

ʁ-SUBSTITUTION:

*WHERE PERCEPTS, PROXIMITY
AND PROSODY MEET*

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Rhotic Substitution

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- Three stages in acquisition of [ʀ] (Ben-David 2001; Cohen 2015)

Deletion → Substitution → Faithful

- **Substitution** is a transitional phase between deletion and faithful production (e.g. Freitas 1994, Cohen 2015, Cohen & Ben-David 2016)
 - Quantity-wise, substitution is a small **minority** of the cases
 - Nevertheless, this small minority is **systematic**

Outline

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Background > Method > Quantity > Prosody > Segmental > Conclusions >

- Background
- Method
- Quantity
- Prosody & Percepts
- Segmental Environment
- Conclusions

Hebrew [ʁ] in Adults

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Background

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Conclusions

□ Adult Realization of [ʁ]

- Uvular Approximant (Bolozy & Kreitman 2007, Cohen et al. 2015)
- Prosodic positions differ in **Phoneme Consistency**, the degree of allophonic variation (Cohen et al. 2015):
 - **Word-final** (_#): little variation
 - **Intervocalic** (V_V): slightly more variation
 - **Word-initial** (#_): substantial variation

Acquisition of [ʁ]

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Conclusions

- Among the **last** consonants to be acquired (Lavie 1978, Ben-David 2001; 2014)
- Acquired first in **word-final** position, then **intervocalic**, then **word-initial** (Cohen 2015; Cohen & Ben-David 2016)
 - **Phoneme Consistency** facilitates acquisition

Acquisition of [ʁ]

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Conclusions

- Among the only cases of **non-prosodically motivated deletion** (Ben-David 2001; Ben-David & Bat-El 2016)
- Substantial inter-child **variation in quality of Substitute Category** (henceforth: SC) (Ben-David 2001; Ben-David & Bat-El 2016)

Selection of SC

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Background

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Conclusions

- Our question: which factors determine the selection of **Substitute Category**?

- Today we look at:
 - ▣ Percepts (Phoneme Consistency)
 - ▣ Prosody
 - ▣ Segmental Environment

Hebrew SCs

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Background

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Conclusions

- Longitudinal study: Ben-David (2001)
 - ▣ 10 Hebrew acquiring children
 - ▣ Qualitative data only

- **Prosody plays a role in substitution**
 - ▣ **Substitution:** ends in codas before onsets
 - ▣ **SCs:** Sonorants [l, j, ŋ] in onsets, fricative [x] in coda

Data

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Conclusions

- **Corpus: *Child Language Project*** (directed by Outi Bat-El and Galit Adam)
 - Two typically-developing monolingual children acquiring Hebrew: SR (a boy) and RM (a girl)
 - Recording started before the first recognisable word
 - Weekly sessions

- **Developmental periods** are determined by vocabulary size, not chronological age (Adam and Bat-El 2008; 2009)

Data Analysis

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Background

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Conclusions

- Productions of /ʁ/ classified into three categories

(Cohen 2015):

1. **Deletion**
2. **Substitution**
3. **Faithful**

- Other strategies (e.g. metathesis) were negligible

Data Analysis

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Conclusions

□ SCs classified by:

1. **Segmental Properties** (place, manner)
2. **Prosodic Position**
 - Word initial (#_)
 - Intervocalic (V_V)
 - Word final (_#)
3. **Adjacent Vowels** (height, backness, roundness)
4. **Nearby Consonants** (place, manner)

Choice of SC

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□ 19 SCs - any consonant in Hebrew!

