2			WM u F	x~h
veinte	ˈ{b~β}einte	ˈpetːe (A)	2	WI S	b~β	No CC	
casa	ˈkasa	ˈtas̪a (A)/(S?)	2	WI S	k	WM u F	s
caballo	kaˈβa{ʝ~j~ʤ}o	_aˈβaɟo	3	WI u	k	WM S Int, WM u F	β, ʝ~j~ʤ
cocodrilo (I)	kokoˈ{d~ð}ɾilo	___ˈtiðo	4	WI u	k	WM u Int (pretonic), WM u F	k, l, no CC

Orthography (I=Imitated)	Adult pronunciation	PPD301 pronunciation(s)	# syl/ wd.	WI stress: S=stressed, u=unstressed	WI C	WM syllable: stress, position in word (final syllable: F; Internal syllable: Int)	WM C
conejo (I)	ko'ne{x~h}o	'k_exo	3	WI u	k	WM S I, WM u F	n , x~h
chimenea (I)	{tʃ~ʃ}imẽ'nea	_e'βe.a	4	WI u	tʃ~ʃ	WM u Int (pretonic), WM S Int	m, n
chocando	{tʃ~ʃ}o'kando	_e'taṇdo (A)/(S)	3	WI u	tʃ~ʃ	WM S Int	k, no CC
chocolate	{tʃ~ʃ}oko'late	_'tatːe (R)	4	WI u	tʃ~ʃ	WM u Int (pretonic), WM S Int WM u F	k, l, t
día	'{d~ð}ia	'ʔi.a	2	WI S	d~ð		
dinosaurio (I)	{d~ð}ino'saurjo	_a'zaujo	4	WI u	d~ð	WM u I (pretonic), WM S Int	n, s, no rising VV
dos	**'{d~ð}{o~ɔ}(s~h)**	**'dɔ̃**	**1**	**WI S**	**d~ð**		
dragón	{d/ð}ra'ɣ{o/õ}(n/ŋ)	βa'ɣoŋ	2	No CC		WM S F	ɣ
elefante	ele'faṇte	_'patːe	4			WM u I (pretonic), WM S Int	l, f, no CC
escalera	e({s~ʰ})ka'leɾa	aṇ'telạ (A/S) (M)	4			WM u Int (pretonic), WM S Int, WM u F ??	k, l, ɾ, no CC
euro	'{eu~u}ɾo	'eðo	2			WM u F	ɾ
Europa	{eu~u}'ɾopa	e'popa (R)	3			WM S Int, WM u F	ɾ, p
foto	'foto	'poto (A)	2	WI S	f	WM u F	t
flecha	'fle{tʃ~ʃ}a	'feʃa	2	No CC		WM u F	tʃ~ʃ
flor(es)	'floɾ{e~ɛ}(s~h)	'foɾ'ɛ	2			WM u F	ɾ
fresa	'fɾesa	'fesa	2			WM u F	s

Orthography (I=Imitated)	Adult pronunciation	PPD301 pronunciation(s)	# syl/ wd.	WI stress: S=stressed, u=unstressed	WI C	WM syllable: stress, position in word (final syllable: F; Internal syllable: Int)	WM C
fruta	ˈfruta	ˈputa	2	No CC		WM u F	t
fuego (I)	ˈfweɣo	ˈxweɣo	2	No VV rising in study		WM u F	ɣ
fútbol	{/ˈfuβ{o~ɔ}(l)/ ~ /ˈfutbol/}	ˈpumbo (A)	2	WI S	f	WM u F	β, no C.C
gato	ˈ{g~ɣ}ato	ˈtato (R)	2	WI S	g~ɣ	WM u F	t
globo(s)	ˈ{g~ɣ}loβ{o~ɔ}(s~h)	ˈβɔβɔ (R)	2		No CC	WM u F	β
gorra	ˈ{g~ɣ}ora	ˈdora (A)/(S?)	2	WI S	g~ɣ	WM u F	r
guitarra	{g~ɣ}iˈtara	_aˈtaja	3	WI u	g~ɣ	WM S Int, WM u F	t, r
hermano (I)	eɾˈmãno	eˈmãno	3			WM u F	No C.C
hipopótamo (I)	ipoˈpotamo	_aˈp_amːo	5			WM u I (pretonic), WM S Int WM u Int, WM u F	p, p, t, m
hoyo	**ˈo{ʝ~j~ʤ}o**	**ˈoʝo**	**2**			**WM u F**	**ɹ~j~ʤ**
hueso	ˈ(g~ɣ)weso	ˈpχweso	2	No VV rising		WM u F	s
jamón (I)	{x~h}aˈmõ(n~ŋ)	_aʰˈmõ	2	WI u	x~h	WM S F	m
jaula (I)	ˈ{x~h}aula	ˈxwana	2	WI S	x~h	WM u F	l
jirafa (I)	{x~h}iˈrafa	_aˈfafa (R)	3	WI u	x~h	WM S Int, WM u F	ɾ, f
juguete	{x~h}uˈɣete	_ˈuweke (A)	3	WI u	x~h	WM S Int, WM u F	ɣ, t
lámpara	ˈlampaɾa	a_ʰˈpaβa	3	WI S	l	WM u F	ɾ

