Exceptions Encoded at the Segmental Level

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1. Introduction

In this paper, we discuss the need for including treatment of exceptions as segmental-level phenomena in the theory as evidenced from exceptional cases to spirantization in Modern Hebrew.

In Modern Hebrew (MH), due to degemination and some historical mergers, spirantization affects only /p/, /b/ and /k/. These stops alternate with their fricative counterparts in allophonic distribution, with fricatives occurring in post-vocalic position, and stops occurring elsewhere (Prince 1975, Adam 2002). This is shown in (1):

(1) Regularly alternating stop / fricative pairs in MH

root	3p.sg.past	infinitive	gloss
/**p**rs/	[**p**aras]	[li**f**ros]	'to spread'
/**b**nh/	[**b**ana]	[li**v**not]	'to build'
/**k**tb/	[**k**atav]	[li**χ**tov]	'to write'

However, there are some cases of underapplication of spirantization, with stops occurring in post-vocalic position, as in (2a). There are also cases of apparent overapplication of spirantization, where fricatives occur in word-initial position, as in (2b):

(2) Non-alternating stops and fricatives in MH

a. Non-alternating stops

[**k**avar]	'buried'	[li**k**bor]	'to bury'
[si**p**er]	'told'	[lesa**p**er]	'to tell'
[**χ**i**b**el]	'sabotaged'	[le**χ**a**b**el]	'to sabotage'

b. Non-alternating fricatives

[**f**aʃla]	'mistake'	[le**f**aʃel]	'to make a mistake'
[**v**iter]	'conceded'	[le**v**ater]	'to concede'
[**χ**alam]	'dreamt'	[la**χ**lom]	'to dream'

This work focuses on the implications of instances of overapplication and underapplication for the theoretical treatment of exceptions. The words in (3) below contain both regularly alternating and non-alternating segments. These data reveal that exceptionality is not necessarily a characteristic of all segments in the word, unlike the predictions of analyses that treat exceptions as rankings or properties associated with entire words (Itô and Mester 1999, Pater 2000, among others).

(3) Words containing both regularly alternating and non-alternating segments in MH

root	3p.sg.past	infinitive	gloss
/**k**b**r**/	[**k**a**v**ar]	[li**k**b**v**or]	'to bury'
/**b**χ**r**/	[**b**a**χ**ar]	[li**v**χ**v**or]	'to elect'
/**k**p**r**/	[**k**i**p**ur]	[le**χ**a**p**ɛr]	'to atone'

Building on Inkelas, Orgun and Zoll (1997), this paper proposes an Optimality Theoretic account for paradigms in which alternating and non-alternating segments occur in MH by encoding the exceptionality at the segmental level. A prespecification approach to segments allows for the correct analysis of these exceptions. In this approach, all exceptional segments are prespecified for a feature

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that does not alternate, whereas regularly alternating segments are left unspecified. Coupled with a high-ranking faithfulness constraint, exceptional segments are blocked from alternating, whereas the unspecified segments alternate, as they incur equal violations of faithfulness.

2. Modern Hebrew

The term Modern Hebrew refers to the variety of Hebrew spoken by native-born Israeli children since the arrival of the Jewish people to Israel at the end of the nineteenth century. Since the inception of the idea to create a Jewish state in Israel, immigrants from many parts of the world have settled in Israel. Languages spoken by these immigrants, spanning from Semitic to Slavic to Germanic languages, have had great influence on many aspects of the language currently spoken in Israel (Adam 2002).

Currently, there are two main varieties of colloquial Hebrew. These varieties are mostly distinguishable in their phonology, with the presence of pharyngeals /ʕ/ and /ħ/ in the Oriental variety, and their absence in the Non-Oriental variety. Normative Hebrew, used mostly in news broadcasts and formal contexts, also displays the use of the pharyngeals, which have merged with other sounds in the Non-Oriental variety (Adam 2002). In this paper, the term Modern Hebrew relates to the Non-Oriental colloquial variety of Hebrew.

2.1. The phonemic inventory

The phonemic inventory in Table 1 below provides a picture of the distribution of the phonemes of native Modern Hebrew speakers.[1]

	Bilabial	Labio-dental	Alveolar	Post-alveolar	Palatal	Velar	Uvular	Glottal
Stop	**/p/ /b/**		/t/ /d/			**/k/** /g/		/ʔ/
Nasal	/m/		/n/					
Fricative		**/f/ /v/**	/s/ /z/	/ʃ/			**/χ/**	/h/
Approx.					/j/		/ʁ/	
Affricate			/ts/					
Lateral			/l/					

Table 1 - Phonemic inventory of Modern Hebrew

In the table above, all supralaryngeal stops and fricatives have been outlined, with the segments participating in spirantization found in bold. Note that /t/, /d/, and /g/ are present in the phonemic inventory, but do not undergo spirantization in MH. An account for the lack of spirantization of these segments in MH is outside the scope of this paper, but can be found in Temkin Martínez (2005).

