Specific Exceptions Driving Variation:

The role of orthography in Modern Hebrew spirantization

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Introduction

This paper reports results from a production experiment examining the role of orthography in conditioning the patterning of variation in morphophonemic alternations. Real and nonce verbs were used to elicit variation in a sentence completion task as a follow-up to a perception experiment (Temkin Martinez 2010) which found gradient variation due to the presence of exceptionality. Linking exceptions represented in the orthography can better explain gradience in variation.

Modern Hebrew Spirantization

[p], [b], and [k] alternate with their fricative counterparts [f], [v], and [χ], with fricatives generally occurring in post-vocalic position and stops occurring elsewhere.

(1) Spirantization distribution in Modern Hebrew

	Root	Infinitive	3.sg.m.past	Gloss
[p] ~ [f]	/pgʃ/	[lifgoʃ]	[pagaʃ]	'meet'
[b] ~ [v]	/bgd/	[livgod]	[bagad]	'betray'
[k] ~ [χ]	/ktb/	[liχtov]	[katav]	'write'

Exceptions to spirantization are instances of [p], [b], [k], [f], [v], and [χ] which, for historical reasons, surface as stops in post-vocalic position or as fricatives elsewhere.

(2) Examples of exceptions to spirantization in Modern Hebrew

	Root	Infinitive	3.sg.m.past	Gloss
/k/ (< *q)	/krʔ/	[likro] (*[liχro])	[kara]	'read'
/v/ (< *w)	/vtr/	[levater]	[viter] (*[biter])	'give up'

All segments involved in spirantization have exceptional counterparts which sound identical but do not participate in the distribution. In some cases, however, the difference between alternating and non-alternating segments is encoded orthographically.

(3) Orthographic representations for each segment

	Alternating	Exceptional Stop	Exceptional Fricative
[k]/[x]	כ	ק from TH [q] (i.e. /krʔ/ (2)) כ - geminates and non-alternating paradigms	ח from TH [ħ], also in borrowings
[p]/[f]	פ	פ - geminates and non-alternating paradigms	פ [f] in borrowings, less frequent than other exceptional fricatives
[b]/[v]	ב	ב - geminates and non-alternating paradigms	ו from TH [v], also in borrowings (i.e. /vtr/ in (2))

Variation has been reported (Schwarzwald 1981, Adam 2002). That is, speakers may opt to not alternate segments that are actually supposed to.

(4) Variation in Modern Hebrew spirantization

	Root	Expected	Acceptable Variant	Gloss
/b/	/kbr/	[likbor]	[likvor]	'to bury'
/k/	/ksh/	[jexase]	[jekase]	'will cover'

A perception experiment (Temkin Martinez 2010) found that variation was significantly more acceptable in alternating segments than in exceptions. It was also deemed more acceptable in post-consonantal position than other positions.

Methods

Forty-eight native speakers of Modern Hebrew participated in a sentence-completion task. Stimuli contained 44 real verbs and 32 nonce verbs.

(4) Sample target sentence

[dani	ohev	*levagel*	dvarim.	Amru li	ʃeʔetmol	hu _______]
Danny	loves to	*NONCE*	things.	Told to me	that yesterday	he _______

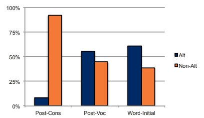
'Danny loves to NONCE things. I've been told that yesterday he_______'

- Verbs were inflected so that the target segment's position would be different in the first and second sentences, and the inflection of the nonce tokens was ambiguous as to whether the target segment was supposed to alternate.
- In sentences containing nonce verbs, in addition to completing the sentences orally, participants were also asked to write down the verb root.

Results – Nonce Verbs

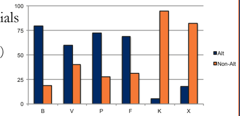
Word position effects correspond with Temkin Martinez (2010)

- Post-consonant position drives effect of word position:
  - Participants prefer non-alternating form in this position.
    - Main effects of word-position (p < .001) and alternation (p = .012)
    - Significant interaction (p < .001)

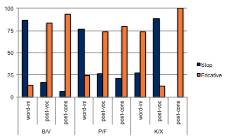


Segment distribution illustrates effect of orthography on alternation preference

- The velars pattern differently than the labials in preferences for alternation:
  - Preference for non-alternation among velars
  - Preference for non-alternation in /v/ higher than other labials
    - Main effect of segment (p < .001) but not alternation (p = .920)
    - Significant interaction between segment and alternation (p < .001)
    - Post-hoc Tukey tests showed a significant difference (p < .001) in the means of the velars with those of the labials in alternating and non-alternating allophones.