Substitute	SR		RM		Overall		Example
x	3	5%	127	55%	130	45%	/paʁ'paʁ/→[baʁ'baʁ] 'butterfly' (SR, 1;08.24)
j	17	29%	22	9%	39	13%	/'koʃ/→['joʃ] 'head' (RM,1;09.27)
g	18	31%	6	3%	24	8%	/'kengʊʁ/→[gu'gʊm] 'kangaroo' (SR, 1;04.10)
w	9	15%	13	6%	22	8%	/ʔaʁ'je/→[ʔaw'je] 'lion' (SR, 1;05.04)
l	6	10%	15	6%	21	7%	/baʁ'vaz/→[bal'vað] 'duck' (SR, 1;11.02)
d	0	0%	10	4%	10	3%	/'kaʃ/→['daʃ] 'noise' (RM, 1;10.13)
k	2	3%	6	3%	8	3%	/ko'a/→[ko'a] 'see 1.sg.fm.pres' (RM, 2;08.02)
t	0	0%	7	3%	7	2%	/ka'kevet/→[ta'kevet] 'train' (RM, 2;01.06)
n	1	2%	5	2%	6	2%	/a'xeʁ/→['xen] 'other' (RM, 1;10.28)
v	0	0%	6	3%	6	2%	/'seʁet/→['sevet] 'movie' (RM, 2;01.06)
m	0	0%	6	3%	6	2%	/nax'zib/→[nax'zim] 'return 1.pl.fut' (RM, 2;04.05)
b	2	3%	1	0.4%	3	1%	/si'puʁ/→[sis'pub] 'story' (RM, 2;05.15)
ʃ	0	0%	3	1%	3	1%	/ka'kevet/→[ʃaa'kevet] 'train' (RM, 2;01.19)
p	0	0%	2	1%	2	1%	/'peʁax/→['pepa] 'flower' (RM, 2;01.19)
ʒ	1	2%	0	0%	1	0.3%	/dʒi'kaʃa/→['ʒiʒa] 'giraffe' (SR, 1;05.04)
f	0	0%	1	0.4%	1	0.3%	/ga'zaʁti/→[ga'zafti] 'cut 1.sg.past' (RM, 2;11.14)
s	0	0%	1	0.4%	1	0.3%	/ko'a/→[so'a] 'see 1.sg.fm.pres' (RM, 2;09.13)
z	0	0%	1	0.4%	1	0.3%	/liʃ'boʁ/→[liʃ'poz] 'break inf.' (RM, 2;01.19)
ʕ	0	0%	1	0.4%	1	0.3%	/letsa'jeʁ/→[lesa'jeʕa] 'draw inf.' (RM, 2;03.29)
Total	59		233		292		

Quantity of Substitution

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Conclusions

- 292 B-substitutions out of 7367 targets (3.96%)
 - SR: 59 out of 2642 targets (2.23%)
 - RM: 233 out of 4725 targets (4.93%)