[1] Segments which are not found in this inventory are the pharyngeals /ʕ/ and /ħ/, found only in the Oriental variety. Also missing are the segments /dʒ/, /tʃ/, and /ʒ/, which are found only in borrowed words. Unlike these three segments, /f/ is found in the inventory even though its phonemic status is similar (e.g. [faʃla] 'mistake' (from Arabic), [flirtet] 'flirted' (from English)) due to its status as an exceptional segment. However, in other instances, unlike the former three segments, /f/ is found in allophonic distribution with /p/.

2.2. Modern Hebrew spirantization

Recall that spirantization occurs in post-vocalic position in Modern Hebrew and is limited to /p/, /b/ and /k/. This is seen in (4) below:

(4) Regularly spirantizing stop / fricative pairs in MH

root	3p.sg.past	infinitive	gloss
/**p**rs/	[**p**aras]	[li**f**ros]	'spread'
/**p**gʃ/	[**p**agaʃ]	[li**f**goʃ]	'meet'
/**b**nh/	[**b**ana]	[li**v**not]	'build'
/**b**χr/	[**b**aχar]	[li**v**χor]	'choose'
/**k**tb/	[**k**atav]	[li**χ**tov]	'write'
/**k**tʃ/	[**k**ataʃ]	[li**χ**toʃ]	'crush'

2.2.1. Analysis for regularly alternating segments

In the analysis of regularly spirantizing segments, a central constraint would have to be one which encourages spirantization in post-vocalic position. Since this contextual markedness constraint is what drives regular spirantization, it will be highly-ranked (Benua 1997).[2]

(5) Context-sensitive markedness constraint
***V-STOP** Post-vocalic stops are prohibited.

The stop / fricative alternation in MH spirantization occurs in allophonic distribution for regularly alternating segments. A universal relative ranking of context-free markedness constraints on stops and fricatives demonstrates that fricatives are more marked than stops (Benua 1997). This being the case, the constraint against fricatives is higher ranked and is defined in (6) below.

(6) Context-free markedness constraint
***[+cont, -sib]** Non-sibilant fricatives are prohibited.[3]

A faithfulness constraint on the feature [continuant], though not required for the correct selection of the optimal candidate in regularly alternating stops, will be essential for the analysis. The low-ranked IDENT-IO[cont] would demonstrate that spirantization is determined solely by markedness, and would prevent changes in continuancy that are not driven by the dominating markedness constraints.

(7) Faithfulness constraint
IDENT-IO[cont] Let α be a segment in the input and β be a correspondent of α in the output. If α is [γcont], then β is [γcont] (McCarthy and Prince 1995).
"Input-output correspondents are identical in [±cont]."

The ranking of these three constraints for the analysis of regularly alternating segments is shown in (8) and schematized in the tableaux in (9) and (10).

(8) Constraint Ranking
*V-STOP » *[+cont, -sib] » IDENT-IO[cont]

The low rank of the faithfulness constraint ensures that the allophonic distribution of the stop / fricative pairs will be unaffected by the presence of either a stop or a fricative in the input. In the

[2] See Kirchner (1998) and González (2003) for other lenition or spirantization-driving constraints.
[3] Ladefoged (1997) describes the need to distinguish sibilants from other fricatives, as they are distinct in acoustic features across the world's languages.

following tableaux, this is demonstrated through the use of fricatives in the input for surface stops and stops in the input for surface fricatives.

In post-vocalic position, spirantization-driving contextual markedness dominates the context-free markedness constraint for fricatives along with faithfulness for continuancy. This causes post-vocalic stops to become fricatives as seen in (9):

(9) *V-STOP » *[+cont, -sib]

/**k**pr/ + (infinitive) *'to deny'*	*V-STOP	*[+cont, -sib]	IDENT-IO[cont]
☞a. li**χ**por		*	*
b. li**k**por	*!		

For stops to surface in non-post-vocalic position, the context-free markedness constraint against non-sibilant fricatives must be ranked higher than faithfulness for continuancy, causing the avoidance of fricatives in post-consonantal position. This is seen in (10a):

(10a) *[+cont, -sib] » IDENT-IO[cont]

/**χf**r/ + (infinitive) *'to deny'*	*V-STOP	*[+cont, -sib]	IDENT-IO[cont]
☞a. li**χp**or		*	*
b. li**χf**or		**!	

