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Phonology, Optimality Theory: Modern Hebrew

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This entry illustrates how Optimality Theory (OT hereafter; Prince and Smolensky 1993) may be applied to the phonology of Modern Hebrew, treating the spirantization of the bgdkpt consonants as a case study.

I. Spirantization in Modern Hebrew

Modern Hebrew spirantization is characterizedby alternation in pronunciation of the consonants כ ,ב , and פ, namely between the stops [b], [k], and [p] and the fricatives [v], [x], and [f], respectively. These consonant pairs are normally in complementary distribution—occurrence of the fricatives is limited mostly to post-vocalic position within a word, whereas the stops occur in all other environments (e.g., after consonants, word-initial position). We see this distribution in the pronunciation of verbs such as פתח *patax* 'to open', בדק *badaq* 'to check', and כתב *katav* 'to write'. When any of these roots is in the infinitive form, the first consonant occurs after a vowel sound and is thus pronounced as a fricative. When the same consonant occurs at the beginning of a word (as in the 3ms. past), however, it is pronounced as a stop. Thus, the infinitive form of the root ב"דק *b-d-q* in *Qal* is לבדוק *livdoq*, with the fricative [v] following the vowel, whereas its 3ms. past form is בדק *badaq*, with a stop [b] at the beginning of the word. For the *Qal* of the root פתח *p-t-x* the relevant forms are לפתוח *liftoax* for the infinitive and פתח *patax* for the 3ms. past. Likewise, the pronunciations of the root כתב in *Qal* are לכתוב *lixtov* for the infinitive and כתב *katav* for the 3m.s.past.

Spirantization is different in Modern Hebrew than it was in older strata of Hebrew. Most notably, Modern Hebrew spirantization affects only three of the six original *bgdkpt* consonants: ב *b*, כ *k*, and פ *p*. In the case of the consonants ג *g*, ד *d*, and ת *t*, the stop pronunciation does not alternate with a fricative realization as it did in Tiberian Hebrew. In addition to this difference, Modern Hebrew has instances of [p], [b], [k], [f], [v], and [x] that never alternate. These exist due to historical sound mergers, as well as some recent borrowings. Some examples of these non-alternating sounds are the [k] in ברק *qavar* 'to bury', pronounced [kavar] in the 3ms.

past and [likbor] in the infinitive (this is due to the fact that the consonants ק *q* and כ *k* [when realized as a stop] are both pronounced [k] in Modern Hebrew), and the [f] in פידח *fideax* 'to joke', pronounced [fideax] in the 3ms. past and [lefadeax] in the infinitive (borrowed from Arabic, where the consonant that corresponds to Hebrew פ is pronounced [f]). The non- alternating sounds that result from historical sound mergers and are relevant to spirantization are listed in Table 1. The first member of each pair still exhibits the alternation (at least in normative Hebrew, e.g., normative בכל [bexol] 'in all' versus colloquial [bekol]), the second does not.

Table 1 – Sound mergers from Tiberian Hebrew (TH) to Modern Hebrew (MH)

Merged sounds (TH → MH)	Spelling	MH Pronunciation	Gloss
/w/ (ו) and [v] (ב) → /v/	לבתר	[levater]	*'to dissect'*
	לוותר	[levater] (< *w)	*'to concede'*
/ħ/ (ח) and [x] (כ) → /x/	מכר	[maxar]	*'he sold'*
	מחר	[maxar] (< *ħ)	*'tomorrow'*
/q/ (ק) and [k] (כ) → /k/	כל	[kol]	*'every'*
	קול	[kol] (< *q)	*'voice'*

Modern Hebrew spirantization is also a highly variable process (Adam 2002; Temkin Martínez 2010). Recall that, according to the rules of spirantization, fricatives occur only after vowels and stops occur at the beginnings of words and following consonants. Variation, then, is characterized by the pronunciation of a stop following a vowel or of a fricative occurring after a consonant or at the beginning of a word. Examples of this variation would be the pronunciation of לבדוק as *[libdok] or the pronunciation of בדק as *[vadak] (which, according to the spirantization rules, should be pronounced [livdok] and [badak], respectively). Such variation can take place either between speakers (meaning that some speakers' pronunciation follows the rules for spirantization while others' does not), or within a particular speaker's idiolect (with a given speaker's pronunciation sometimes following the spirantization rules and sometimes not) within non-normative pronunciation.

II. Introduction to Optimality Theory

Linguists have noted a constant tension between ease of articulation (which sounds are easier to make and in given environments) and the need for semantic transparency (connections between related words), which strives to maintain the transparency of the derivational base or root. In OT, a constraint-based system, this translates roughly into two types of violable constraints: *markedness* (constraints that advocate well-formedness and ease of articulation) and *faithfulness* (constraints that advocate staying true to either the derivational base or the way the word was originally heard or perceived, as well as to preserving contrast between words). These constraints are assumed to be universal across the world's languages, with different languages and dialects emerging from differences in the ranking of these constraints. The pronunciation of a word (the *optimal candidate*) in a given language is selected from a group of generated possible pronunciations (called *candidates*) through an evaluation of these candidates by the constraint ranking of the language. Candidates violating higher-ranked constraints are eliminated as possibilities, the optimal candidate being the one that remains once all others have been eliminated because they incurred more violations of higher-ranked constraints.

Consider an example from Modern Hebrew. As mentioned above, [d] does not become [ð] in Modern Hebrew. This could be due to a highranking markedness constraint banning the sound [ð], i.e., No[ð]. In the constraint hierarchy for Modern Hebrew, No[ð] would have to outrank or *dominate* both the constraint banning stops following vowels, i.e., Spirantize, and the constraint prohibiting the sound [d], i.e., No[d]. The tableau in Table 2 illustrates the evaluation of two candidates given the ranking of the three constraints. Constraints are always listed in columns in the order of their ranking, with the highest-ranked constraint on the left. An asterisk (*) denotes a violation of a specific constraint. An asterisk followed by an exclamation point (*!) denotes a fatal violation and the elimination of the candidate that incurred the violation. The pointing hand (☞) denotes the optimal candidate for a given evaluation.

