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A Note on Initial Consonant Clusters in Israeli Hebrew

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Abstract

The acceptability of initial consonant clusters in Israeli Hebrew is affected by various factors, notably the sonority hierarchy, place and/or manner of articulation, and voicing. This note focuses on two constraints that have received little attention in the literature: one involving voicing, the other reflecting the difficulty of making very fine transitions in manner and place of articulation transitions. It is claimed that constraints on initial consonant clusters are essentially due to the difficulty of effecting articulatory transitions that are either too extreme or too minute, whereas ease-of-articulation favors assimilation, gradual transition or cluster splitting so as to avoid such transitions.

1. **Introduction**

Often, a sequence of medial two or three consonants can be syllabified in a manner that facilitates pronunciation of the sequences involved. Thus, while יְלָדִים */yla-dim/* 'children' cannot be pronounced as such on its own (see discussion of the sonority hierarchy below), re-syllabification in הַיְלָדִים *ay-la-dim* 'the children' resolves the difficulty. Concentrating on initial clusters brings out those sequences that are unequivocally hard to articulate at the syllable onset, without the intervention of the facilitating effects of re-syllabification.[1]

The following three factors determine the acceptability of word-initial consonant clusters in Israeli Hebrew: (a) the degree to which they conform to the sonority hierarchy; (b) the place and manner of articulation of adjacent segments; and (c) the agreement in voicing in clusters of obstruents. Some of the constraints on word-initial clusters in Israeli Hebrew have already been discussed, e.g., by Rosén,[2] Bolozky[3] and recently by Laufer[4] and Schwarzwald.[5] Below, we will examine each of the factors involved,

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[1] In the absence of a spoken corpus of natural speech for Israeli Hebrew, concentrating on initial clusters made it also difficult to locate a sufficient number of instances among the many recordings I made over the years. So in some cases I had to resort to recordings in which initial sequences were **elicited**, and whose naturalness could be questioned (e.g., eliciting זקוף תיראש 'straighten your head!', etc.).

[2] Haiim B. Rosén, העברית שלנו *ha`ivrit šelanu (Our Hebrew Language)*, Tel Aviv: Am Oved (1957).

[3] Shmuel Bolozky, "On Morphological and Phonetic Constraints in Modern Hebrew." *Hebrew Computational Linguistics* 6 (1972) 1-12.

[4] Asher Laufer, "צירופי פונמות -- פונוטקטיקה *cerufey fonemot – fonotaktika* (Phoneme combinations – phonotactics," in Moshe Gottstein, Shlomo Morag and Simha Kogut, eds, שי לחיים רבין *Shai LeChaim Rabin*, Jerusalem: Hebrew University (1991). 179-193.

[5] Ora Rodrigue Schwarzwald, פרקים במורפולוגיה עברית *praqim bemorfologya `ivrit Studies in Hebrew Morphology*, Tel Aviv: The Open University of Israel (2002); "Modern Hebrew Consonant Clusters," in Dorit Diskin Ravid & Hava Bat-Zeev

introducing two constraints that have received little or no attention so far, as well as the (general) reasons underlying constraints on initial consonant clusters.

2. **The sonority hierarchy**

Initial cluster cannot violate the sonority hierarchy. In the absence of a single, universal definition of the sonority concept, it would be useful to briefly define its meaning for the purpose of this article. Sonority may be regarded as the amount of energy audibly released during the production of a phonological segment. Thus, *a* is the most sonorant segment in Hebrew: the vocal tract is wide open, with minimal obstruction to the air column, and all the energy created is audibly released. A consonant like *t*, on the other hand, is hardly audible, since most of the energy involved in its production is spent on the closure of the vocal tract, and very little that is audible actually comes out. It is the vowel following *t* that projects most of the audible energy emitted. Thus, *t* is one of the least sonorant consonants. If we arrange the phonological inventory by increasing sonority, we will start with stops/plosives such as *t*, proceed with fricatives, e.g., *f*, where the closure is incomplete. Next come nasals such as *m*, followed by liquids, such as *l*, where the obstruction is considerably weaker, then semi-vowels such as *y*, where the closure is minimal. In vowels, there is no obstruction at all, but there can be aperture narrowing: the amount of energy allowed to come out is determined by degree of opening: high vowels are less sonorant than mid ones, mid vowels less sonorant than low ones. The importance of the sonority concept is in enabling us to define the structure of the syllable in relation to its components. A syllable has an optional consonantal onset, an obligatory sonority peak, and an optional consonantal coda. The sonority peak is normally a vowel, but may also constitute a syllabic consonant functioning as a sonority peak, as in the case of *n* in the second syllable of *button*. The syllable must be structured so, that sonority gradually increase from the beginning of the onset to the sonority peak, and gradually decrease from the peak towards the end of the coda. For example, in a borrowed word like שְׁמַלְץ *šmalc*[6] 'schmaltz,' *m* is more sonorant than *š*, and *a* is the peak. In the coda, *c* is less sonorant than *l*. The consonants, either in the onset or in the coda, cannot be ordered in any other way: neither **šmacl*, **mšalc* or **mšacl* can be pronounced as a single syllable. With sonority defined as the degree of openness of the vocal tract, it is easier to articulate a sequence of segments that involves gradual progression – either increasing or decreasing – in degree of openness.