Quantity of Substitution

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Method

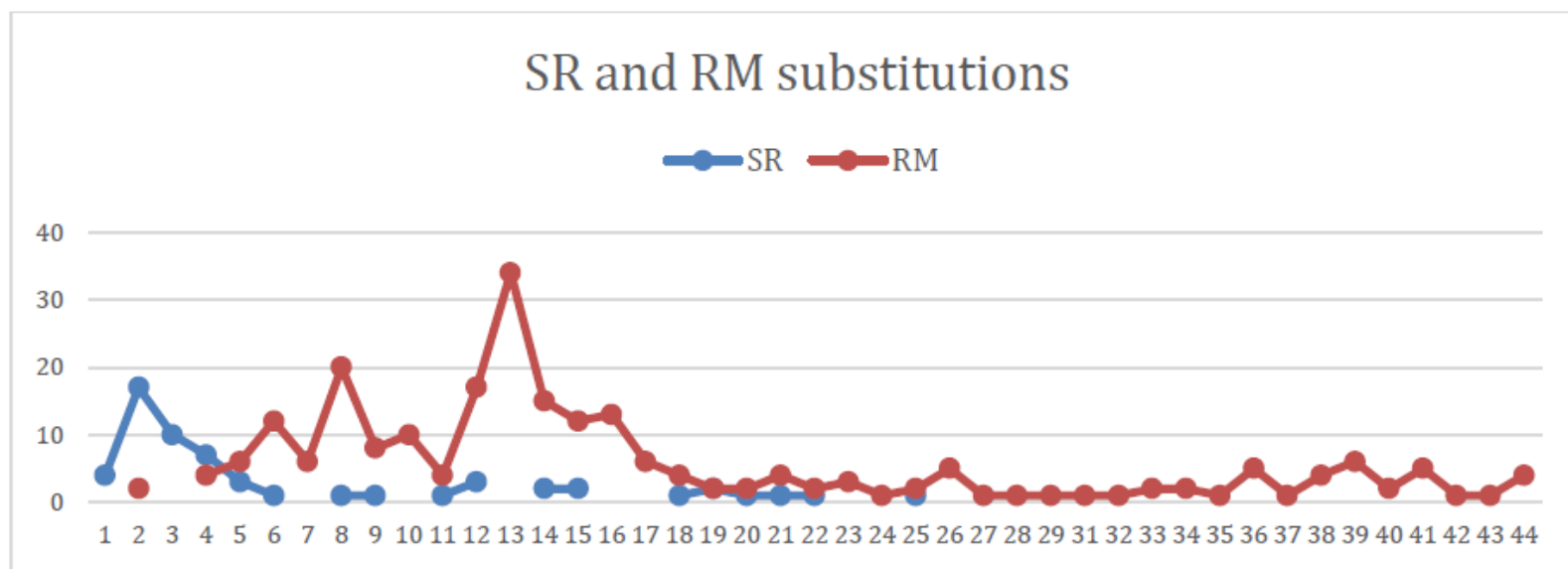
Quantity

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Conclusions

- Substitution across developmental periods
 - ▣ **SR** – peak at **period 2** (n=17)
 - ▣ **RM** – peak at **period 13** (n=34)



Quantity of Substitution

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Conclusions

- Differences among the two children (Bat-El 2012; Cohen 2012; Gafni 2012)
 - SR: segments fast, prosody slow
 - RM: segments slow, prosody fast

Quantity of Substitution

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Quantity

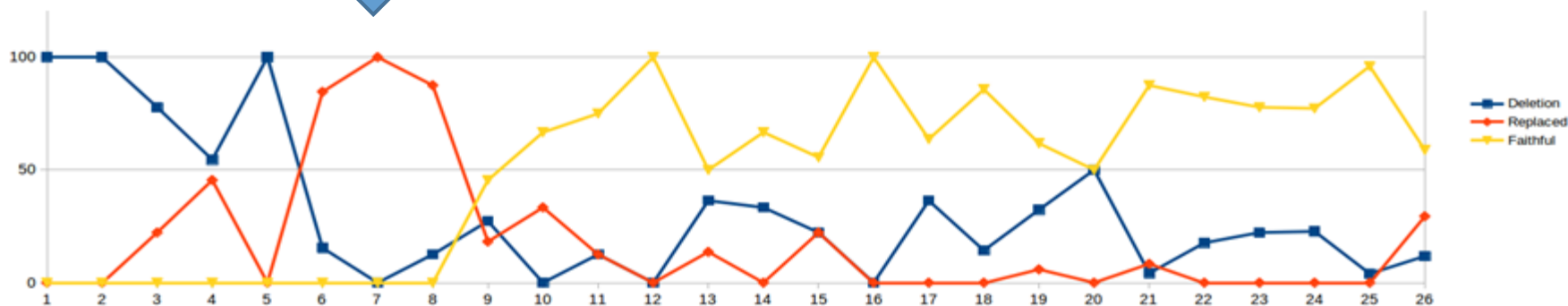
Prosody

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Conclusions

- Substitution as a transitional phase in word-initial productions of /ʁ/ (from Cohen 2015)

□ SR



Prosodic Factors

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Conclusions

- **Larger variability in onsets, relative stability in coda**
 - ▣ Phoneme Consistency (Cohen 2015)

RM	Word-initial			Intervocalic			Word-final		
	SCs	Substitutions		SCs	Substitutions		SCs	Substitutions	
	[x]	48%	24	[x]	32%	17	[x]	71%	72
	[l]	12%	6	[j]	17%	9	[j]	6%	6
	[d]	10%	5	[d]	9%	5	[w]	6%	6
	[j]	6%	3	[w]	9%	5	[l]	4%	4
	[g]	4%	2	[t]	7%	4	[m]	3%	3
	[k]	4%	2	[v]	6%	3	[k]	2%	2
	[n]	4%	2	[k]	4%	2	[n]	2%	2
	[w]	4%	2	[l]	4%	2	[b]	1%	1
	[m]	2%	1	[m]	4%	2	[g]	1%	1
	[s]	2%	1	[p]	4%	2	[t]	1%	1
	[ʃ]	2%	1	[g]	2%	1	[v]	1%	1
	[t]	2%	1	[n]	2%	1	[z]	1%	1
				[ʃ]	2%	1	[ʔ]	1%	1