Orthography (I=Imitated)	Adult pronunciation	PPD301 pronunciation(s)	# syl/wd.	WI stress: S=stressed, u=unstressed	WI C	WM syllable: stress, position in word (final syllable: F; Internal syllable: Int)	WM C
lápiz	ˈlapi/ˈlapi{θ~s~h}	ˈ_api	2	WI S	l	WM u F	p
leche	ˈle{tʃ~ʃ}e	ˈs̬es̬e ˈʃeʃe (R)	2	WI S	l	(WM u F) 1/2	tʃ~ʃ
luz	**ˈlu /ˈlu{θ~s~h}**	**ˈlu**	**1**	**WI S**	**l**		
llave	ˈʤ{ʝ~j}aβe	ˈdaðe (A/M)	2	WI S	ʤ, ʝ/j	WM u F	β
llorando	ʤ({ʝ~j}oˈran̪do	__ˈlan̪do	3	WI u	ʤ, ʝ/j	WM S Int	ɾ
llueve (I)	ˈʤ{ʝ~j}ue.βe	ˈweβe	2	No VV rising		WM u F	β
martillo	ma{ɾˈt~tˈt}i-{ʝ~j~ʤ}o	__ˈtið̞o	3	WI u	m	WM u F (no C.C)	ʝ~j~ʤ
mesa	ˈmesa	ˈpesa (A)	2	WI S	m	WM u F	s
muñeca (I)	mũˈɲeka	_ˈɣweka	3	WI u	m	WM S Int, WM u F	ɲ, k
nariz	{naˈɾi ~ naˈɾi{/θ~s~h/}}	naˈzi	2	WI u	n	WM S F	ɾ
nieve (I)	ˈnieβe	ˈβeβe (R)	2	No VV rising		WM u F	β
noche	ˈno{tʃ~ʃ}e	ˈtos̬e (A)/(*Sub?*)	2	WI S	n	WM u F	tʃ~ʃ
oigo	ˈoiɣo	ˈoŋgo	2	WI S		WM u F	ɣ
pájaro (I)	ˈpaxaɾo	ˈta_ðo (A)/(*Sub?*)	3	WI S	p	WM u Int, WM u F	x/h, ɾ
pan	**ˈpã(n~ŋ)**	**ˈpaŋ**	**1**	**WI S**	**p**		
pantalón	pã(n)taˈlõ(n~ŋ)	paˈloŋ	3	WI u	p	WM S F No C.C	l
papá	**paˈpa**	**paˈpa**	**2**	**WI u**	**p**	**WM S F**	**p**
Paula (I)	ˈpaula	ˈpan̪da ˈpan̪da	2	WI S	p	WM u F No C.C	l