For stops to surface in word-initial position, regardless of the input, faithfulness is dominated by the context-free markedness constraint against non-sibilant fricatives, as seen in (10b):

(10b) *V-STOP » IDENT-IO[cont]

/**χ**ns/ + (3p.past) *'gathered'*	*V-STOP	*[+cont, -sib]	IDENT-IO[cont]
☞a. **k**ines			*
b. **χ**ines		*!	*

In exceptional cases, however, the ranking above does not allow for the correct candidate to surface. In the tableaux in (11), we see that due to the higher ranking of markedness, the optimal candidate in these paradigms is (wrongly) selected to be the one containing a stop in word-initial position, or a fricative in post-vocalic position (💣 denotes a wrongly selected optimal candidate).

(11) Tableaux for exceptional, non-alternating segments

	*V-STOP	*[+cont, -sib]	IDENT-IO[cont]
A. /**v**tr/ + (3p.past) *'forgave'*			
a. **v**iter	*	*!	
💣b. **b**iter	*		*
B. /**χ**ps/+ (3p.past) *'looked for'*			
a. **χ**ipes	*	*!	
💣b. **k**ipes	*		*
C. /s**p**r/+ (infinitive) *'to tell'*			
a. lesa**p**er	*!		
💣b. lesa**f**er		*	*

A re-ranking of the constraints in the tableaux above (ranking faithfulness higher than the two markedness constraints) would allow for the correct analysis for the exceptional cases seen in (11). However, it would prove troublesome for the analysis of regularly alternating segments shown in the tableaux in (9) and (10). Additionally, the correct analysis for MH spirantization must account not only for both regularly alternating and non-alternating segments, but also for words containing both a regularly spirantizing and an exceptional segment (such as those seen in (3) above). Thus, the analysis cannot simply provide a re-ranking of the constraints shown thus far.

2.3. Exceptions to Modern Hebrew spirantization

Recall the exceptions to MH spirantization listed in (2) above. These include instances where stops surface in post-vocalic position or fricatives occur in non-post-vocalic position. These exceptional cases are largely due to historical mergers and degemination from Tiberian Hebrew, along with recent borrowings from various languages.[4] In (12a) and (12b), exceptional occurrences of fricatives and stops are outlined respectively:

(12a) Non-alternating fricatives

Segment	**Word-initial**		**Word-medial**	
/f/ (borrowed)	[**f**aʃla]	'mistake'	[le**f**aʃel]	'to make a mistake'
/v/ (<*w)	[**v**iter]	'conceded'	[le**v**ater]	'to concede'
/χ/ (<*ħ)	[**χ**alam]	'dreamt'	[laχlom]	'to dream'

(12b) Non-alternating stops

Segment	**Word-initial**		**Word-medial**	
/k/ (<*q)	[**k**avar]	'buried'	[li**k**bor]	'to bury'
singleton stops	[si**p**er]	'told'	[lesa**p**er]	'to tell'
{/p/, /b/, /k/}	[χa**b**ala]	'sabotage'	[leχa**b**el]	'to sabotage'
(from historical geminates)				

I propose that exceptions seen in (12) have been lexicalized, and that an appropriate analysis must account for this lexicalization of non-alternating segments. Such an analysis would account for the difficulty with which native speakers acquire these exceptions, citing Ravid's (1995) claim that complete mastery of the Modern Hebrew phonological system is attained, at the earliest, around twelve years of age.

Idsardi's (1997) rule-based analysis of exceptions in Modern Hebrew may shed some light on providing a proper Optimality Theoretic analysis. When discussing the opaque case of non-alternating /k/ (<*q) and /χ/ (<*ħ), he proposes a three-way distinction based on the feature [continuant]. Namely, he claims that non-alternating segments must be underlyingly prespecified for this feature, while regularly alternating segments remain unspecified in speakers' mental representation. This three-way distinction can be further expanded to include other three-way paradigms in Modern Hebrew, as depicted in Table 2 below.

	Regularly alternating	Non-alternating Fricative	Non-alternating Stop
[k] / [χ]	spirantizing /k/	**/χ/** (<*ħ)	**/k/** (<*q)
[p] / [f]	spirantizing /p/	**/f/** (borrowed)	**/p/** (historical geminate)
[b] / [v]	spirantizing /b/	**/v/** (<*w)	**/b/** (historical geminate)

Table 2 - Three-way distinction between alternating pairs, non-alternating fricatives, and non-alternating stops

[4] For a detailed explanation of language change and its influence on MH spirantization see Temkin Martínez (2005).

This three-way distinction is essential for the correct analysis of both regularly alternating and exceptional cases in MH spirantization. Section 2.3.1 provides the proposed analysis for MH spirantization utilizing this three-way characterization of segments.

2.3.1. Analysis for non-alternating segments in Modern Hebrew spirantization

Following Idsardi (1997), and building on Inkelas, Orgun and Zoll (1997), I propose that the three-way distinction shown above can best be analyzed with the prespecification and underspecification of the feature [continuant] for the segments in the input, a possibility predicted by Richness of the Base (Prince and Smolensky 1993). These representations, along with the notation used in the analysis, are depicted in Table 3. Note that regularly alternating segments are represented with a capital letter corresponding to the IPA character for the stop, and non-alternating segments are represented with their respective IPA symbol along with a node specifying the value for the feature [continuant] for that segment.