Prosodic Factors

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Conclusions

- Less data, but same tendencies

SR	Word-initial			Intervocalic			Word-final		
	SCs	Substitutions		SCs	Substitutions		SCs	Substitutions	
	[w]	100%	1	[g]	39%	16	[w]	50%	6
				[j]	37%	15	[x]	17%	2
				[l]	10%	4	[g]	8%	1
				[b]	5%	2	[j]	8%	1
				[k]	5%	2	[l]	8%	1
				[w]	2%	1	[n]	8%	1
				[ʒ]	2%	1			

Cross-Sectional Data

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Conclusions

- **Cross-sectional** study: Cohen & Ben-David (2016)
 - 581 children
 - 9748 B-targets
 - 985 (10.1%) B-substitutions: Initial (302), medial (307) and final (376)
 - Tokens classified by **SC type** and **prosodic position**

Cross-Sectional Data

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Conclusions

□ Variability in onsets, stability in coda

□ Consistent with longitudinal data

Word-initial		Intervocalic		Word-final	
SCs	Substitutions	SCs	Substitutions	SCs	Substitutions
[j]	55%	[j]	57%	[x]	87%
[l]	22.7%	[l]	23%	[ŋ]	9%
[w]	8.9%	[w]	9%	[l]	3.8%
[x]	4.6%	[x]	5%	[k]	0.2%
[ŋ]	2.5%	[ŋ]	2.8%		
[n]	2.4%	[n]	1.9%		
[k]	1.9%	[g]	1.3%		
[g]	0.9%				
[d]	0.7%				
[h]	0.4%				

Segmental Factors

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Conclusions

- Reminder – we look at nearby **vowels** and **consonants**

- Why Vowels?
 - **Consonant-Vowel assimilation** (e.g. Hyman 1973, Hume 1990; 1994; 1996, Pulleyblank 1989, Broselow & Niyondagara 1989, Mester & Ito 1989, Lahiri & Evers 1991, Padgett 2011)
 - Front vowels (i, e) with front (coronal) consonants
 - Back vowels (a, o, u) with back (dorsal) consonants

- Why Consonants?
 - **Consonant harmony** (e.g. Lewis 1936/1951, Cruttenden 1978, Levelt 1994, Berg 1992, Rose 2000, Goad 1997, Pater 1997, Pater and Werle 2001, for a review see Gafni 2012)

Preceding Vowel

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Conclusions

□ SR:

□ SCs harmonic with Vs

- **Coronals** after **front** vowel (86%)

- **Dorsals** after **back** vowel (65%)

□ **Labials** are negligible throughout

Preceding Vowel		LAB		COR		DOR		Total
SR	Front	0	0%	12	86%	2	14%	14
	Back	2	5%	13	30%	28	65%	43
	#	0	0%	0	0%	1	100%	1

Preceding Vowel

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Conclusions

□ RM:

□ **Dorsals > Coronals** in all environments

□ **Dorsals after back (74%) > Dorsals after front (54%)**

Preceding Vowel		LAB		COR		DOR		Total
RM	Front	8	15%	16	31%	28	54%	52
	Back	7	6%	25	20%	91	74%	123
	#	1	2%	19	38%	30	60%	50
	C	0	0%	4	50%	4	50%	8

Preceding Vowel

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□ RM compared to SR:

▣ Period 1-10 – Identical, **SCs harmonic with Vs**

▣ Later – **Dorsals > Coronals**

		Preceding Vowel	LAB		COR		DOR		Total
RM	P. 1-10	Front	1	7%	10	71%	3	21%	14
		Back	4	10%	11	27%	26	63%	41
		#	1	8%	9	75%	2	17%	12
		C	0	0%	1	100%	0	0%	1
	P. 11-20	Front	3	13%	4	17%	16	70%	23
		Back	1	2%	8	13%	51	85%	60
		#	0	0%	9	43%	12	57%	21
		C	0	0%	3	60%	2	40%	5
	P. 21-44	Front	4	27%	2	13%	9	60%	15
		Back	2	9%	5	23%	15	68%	22
		#	0	0%	1	6%	16	94%	17
		C	0	0%	0	0%	2	100%	2