Orthography (I=Imitated)	Adult pronunciation	PPD301 pronunciation(s)	# syl/ wd.	WI stress: S=stressed, u=unstressed	WI C	WM syllable: stress, position in word (final syllable: F; Internal syllable: Int)	WM C
peine	{ˈpeine~ˈpenːe}	ˈpenne	**2**	**WI S**	p	**No geminates in study**	
pelo	ˈpelo	ˈpelo	**2**	**WI S**	p	**WM u F**	**l**
perro	ˈpero	ˈpeɣo	2	WI S	p	WM u F	r
pescado	p{e~ɛ}({s~ʰ})ˈka-{ð~ø}o	peʰˈkao	**3**	**WI u**	p	**WM S Int, (WM u F)**	**k, (ð)**
pez	ˈp{e~ɛ}(θ~s~ʰ)	ˈpɛh	**1**	**WI S**	p		
playa	ˈplaʝa	ˈpaɣa	2	WI S	No CC	WM u F	ʝ
pluma (I)	ˈpluma	ˈpuma	2	WI S		WM u F	m
primavera (I)	pɾimaˈβeɾa	_eʰˈteɾa	4	WI u		WM u I (pretonic), WM S Int WM u F	m, β, ɾ
princesa	pɾin̪ˈ{θ~s}esa	aˈfes̪a	3	WI u		WM u F	s
ratón (I)	raˈtõ(n~ŋ)	taˈton̪ (R)	2	WI u	r	WM S F	t
regalo	reˈɣalo	_eˈz̪aðo (A,M)	3	WI u	r	WM S Int, WM u F	ɣ, l
reloj	reˈl{o~ɔ}(x~h)	ðeˈlɔ (S) ðeˈðɔ (R)	2	WI u	r	WM S F	l
rojo	ˈro{x~h}o	ˈxoxo	2	WI S	r	WM u F	x~h
ruido	ˈrwiðo	ˈdwiðo	2	WI S		WM u F	ð
saltando	sa{lˈt~tˈt}ando	esˈtan̪do (M)	3	WI u	s	No C.C	
sed	ˈs{e~ɛ}(d)	ˈse	ˈse	**WI S**	s		
silla	ˈsi{ʝ~j}a	ˈsiða (A?/Sub?)	2	WI S	s	WM u F	ʝ~j

Orthography (I=Imitated)	Adult pronunciation	PPD301 pronunciation(s)	# syl/ wd.	WI stress: S=stressed, u=unstressed	WI C	WM syllable: stress, position in word (final syllable: F; Internal syllable: Int)	WM C
suave	ˈsuaβe	ˈ gwaβe	2	No VV rising		WM u F	β
zanahoria	{θ~s}anaˈorja	_aˈzoða (M-Feat)	4	WI u	θ~s	WM u Int (pretonic)	n
zapato	{θ~s}aˈpato	_aˈpato _aːˈpato	3	WI u	θ/s	WM S Int, WM u F	p, t
sombrero	somˈbreɾo	_eˈβeðo	3	WI u	s	WM u F	ɾ
techo	**ˈte{tʃ~ʃ}o**	**ˈteʃo**	**2**	**WI S**	**t**	**WM u F**	**tʃ~ʃ**
teléfono (I)	teˈlefono	_eʰˈpelo (M)	4	WI u	t	WM S Int, WM u Int, WM u F	l, f, n
toca	ˈtoka	ˈkoka (R)	2	WI S	t	WM u F	k
tortuga	to{ɾˈtu~tˈt}ɣa	_aˈtula	3	WI u	t	WM u F (no geminates)	ɣ
triángulo	ˈtrjaŋgulo	ˈtajo	3			WM u F	l
uva(s)	**ˈuβ{a~a̯}(s~ʰ)**	**ˈuβa̯**	**2**	**WI S**		**WM u F**	**β**

Note. *Ceceo variants not included because this child did not use interdentals. Only indisputable singleton Cs were included in the singleton consonant analysis, i.e. no consonant sequences, rising diphthongs (where the child may treat the /w/ or /j/ as part of a consonant onset clusters, or consonant geminates (which can occur in *peine/penne*, *saltando/sattando)*. Most word-initial voiced stops were produced as such, but some tokens were produced as the second word in a phrase with a vowel preceding, giving the context for the voiced approximant/fricative. Note that we use the fricative symbols for the voiced fricative/approximants although they are produced as approximants. (The diacritic for approximant is very hard to read in the fonts.)

Granada Spanish: Acquisition of singleton onsets.

Supplemental File 2. Granada Spanish Onset Consonoants. Statistical values for key results, beta regression model.