Table 2 – Tableau for lack of [ð] in Modern Hebrew

Input /badak/	No[ð]	Spirantize	No[d]
☞a. [badak]		*	*
b. [baðak]	*!		

Despite incurring the fewest violations overall, Candidate b ([baðak]) is eliminated because it violates the highly ranked constraint No[ð]. Since all constraints are violable, it is often the case that an optimal candidate violates one or more constraints. However, as illustrated above, an optimal candidate always has fewer violations of higher-ranked constraints than any other candidate.

III. Modern Hebrew Spirantization in OT

The analysis of spirantization in Modern Hebrew involves two markedness constraints— one banning stops following vowels (Spirantize) and one banning fricatives (NoFricative)—and one faithfulness constraint—Faith[continuant], which requires that sounds in the output be identical to their input counterparts in the feature [continuant] (the feature that distinguishes stops, which are [−continuant], from fricatives, which are [+continuant]). In other words, this constraint bans stops from being pronounced as fricatives and vice versa, as often occurs with spirantization. In the case of Hebrew verbs, the inputs are combinations of tri-consonantal roots and inflections. Candidates incur one violation of Faith[continuant] for every stop in the root that is pronounced as a fricative or fricative in the root that is pronounced as a stop.

To account for the observed alternation between stops and fricatives, the markedness constraint Spirantize must outrank NoFricative, which in turn must outrank the faithfulness constraint Faith[continuant]. An illustration of how these constraints and this ranking account for alternation in Modern Hebrew spirantization appears in Tables 3 and 4 (the illustration is simplified for the purposes of this entry; for a more detailed analysis see Temkin Martínez 2010).

Table 3 – Tableau for fricative following a vowel

פתח /ptx/+ (infinitive) *'to open'*	Spirantize	NoFricative	Faith[continuant]
☞a. liftoax		**	*
b. liptoax	*!	*	

The tableau in Table 3 contains two candidate pronunciations for the infinitive form of the *Qal* verb פתח /ptx/. Here we see that, with the infinitival prefix added to the root such that the rootinitial consonant follows a vowel, the optimal candidate is the one containing a fricative—[liftoax]. This is because the candidate containing a stop in this position—[liptoax]—fatally violates highly ranked Spirantize. The high ranking of Spirantize makes this violation more important than violations of other constraints by either candidate. Note that the optimal candidate incurs more violations of *Fricative than the other candidate (one for [f] and another for [x], thus the two asterisks in the relevant space of the tableau above), and also violates the faithfulness constraint Faith[continuant]. However, since these constraints are ranked below Spirantize and no other candidate satisfies Spirantize, these violations are not fatal. This same ranking compels a stop realization of the first root consonant when it is in word-initial position, as seen in Table 4.

Table 4 – Tableau for a stop at the beginning of words

פתח /ptx/ + (3p.past) *'opened'*	No[θ]	Spirantize	NoFricative	Faith[continuant]
☞a. patax		*	*	
b. fatax		*	**!	*
c. paθax	*!			
d. faθax	*!			

The tableau in Table 4 contains four candidates for the third person singular masculine form of the root פתח /ptx/. In this form, the root-initial [p] occurs at the beginning of the word, which leads to the selection of a candidate with a word-initial /p/—[patax]. Canddates c and d are eliminated because they violate the highly ranked constraint No[θ], leaving only [patax] and [fatax] in the evaluation. Although both incur the same number of violations of Spirantize (for containing a stop—[t]—

following a vowel), the fricative-initial candidate, [fatax], incurs a fatal violation of NoFricative because it contains two fricatives—[f] and [x]—as compared with [patax], which contains only one—[x]. While Tables 3 and 4 illustrate how regular alternation of stops and fricatives works in OT, it is also necessary to account for variation, where the actual pronunciation of a word may not follow the spirantization rule (such as the possibility of either a [b] or a [v] surfacing in לִבְדוֹק — *[libdok] or [livdok]). OT allows for some manipulation of the constraint ranking mechanism, such as through *variable ranking* of constraints. This means that a given set of constraints may not always have the same ranking. Such variable ranking can represent between-speaker variation and/or within-speaker variation. By variably ranking the constraints that each of the competing candidates (*[libdok] or [livdok]) fatally violate, a variable grammar (Adam 2002) is possible. This is illustrated in Tables 5 and 6. For the two possible pronunciations of לִבְדוֹק —*[libdok] and [livdok]—the constraints that are variably ranked are Spirantize and NoFricative. When Spirantize dominates NoFricative, as in Table 5, the candidate containing the fricative [v] is selected, as predicted by the spirantization rule.

Table 5 – Tableau 1 for variation in spirantization

בדק /bdk/ + (infinitive) *'to verify'*	SPIRANTIZE	*FRICATIVE	FAITH[continuant]
☞a. livdok	*	*	
b. libdok	**!		*

Conversely, when NoFricative dominates Spirantize, as in Table 6, the variant candidate, which contains the stop [b], is selected.

Table 6 – Tableau 2 for variation in spirantization

בדק /bdk/+ (infinitive) *'to verify'*	*Fricative	Spirantize	Faith[continuant]
a. livdok	*!	*	
☞b. libdok		**	*

This entry presents a simplified illustration of how a phonological process such as spirantization can be accounted for using OT. For more detailed accounts, see Adam (2002) and Temkin Martínez (2010).

References

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