Preceding Consonant

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Conclusions

- We also look at nearby consonants
 - ▣ Examples of full and partial (place) harmony

	Surface Form	Target	Gloss	Child	Period	Age
Full harmony	'pepa	'pe ʔ ax	'flower'	RM	16	2;01.19
	va'vod	va' ʔ od	'pink'	RM	9	1;11.18
	gu'gum	'kengu ʔ u	'kangaroo'	SR	2	1;04.10
Partial harmony	'tuul	ka'du ʔ	'ball'	RM	2	1;05.14
	'sijaa	si' ʔ a	'boat'	SR	4	1;05.15
	'kakəl	'tʁakto ʔ	'tractor'	SR	3	1;05.08

Preceding Consonant

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Conclusions

- RM: **Dorsals are equally preferred** across all environments

Preceding Consonant		LAB		COR		DOR		Total
RM	LAB	8	16%	8	16%	35	69%	51
	COR	6	8%	21	27%	51	65%	78
	DOR	0	0%	11	31%	25	69%	36
	No Preceding Consonant	2	3%	23	34%	43	63%	68

Preceding Consonant

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Conclusions

- **SR: Consonants matter!**
 - **Coronals after Coronals (81%)**
 - **Dorsals after Dorsals (89%)**

Preceding Consonant		LAB		COR		DOR		Total
SR	LAB	2	18%	4	36%	5	45%	11
	COR	0	0%	13	81%	3	19%	16
	DOR	0	0%	2	11%	16	89%	18
	No Preceding Consonant	0	0%	6	43%	8	57%	14

Interim Summary

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Conclusions

- So far: Preceding Vowel & Consonant
 - ▣ RM: **Vowels** are triggers, consonants are not
 - ▣ SR: **Vowels** and **consonants** are triggers

Segmental Cumulative Effect

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Conclusions

□ SR: Cumulative effect

▣ Substitution mostly **when V and C are harmonic**

▣ **Consistent with typology:** *Consonant harmony across homorganic vowels is less marked than non-homorganic*
(Levelt 1994, Stoel-Gammon 1996, Pater & Werle 2001)

			LAB		COR		DOR		Total
SR	Front	LAB	0	0%	1	100%	0	0%	1
		COR	0	0%	10	83%	2	17%	12
		DOR	0	0%	0	0%	0	0%	0
	Back	LAB	2	20%	3	30%	5	50%	10
		COR	0	0%	3	75%	1	25%	4
		DOR	0	0%	2	11%	16	89%	18

Segmental Cumulative Effect

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Conclusions

- RM (periods 1-10): No cumulative effect

			LAB		COR		DOR		Total
RM	Front	LAB	0	0%	2	67%	1	33%	3
		COR	0	0%	2	50%	2	50%	4
		DOR	0	0%	5	100%	0	0%	5
	Back	LAB	2	13#	0	0%	14	88%	16
		COR	0	0%	1	20%	4	80%	5
		DOR	0	0%	3	43%	4	57%	7

Conclusions

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Conclusions

- Our question was:

Which factors determine the selection of **Substitute Category**?

- Percepts (i.e. Phoneme Consistency)
- Prosody
- Segmental Environment

Conclusions

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Conclusions

- **Prosody** and **Percepts** determine variability
 - ▣ Less variability in coda compared to onset
 - ▣ Predicted by **Phoneme Consistency** (Cohen 2015)

- **Segmental factors** play a role as well
 - ▣ Contribute to selection of **place of articulation** in early substitution
 - ▣ **Two stages**, similarly to Quebec French (Rose 2000; 2003):
 - Stage I: **Assimilatory** (C-V assimilation / Consonant harmony)
 - Stage II: **Non-assimilatory** (Dorsal [x]), skipped by SR

Next Steps

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Conclusions

- Substitution in **other segments**
 - [l] – acquired in onset before coda
 - [x] - ?

- Effect of **phoneme frequency** across prosodic positions?

- **Acoustic cues** for /ʁ/ in SCs? (see Knight et al. 2007)

Thank you vewy much!

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