Model	FSM/ TUM	WI/ WM	Pseudo-R^2 for beta model	Factors	2 or 3-way interactions $p \leq .01$	Wald Z	p
All Cs	FSM	WI	.74				
		WM	.8				
		WI		TD/PPD		8.630	<.001*
		WM		TD/PPD		-11.354	<.001*
		WI		4 vs 3 yr		6.173	<.001*
				5 vs 3 yr		9.133	<.001*
		WM		4 vs 3 yr		5.038	<.001*
				5 vs 3 yr		9.114	<.001*
All Cs	TUM	WI	.38				
		WM	.4				
		WI		TD/PPD		4.585	<.001*
		WM		TD/PPD		-0.675	.5
		WI		4 vs 3 yr		4.785	<.001*
				5 vs 3 yr		5.478	<.001*
		WM		4 vs 3 yr		1.503	.133
				5 vs 3 yr		6.228	<.001*
Word length	FSM	WI	.61				
		WM	.71				
		WI		TD/PPD		-1.067	.286
		WM		TD/PPD		-2.846	.004*
		WM		4 vs 3 yr		3.186	.001*
				5 vs 3 yr		3.74	<.001*
		WI		2 vs 1 syl		-3.505	<.001*
				3 vs 1 syl		-4.141	<.001*
				4 vs 1 syl		-3.337	.001*
		WM		2 vs 4/5 syl		1.595	.111
				3 vs 4/5 syl		1.125	.261
		WI			5yr*2/1 syl	2.933	.003*
					5 yr*3/1 syl	3.283	.001*
					PPD*5yr*4/1 syl	2.851	.004*
	TUM	WI	.4				
		WM	.32				
		WI		TD/PPD		-2.495	.013(*)

| | | WM | | TD/PPD | | -3.597 | <.001* |

Supplemental File 2 (cont.)

Model	FSM/ TUM	WI/ WM	Pseudo-R² for beta model	Factors	2 or 3-way interactions $p \leq .01$	Wald Z	p
		WI		4 vs 3 yr		.627	.531
				5 vs 3 yr		1.406	.160
		WM		4 vs 3 yr		-.15	.881
				5 vs 3 yr		2.01	.044(*)
		WI		2 vs 1 syl		-3.08	.002*
				3 vs 1 syl		-5.581	<.001*
				4 vs 1 syl		-5.659	<.001*
		WM		4/5 vs 2 syl		2.003	.045(*)
				4/5 vs 3 syl		1.935	.053
		WI			5yr*3/1 syl	3.573	<.001*
					5yr*4/1 syl	4.101	<.001*
					PPD*4yr*2/1 syl	8.607	<.001*
					PPD*4yr*4/1 syl	5.757	<.001*
					PPD*4yr*3/1 syl	5.31	<.001*
		WM			PPD*4yr*2/1 syl	-2.499	.012(*)
		WM			PPD*5yr*2/1 syl	-3.56	<.001*
Stressed- unstressed	FSM	WI	.69				
		WM	.32				
		WI		TD/PPD		-9.36	<.001*
		WM		TD/PPD		-3.366	.001*
		WI		4 vs 3 yr		5.42	<.001*
				5 vs 3 yr		10.42	<.001*
		WM		4 vs 3 yr		2.721	.007*
				5 vs 3 yr		3.213	.001*
		WI		Stressed/		-4.82	<.001*
		WM		unstressed		.650	.516
		WM			PPD*4yr*Stress	2.807	.005*
	TUM	WI	.44				
		WM	.10				
		WI		TD/PPD		-5.38	<.001*
		WM		TD/PPD		.634	.526
		WI		4 vs 3 yr		2.79	.005*

| | | | | 5 vs 3 yr | | 1.59 | .113 |

Supplemental File 5 (cont.)

Model	FSM/TUM	WI/WM	Pseudo-R² for beta model	Factors	2 or 3-way interactions $p \leq .01$	Wald Z	p
		WM		4 vs 3 yr		.243	.808
				5 vs 3 yr		-.489	.625
		WI		Stressed/		-4.58	< .001*
		WM		unstressed		-.303	.762
		WI			4 vs 2yr* Stress	2.25	.024(*)
					5 vs 2yr* Stress	4.78	< .001*
Final vs internal syl.	FSM	WM	.39				
				TD/PPD		-6.355	< .001*
				4 vs 3 yr		4.25	< .001*
				5 vs 3 yr		5.248	< .001*
				Intern vs final syl		-1.401	.161
					Syl intern* PPD*4 vs 2 yr	1.845	.004*
					Syl intern* PPD*5 vs 2 yr	2.824	.005*
	TUM	WM	.39				
				TD/PPD		-1.716	.086
				4 vs 3 yr		1.735	.083
				5 vs 3 yr		3.425	.001*
				Intern vs final syl		-2.233	.026(*)
Final stress vs unstressed	FSM	WM Age 3	.37				
				TD/PPD		-1.434	.151
				Final stress/ unstressed		.092	.927
	TUM		.10	TD/PPD		-.122	.903

Supplemental File 2 (cont.)