	Regularly alternating	Non-alternating Fricative	Non-alternating Stop
	unspecified for [cont]	*prespecified [+cont]*	*prespecified [-cont]*
Representations for velars: unspecified and prespecified segments	/k/ [-son] [+cons] [Dors] [-voi] ∅	/k/ [-son] [+cons] [Dors] [-voi] [+cont]	/χ/ [-son] [+cons] [Dors] [-voi] [-cont]
Notation for prespecified vs. unspecified segments	/K/	/k/ | [+cont]	/χ/ | [-cont]

Table 3 - Revised three-way distinction in stop / fricative pairs

With faithfulness dominating markedness, non-alternating segments will be prevented from alternating by prespecifying them as either [+cont] or [-cont] in the input. Unspecified segments, on the other hand, incur equal violations of faithfulness whether they are instantiated as a stop or a fricative in the output. That is, assuming outputs are fully specified, specifying these segments as [+cont] or [-cont] will each incur equal violations of faithfulness. This allows the lower ranked markedness constraints to decide the realization of the unspecified segments. Possible mappings that violate or obey IDENT-IO[cont] are depicted in Table 4.

Input	Output	IDENT-IO[cont]
/χ/ | [+cont]	[k]	*
	[χ]	✓
/k/ | [-cont]	[χ]	*
	[k]	✓
/K/	[k]	*
	[χ]	*

Table 4 - Possible mappings that violate or obey faithfulness

Bearing in mind the violations of IDENT-IO[cont] and the prespecification or underspecification of the segments in the input, the tableaux in (13) demonstrate the correct selection of the optimal candidates by the ranking of IDENT-IO[cont] over the markedness constraints. In (13a), we see how this analysis handles a root with two specified segments. In this case, the root-initial fricative /χ/ stems from a historical sound merger, and the /p/ in this root is also a descendent of Tiberian Hebrew

geminate /p/, which did not undergo spirantization. In the tableau, the high-ranking faithfulness constraint allows only the fully faithful candidate to surface, not permitting any variation in correspondence between the input and output. The remaining candidates incur fatal violations of IDENT-IO[cont], and therefore lose. In this case we see a fricative in word-initial position as well as a stop in post-vocalic position in the output.

(13a) Two prespecified segments

/χ p s/ + (3p.past) [+cont] [-cont] *'looked for'*	IDENT-IO[cont]	*V-STOP	*[+cont, -sib]
☞a. χipes		*	*
b. kipes	*!	*	
c. χifes	*!		**
d. kifes	*!*		*

In the tableaux in (13b), the root contains a non-alternating segment in root-initial position and a regularly alternating segment in root-medial position. The specified segment (/k/ in this case) is always instantiated according to its specification (a stop in this case), without regard to context, whereas the unspecified segment alternates in accordance with markedness. In these tableaux, we see that forms containing both regularly alternating and non-alternating segments are correctly analyzed using prespecification and underspecification. Crucially, whole-word approaches to exceptionality have failed to provide an appropriate analysis for cases such as those illustrated here (Temkin Martínez 2005).

(13b) One prespecified segment, one unspecified segment

Input	Output	IDENT-IO[cont]	*V-STOP	*[+cont, -sib]
/kBr/ + (infinitive) [-cont] *'to bury'*	☞a. likbor	*	*	
	b. liχbor	**!		*
	c. liχvor	**!		**
	d. likvor	*	*	*!
/kBr/ + (3p.past) [-cont] *'buried'*	☞a. kavar	*		*
	b. χavar	**!		**
	c. χabar	**!	*	*

Finally, in the tableaux in (13c), we see that words that do not contain any exceptional segments can be correctly analyzed using this approach as well. Since all candidates tie in their violations of the faithfulness constraint, markedness is left to select the correct winning candidate.

(13c) Two unspecified segments

Input	Output	IDENT-IO[cont]	*V-STOP	*[+cont, -sib]
/BKh/ + (infinitive) *'to cry'*	☞a. livkot	**		*
	b. libkot	**	*!	
	c. livχot	**		**!
	d. libχot	**	*!	*
/BKh/ + (3p.past) *'cried'*	☞a. baχa	**		*
	b. baka	**	*!	
	c. vaχa	**		**!
	d. vaka	**	*!	*

3. Conclusion

Roots such as /kbr/ containing one regularly alternating segment and one non-alternating segment provide evidence that the theory must include the ability to denote exceptionality at the segmental level. Utilizing the prespecification approach proposed in Inkelas, Orgun, and Zoll (1997) provided the correct analysis for these hybrid roots, as well as for roots containing two regularly alternating segments and two exceptional, non-alternating segments.

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