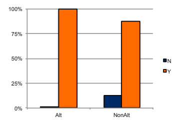


- This can be further explained looking at the distribution of stops and fricatives with in each position by stop/fricative pair:
  - /b/ and /v/ pattern *similarly* to /p/ and /f/
  - /k/ and /χ/ pattern differently word-initially and post-vocalically



Production of alternation and spelling choice

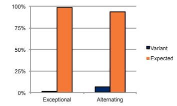
- Significant correlation between choice to alternate or not and the choice of grapheme to represent the segment:
  - When producing alternating segments, participants used the orthographic representation correlating with alternation.
  - When producing non-alternating segments, participants preferred using the orthographic representation correlating with exceptionality, but *also* used that of the alternating segments.
    - No main effect of alternation (p = .705) – choice of alternation was random.
    - Main effect of matching production with spelling (p < .001)
    - Main interaction of alternation and spelling matching (p = .002)



Results – Real Verbs

Alternating vs. Exceptional Segments:

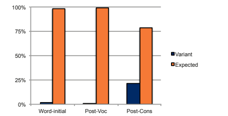
- The expected allophone was produced significantly more than the variant in both alternating and exceptional segments.
  - There was a higher rate of variation in alternating segments than in exceptional ones.
    - Main effects of both segment type and allophone (p < .001)
    - Significant interaction of segment type and allophone (p < .001)



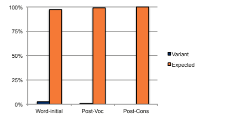
Word position:

- Variation in alternating segments was significantly more prevalent in post-consonantal position than in other positions.
- Variation in exceptional segments was also significantly different across word positions, but no variation was acceptable in post-consonantal position and the effect was driven by word-initial position.

Alternating Segments



Exceptional Segments



- In both alternating and exceptional segments:
  - Main effects of both word position and allophone (p < .001)
  - Significant interaction of word position and allophone: (p < .001)

Discussion

Variation and exceptionality in a single phenomenon (Temkin Martinez 2010):

- Alternating segments are in complementary distribution – allophony.
  - *V-stop » *[+cont, -sib] » Ident-IO[cont], *Stop
- Exceptionality (non-alternation) is captured through set-indexation (Pater 2000).
  - All non-alternating segments are indexed to a single set
  - Indexed Faithfulness » Markedness » General Faithfulness
- Gradience in variation is accounted for by implementing Stochastic OT (Boersma 1998, Hayes & MacEachern 1998, Zuraw 2000).

/**bk₁**S/ + sg.m.pres 'asks for'	IDENT-IO[cont]₁ (.723)	*V-STOP (.637)	*[+cont, -sib] (.592)	*STOP (1)	IDENT-IO[cont]
☞ a. me**v**a**k₁**eS *Input (57.4%)* *Generated* ***(42.3%)***		*	*	*	*
b. me**b**a**k₁**eS *Input (39.3%)* *Generated* ***(33.8%)***		**!		**	
c. me**v**a**X₁**eS *Input (0%)* *Generated* ***(23.9%)***	*!		**		**
d. me**b**a**X₁**eS *Input (3.3%)* *Generated* ***(0%)***	*!	*	*	*	*

	Sample Target	Input Frequency	Generated Frequency
Alternating	[ba**k**a]	0.07	0.34
Exceptional	[meχajem]	0.00	0.24
Hybrid	[meva**k**er]	0.72	0.42

Learning and learnability

- Without consideration for orthography, some generated outputs do not match input:
  - In some cases, generated tokens never occurred in the input (not deemed acceptable to any speaker)
    - Should markedness constraints (affecting only the alternating segments) be specified for sets based on corresponding exceptional segments' orthographic representations?

Future directions:

- Production experiments with pre-literate children.
- Diachronic data – examine directionality of variation.
- Corpus study (CoSIH) to determine occurrences of variation in natural speech.