Model	FSM/ TUM	WI/ WM	Pseudo-R^2 for beta model	Comparison	2 or 3-way interactions $p \le .01$	Wald Z	p
	TUM	WM Age 3		Final stress/ unstressed		-728	.467
Internal stress/ unstressed	FSM		.45				
				TD/PPD		-3.241	.001*
				Internal stress/ unstressed		.017	.986
	TUM		.27				
				TD/PPD		-2.201	.028(*)
				Internal stress/ unstressed		-1.927	.054

Note. Syl = syllable; yr = year; intern = internal; TD = typically developing; PPD = protracted phonological development; FSM = full segmental match; TUM = timing unit match. WI = word-initial; WM = word-medial intervocalic. An expanded version of this table is available from the authors with coefficients and standard errors plus information on beta regression models.

Supplemental 3: Statistical analyses of spontaneous (Spont) and imitated (Imit) utterances in the sample.

Table S3.1. Mean (SD) proportions of imitation and match levels for imitated and spontaneous utterances by group.

Group	Word-initial consonants			Word-medial consonants		
	% Imitation	% match Imit C	%Match Spont C	% Imitation	% match Imit C	% Match Spont C
TD3	.3670 (.13)	.8711 (.09)*	.8114 (.09)*	.3816 (.15)	.8220 (.08)	.8674 (.09)
TD4	.1924 (.06)*	.9661 (.04)	.9520 (.03)	.2617 (.06)*	.9537 (.05)	.9675 (.03)
TD5	.1077 (.05)**	1.000 (.00)*	.9766 (.03)*	.1537 (.06)**	.9616 (.04)	.9813 (.07)
PPD3	.3481 (.10)*	.5492 (.11)	.5061 (.18)	.4186 (.10)*	.5592 (.14)	.6440 (.10)
PPD4	.1837 (.07)*	.7804 (.17)	.7378 (.14)	.2550 (.12)*	.7069 (.14)	.7549 (.09)
PPD5	.1493 (.03)*	.9644 (.07)*	.9137 (.04)*	.1730 (.04)*	.8579 (.08)	.8918 (.05)

Note. TD = typically developing; PPD = protracted phonological development: ages three- four- and five-year-olds.
*$p<.05$, 2-sided Paired t-test
**$p =.003$ after Bonferroni correction, 2-sided Paired t-test comparing imitated/spontaneous (columns 3,4; 6;7) or proportion of imitated words (columns 2, 5).

Results and commentary:

1. For TD4 andTD5 there was a significant difference for **proportion of imitation** of target words with word-initial (WI) versus word-medial (WM) consonants. WM consonants are more frequent in longer words, and so we did an additional analysis of word length and relative accuracy of WM consonants (disyllabic/multisyllabic) for the children who imitated the most (three-year-olds) and found no significant effects by word length (greater than $p = .05$).
2. Some children had higher match levels in spontaneous utterances, and some in imitated utterances but significance did not reach the corrected level for any group after Bonferroni correction ($p = .003$) on Paired t-tests.
3. ANOVA: See Table S3.1 above and data charts below. There was a significant decrease in imitation by age in both groups (TD/PPD).

4. For the WI consonants that showed some significant differences (not with correction but including TD3, TD5, PPD3, PPD5) we did a further analysis of the influence of syllable stress in interaction with elicitation context (Imitated/Spontaneous). See the notes at the end of this document.