It can now be seen how sonority is relevant to the acceptability of initial consonant clusters in Hebrew. Take a word like נְקָמָה *nekama* 'revenge,' for instance. Since it belongs to the same pattern as בְּרָכָה *braxa* 'blessing,' it should be represented as a bi-syllabic */nkama/* underlyingly, but a syllable like [**nka*] cannot be maintained, as it violates the sonority hierarchy, with *n* preceding *k* instead of following it. Articulating [*nka*] would require starting with an oral closure while keeping the nasal cavity open for

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Shyldkrot (eds.) *Perspectives on language and Language Development*, 45-60, Dordrecht: Kluwer (2002).

[6] For Modern Hebrew, the symbol /c/ will be used to represent the voiceless dental affricate צ *tsadi*.

the nasal stop *n*, then maintaining that oral closure while blocking the nasal cavity for [*k*], then opening the oral vocal track widely for the vowel [*a*]. These transitions are too extreme to execute within a single syllable. As shown by Bolozky, Laufer and others,[7] there are a number of ways of resolving the difficulty, such as: (a) making the *n* syllabic, so that it function as the nucleus of a new syllable ([*n̲-ka-ma*];[8] (b) adding a "prosthetic" consonant followed by an epenthetic vowel, which places the *n* at the coda of a new syllable (e.g., [*'en-ka-ma*] or [*hen-ka-ma*]);[9] or (c) splitting the cluster with an epenthetic vowel, which places the *n* at the onset of a new syllable: [*ne-ka-ma*]. The last option, (c), is the only one available in Israeli Hebrew. In either case, a single syllable has to turn into two syllables to resolve the difficulty.[10]

3. **Place and manner of articulation**

Place and manner of articulation also play a role in the definition of constraints on initial clusters. Generally, neither identical sequences nor homorganic consonant clusters are allowed, unless they differ in manner of articulation.[11] The reason is that if two adjacent consonants are too similar or too close to each other, it is difficult to articulate them in a manner that maintains the distinctiveness of each so that one does not assimilate into the other, or that splits the cluster by inserting a vowel. These constraints naturally also apply to initial clusters. The following homorganic clusters are acceptable because their manner of articulation is different:

(1) סְתִימָה *stima* 'filling' תְּסִיסָה *tsisa* 'fermentation'
סְנִיפִים *snifim* 'branches' סְדָקִים */sdakim/* 'cracks' ~ [*zdakim*]
תְּנוּפָה *tnufa* 'impetus'

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[7] Shmuel Bolozky, "Fast Speech as a Function of Tempo in Natural Generative Phonology," *Journal of Linguistics* (1977) 13:2. 217-238 and elsewhere; Asher Laufer, "צירופי פונמות -- פונוטקטיקה *cerufey fonemot – fonotaktika*… Also included in the Laufer article are discussions of the concepts of the syllable and of sonority.

[8] *n̲* represents a syllabic *n*.

[9] In Mishnaic Hebrew, the prosthetic consonant-plus-vowel option was often used in adapting borrowed words, e.g., */strategos/* 'military commander (Gk)' > אִיסְטְרָטֶגוֹס *'istrartegos*. Laufer also quotes Biblical Hebrew cases: תְּמוֹל */tmol/* 'yesterday' > אֶתְמוֹל *'etmol*, זְרוֹעַ /*zroa`*/ 'arm' > אֶזְרוֹעַ *'ezroa`*.

[10] This constraint is universal. One possible exception that comes to mind is that of pre-nasalized consonants in some African languages, with #^{m}*bV* sequences etc. (V stands for any vowel). However, since the sequences are homorganic, realizations such as #^{m}*b* may very well not be a sequence at all, but rather a single, pre-nasalized consonant, usually analyzed as bi-syllabic if tone is involved (John Kingston, personal communication).

[11] See Schwarzwald, *Studies* Unit 7. Greenberg stated these restrictions for all Semitic languages in an orderly fashion in 1950 – see Joseph H. Greenberg, "The Patterning of Root Morphemes in Semitic," *Word* 6 (1950) 162-181 – but they were observed as early as in the Middle Ages, by Sa`adya and others.

As shown by Bolozky,[12] when a plosive is followed by a homorganic fricative, the sequence is often merged into a single-unit affricate in non-formal speech (regressive assimilation is also common):

(2) תְּשׂוּמֶת לֵב */tsúmet lèv/* 'attention' > [*cúmetlèv*]
תְּזוּזָה */tzuza/* 'movement' > [*dzuza*][13]

When a morpheme combination brings together a plosive and an homorganic affricate, that is, when a *t*-prefix is appended to a stem beginning with a *c*, the plosive-affricate difference in manner of articulation is too small to qualify as 'different articulation,' because an affricate starts as a plosive. Such a combination is equivalent to having a sequence of two identical plosives that must be either split or merged. Generally splitting is preferred, in order to maintain the distinctiveness of the two component phonemes:

(3) תְּצוּרָה */t+cur+a/* 'formation' > [*tecura*] (cf. תְּשׁוּבָה *tšuva* 'response; repentance,' תְּקוּמָה *tkuma* 'revival') ~ [*cura*]
תְּצוּגָה */t+cug+a/* 'exhibit' > [*tecuga*] ~ [*cuga*]

Splitting also avoids ambiguity that may be caused by a *t+c* > *c* merger, so that a variant like [*cura*] 'formation' above is not confused with a different homonymous word with no *t*-prefix, צוּרָה, meaning 'shape.'