2. Research hypothesis: Imitative utterances decreased by age for both groups (TD/PPD).

ANOVA

				Sum of Squares	df	Mean Square	F	Sig.
TDPropiMITWICPropimit VAR00003	Between Groups	(Combined)		.340	2	.170	24.493	<.001
		Linear Term	Unweighted	.333	1	.333	48.002	<.001
			Weighted	.326	1	.326	47.050	<.001
			Deviation	.013	1	.013	1.936	.175
	Within Groups			.187	27	.007		
	Total			.527	29			
TDPropImitW	Between Groups	(Combined)		.257	2	.129	14.065	<.001
		Linear Term	Unweighted	.257	1	.257	28.107	<.001
			Weighted	.257	1	.257	28.104	<.001
			Deviation	.000	1	.000	.026	.874
	Within Groups			.247	27	.009		
	Total			.504	29			

ANOVA Effect Sizes[a]

		Point Estimate	95% Confidence Interval	
			Lower	Upper
TDPropiMITWICPropimit VAR00003	Eta–squared	.645	.366	.755
	Epsilon–squared	.618	.319	.737
	Omega–squared Fixed–effect	.610	.312	.730
	Omega–squared Random–effect	.439	.185	.575
TDPropImitW	Eta–squared	.510	.197	.659
	Epsilon–squared	.474	.138	.633
	Omega–squared Fixed–effect	.466	.134	.626
	Omega–squared Random–effect	.303	.072	.455

a. Eta–squared and Epsilon–squared are estimated based on the fixed–effect model.

ANOVA

			Sum of Squares	df	Mean Square	F	Sig.
PPDPropIMitWI	Between Groups	(Combined)	.191	2	.096	13.292	<.001
	Linear Term	Unweighted	.173	1	.173	24.107	<.001
		Weighted	.173	1	.173	24.107	<.001
		Deviation	.018	1	.018	2.476	.128
	Within Groups		.187	26	.007		
	Total		.378	28			
PPDPropImitWM	Between Groups	(Combined)	.255	2	.127	11.556	<.001
	Linear Term	Unweighted	.241	1	.241	21.898	<.001
		Weighted	.241	1	.241	21.898	<.001
		Deviation	.013	1	.013	1.215	.280
	Within Groups		.286	26	.011		
	Total		.541	28			

ANOVA Effect Sizes[a]

		Point Estimate	95% Confidence Interval	
			Lower	Upper
PPDPropIMitWI	Eta-squared	.506	.185	.657
	Epsilon-squared	.468	.122	.631
	Omega-squared Fixed-effect	.459	.119	.622
	Omega-squared Random-effect	.298	.063	.452
PPDPropImitWM	Eta-squared	.471	.149	.631
	Epsilon-squared	.430	.084	.603
	Omega-squared Fixed-effect	.421	.081	.595
	Omega-squared Random-effect	.267	.042	.423

a. Eta-squared and Epsilon-squared are estimated based on the fixed-effect model.

3. Additional Analysis of *Word-Initial Position* with respect to *Stress* and *Elicitation Context* (Imitated/Spontaneous) for three- and five-year-olds (TD/PPD). Fisher *t* PROBABILITY TEST (comparing matches/mismatches by context in two 2 x 2 tables).

Further analysis of the word-initial consonant match levels were conducted for the three- and five-year-olds as it concerned word-initial stress. The Fisher probability test provided 2 x 2 tables with matches and mismatches for the variables in question, i.e., spontaneous/imitated, stressed syllable/unstressed syllable. Hypotheses and *p* values (two-tailed) were:

TD3
Research hypothesis 1: Words with initial unstressed syllables would be imitated more often than words with stressed initial syllables: p=.009
Stressed = .265 (proportion of imitation)
Unstressed = .363 (proportion of imitation)

Result: Hypothesis supported: the proportion of imitation was slightly higher for words with initial unstressed syllables

Research hypothesis 2: Word-initial onset consonants in imitated words would have a higher match than those in spontaneous words:
Overall: *p* =.152
Stressed: *p* =.684
Unstressed: *p*=.135

Result: The overall result was contrary to the major analysis (Table 2) in which there was a significant difference for TD3. Disconfirmed overall.

*Hypothesis 3: *Onset consonants in stressed initial syllables would have a higher match than unstressed **(examined thoroughly in the beta regression analyses, Supplemental File 3**).*
Overall: *p*=.152
Stressed: *p*=.684
Unstressed: *p*=.135

 Result: Disconfirmed. Elicitation contexts had similar non-significant results. But see the regression analyses.

TD5
1. *Research hypothesis 1: Words with initial unstressed syllables would be imitated more often than words with stressed ones.*
Unstressed imitated more often than stressed: p=.313

Stressed = .117 (proportion of imitation)
Unstressed = .091 (proportion of imitation)

Result: Disconfirmed. For the TD five-year-olds, there was a marginally higher non-significant proportion of spontaneous utterances for the words with stressed initial syllables (unlike the result for the TD3 group).

Research hypothesis 2: Word-initial onset consonants in imitated words would have a higher match than those in spontaneous words:
Overall: *p*=.097
Stressed: *p*=.582
Unstressed: *p*=.055

Result: Similar to the TD3 group, imitated words did not have a higher onset consonant match (contrary to findings of the Paired *t*-test reported in Table 2), but this was approaching significance in the case of the unstressed syllables, i.e., they were trending to be more accurate when imitated. The reduced sample size here in comparison to the overall analysis in the paired *t*-test gave limited power (Note: a Wilcoxon's was also not significant.)

*Research hypothesis 3: *Onset consonants in stressed initial syllables would have a higher match than unstressed **(examined thoroughly in the beta regression analyses, Supplemental File 2)**.*
Overall: *p*=.018
Spontaneous: *p*=.019
Imitated: *p*= could not compute - no mismatches.
Results: These word structure findings match the findings of the more complex beta regression analysis.

PPD3
Research hypothesis 1: Words with initial unstressed syllables would be imitated more often than words with stressed initial syllables:
p=.008
Stressed = .364 (proportion of imitation)
Unstressed = .481 (proportion of imitation)
Result: Hypothesis supported, although the proportion of imitation is not that much higher for words with initial unstressed syllables.

Research hypothesis 2: Word-initial onset consonants in imitated words would have a higher match than those in spontaneous words:

Overall: *p*<.001

Result: Hypothesis supported for PPD3, consistent with the paired *t*-tests.

*Research hypothesis 3: *Onset consonants in stressed initial syllables would have a higher match than unstressed **(examined thoroughly in the beta regression analyses, Supplemental File 2)**.*
Overall: *p*=.157, no effect
Stressed initial syllable: *p*=.129, no effect
*Unstressed initial syllable: *p=.021.*

Result: This jibes with the beta regression analysis.

PPD5
1. *Research hypothesis 1: Words with initial unstressed syllables would be imitated more often than words with stressed ones.*
Unstressed imitated more often than stressed: p=.800
Stressed = .145 (proportion of imitation)
Unstressed = .155 (proportion of imitation)
Result: For the five-year-olds with PPD, there was only a marginally higher non-significant proportion of imitated utterances for the words with unstressed initial syllables. (unlike the result for the PPD3 group).

Research hypothesis 2: Word-initial onset consonants in imitated words would have a higher match than those in spontaneous words:
Overall: p=.097
Stressed: p=.582
Unstressed: p=.055

Result: Similar to the PPD3 group, imitated words did not have a higher onset consonant match (unlike the Paired *t*-test reported in Table 2), but this was approaching significance in the case of the unstressed syllables, i.e., they were trending to be more accurate when imitated. There was a small sample size and limited power.

*Research hypothesis 3: *Onset consonants in stressed initial syllables would have a higher match than unstressed **(examined thoroughly in the beta regression analyses, Supplemental File 2)**.*

Overall: p=.237
Spontaneous: p=.497
Imitated: p=.115
Results: These results jibe with the beta regression which saw this finding reduce in the five-year-olds compared with the three-year-olds, as match levels reached ceiling level.

Supplemental File 4. Disyllabic words: Consonant mismatch patterns, including RAM patterns and sequence constraints.

Table S4.1. Percentage of major mismatch patterns over word-initial and word-medial onset targets by contrasting disyllabic context (Su, uS) for three-year-olds with protracted phonological development.

Context	Stress	Word type	# targets	Deletion (syl or C)	Subst (not RAM)	Ambiguous: Subst. or RAM?	Reduplication	Assimilation	Metathesis/ migration	% total RAM
WI	S	Su	168	3.0	20.8	10.7	6.0	7.1	2.4	14.3
WM final	u		319	.003	18.8	1.9	1.6	2.3	1.9	5.6
WI	u	uS	43	4.7	37.2	22.0	18.6	2.3	0	20.9
WM final	S		57	1.7	7.0	1.8	8.8	8.8	5.3	22.8

Note. RAM = Reduplication, assimilation, metathesis/migration. Subst. = substitution. **Bold = greater than 5% of targets.** Final = onset to the final syllable in the word.

Table S4.2. Onset to onset sequence constraints in words with *iambic stress (uS)* including triggers and targets of RAM patterns in three-year-olds with protracted phonological development.

Category	Sequence	Target	Trigger	RAM Pattern	Words	Percent occurrence (/Targets)
Manner	Trill_Stop (Sonorant_Obstruent)	/r/	/t/	/t/ (R) R to L	ratón	.38 (3/8)
	Trill_Lateral (Sonorant_Sonorant)	/r/	/l/	/l/ (R) R to L	reloj	.45 (5/11)
	Fricative_Nasal	/x-h/	/m/ [-continuant]	[-continuant] (A) R to L >Stop k (2), p, t	jamón	.57 (4/7)
Voicing	[+vd] ([+son])_[-vd]	/r/	/t/	/t/ (R) R to L	ratón	.38 (3/8)
	[-vd]_[+vd] ([+son]				(jamón)	0
Place	Dorsal_Labial	/x/	/m/	[Labial] (A) R to L ([p])	jamón	.13 (1/8)

Note. In the column of words, parentheses indicate that the pattern on that row did not occur.
RAM patterns include reduplication, assimilation, and metathesis (migration).

Table S4.3. Onset to onset sequence constraints in *trochees* (Su words) with triggers and targets of RAM patterns in three-year-olds with protracted phonological development.

Category	Sequence	Target	Trigger	RAM Pattern	Words[b]	Percent occurrence (/Targets)
Manner	Stop[a]_Nasal	/p/, /b/	Nasal /ɲ/	Nasal (A) R to L	baño peine (veinte)	.2 (6/26) (baño)
	Fricative_Lateral	/{x-h}/	Lateral /l/	Lat (R) R to L	jaula	.14 (1/7)
	Stop[a]_Liquid	/p/, /g/	Liquid /l/, /r/	Liquid (R) R to L	Paula (pelo) (perro) gorra	.06 (2/33) (Paula, gorra)
	Obstruent_ Sonorant	/x/, /p/, /b/, /g /	[+sonorant] /l/, /n/, /r/	Sonorant (A, R) R to L	baño peine xaula Paula (pelo) (veinte) perro gorra	.14 (9/66)
	Nasal_Fric/ Affricate	[+nasal] /m/, /n/	[-sonorant] /s/, /tʃ/-/ʃ/	[-sonorant] R to L	mesa noche	.31 (5/16)
	Lat_Stop/Affricate	Lateral /l/	Stop /p/ Affricate/Fric. /tʃ/-/ʃ/	Obstruent (R) R to L	lápiz leche	.21 (3/14)
	Rhotic_Fricative	Trill/tap	Fricative	[-son] (A, R) R to L	rojo	.375 (3/8)
	Sonorant_ Obstruent	Sonorant	[-sonorant]	[-sonorant] (A, R) R to L	mesa noche lápiz leche rojo	.26 (10/38)
Obstruent voicing	[+voiced]_ [-voiced]	[+voiced]	[-voiced]?	[-vd] (A) R to L	veinte oca barco gato	.26 (9/34)
Place	Dorsal_Coronal	Dorsal	Coronal?	Coronal (A, R) R to L	casa xaula gato gorra	.34 (11/32)
	Dorsal_Labial	Dorsal	Labial	Labial from V, R to L	xaula gorra	.2 (3/15)
	Labial_Dorsal	Labial	Dorsal	?	(baño barco oca)	0 (/24)
	Labial_Coronal	Coronal	Labial	Labial L to R (A, R)	Paula (veinte foto baño mesa pelo perro)	.04 (3/71)
	Coronal_Labial	Either	Either	Labial R to L (R) Coronal L to R (R)	llave lápiz	.14 (2/14)
	Coronal_Dorsal	Either	Either	M; R. Dorsal R to L, Coronal L to R	toca rojo	.38 (6/16)

Notes. [vd] = [voiced], [son] = [sonorant]; A = assimilation; R = reduplication; M = migration/metathesis; R to L = right-to left assimilation/reduplication. RAM = reduplication/assimilation/metathesis or migration.
[a]Voiced stop approximant allophones were not included in analysis of manner.
[b]Words in parentheses did not trigger RAM patterns for the sequence on that row.