Also note that difference in voicing does not suffice to allow otherwise-identical consonant sequences. There are cases where a form, had it been totally regular, includes an initial cluster, as in the *CCiCut* pattern, and a closely-similar sequence is avoided, again by splitting with *e* (note that this *t* is part of the stem):

(4) תְּדִירוּת */tdirut/* 'frequency' (cf. סְבִירוּת *svirut* 'plausibility') > [*tedirut*]

Basically, such constraints reflect the difficulty of co-articulating closely similar segments without assimilating one into the other or splitting the cluster with a vowel. Producing such sequences requires complex articulatory coordination that is not easily achieved in normal speech.

4. **Voicing in obstruent sequences**

Achieving uniformity of voicing in obstruent clusters is largely dependent on degree of casualness and/or rate of speech (Bolozky[14]), and is fairly automatic, so that in very casual or casual/fast speech, uniformity of voicing is almost obligatory:

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[12] Shmuel Bolozky, "On the Monophonematic Interpretation of Modern Hebrew Affricates." *Linguistic Inquiry* 11:4 (1980) 793-799.
[13] While *cúmetlèv* is found at most registers, alternants like *dzuza* are characteristic of casual speech.
[14] Shmuel Bolozky, "Fast Speech…"

(5) תִּסְגּוֹר */tisgor/* '(you will) close' ~ [*tizgor*]
סְגוֹר */sgor/* 'close (m.s.)!' ~ [*zgor*]
תִּזְקוֹף *tizkof* '(you will) straighten' ~ [*tiskof*]
זְקוֹף */zkof/* 'straighten (m.s.)!' > [*skof*]

Even cases immune to it a few decades ago, such as *v* not causing voicing assimilation and *x* not undergoing it, are now regularized:

(6) כְּבָר */kvar/* 'already' ~ [*gvar*]
יַחְזוֹר */yaxzor/* 'he will come back' > [*yaɣzor*]

The naturalness of voicing assimilation was already noted in the Talmud. The Tosafot to the b. Ber 15:2 warns, in connection with לְמַעַן תִּזְכְּרוּ *ləma`an tizkəru* 'so that you remember':

(7) צָרִיךְ לְהַתִּיז זַיִן שֶׁל תִּזְכְּרוּ שֶׁלֹּא יִשָּׁמַע שִׁ֫ין *ṣarix ləhattiz zayin šel tizkəru šello yiššama` śin* 'one needs to voice the *z* of *tizkəru* so that it does not sound like *ś*'

There are, however, differences in the likelihood of assimilation taking place in the different forms in (5) above, depending on the complexity of transitions in voicing.[15] The most complex voicing transitions occur in the production of זְקוֹף *zkof*. In the case of תִּסְגּוֹר */tisgor/* ~ [*tizgor*], [*tizgor*] is easier, since starting with *i*, the whole word is uniform for voicing; in *tisgor*, voicing ceases in anticipation of *s* at the end of the first syllable, and resumes in the second. In סְגוֹר */sgor/* ~ [*zgor*], voicing can start later or earlier, and be maintained to the end of the word, which is easy in either case. In תִּזְקוֹף */tizkof/* ~ [*tiskof*], there is also the question of when voicing should cease: at the beginning of the second syllable, or already at the end of the first syllable. In either case, it resumes with the vowel *o*. Although resumption of voicing is easier when the coda of the first syllable and the onset of the second agree in voicing value – in this case, both voiceless, [*tiskof*] – it is still manageable even if the two obstruents do not agree in voicing ([*tizkof*]). On the other hand, זְקוֹף *zkof* is not easy to articulate. It requires that voicing start for *z* and immediately cease in anticipation of the voiceless *k* in the same syllabic onset, and then resume for the following vowel *o*. Such maneuvering is not easy to perform in natural speech. The difficulty may neither be inherent, nor universal, since nothing physiological rules it out in principle to start with. However, in an initial sequence of two obstruents, each of the two is shorter than it would be on its own, and limited articulation time makes it difficult to effect the voicing–no voicing–voicing transition. This is why assimilation to [*skof*] is essentially a must in casual speech. [*zkof*] can only be found in the formal register. My recordings suggest that the casual register of Israeli Hebrew does not allow an initial cluster of obstruents in which the first segment is voiced while the second is

[15] Laufer discusses the effects of voice onset timing – see Asher Laufer, "Voicing in Contemporary Hebrew in Comparison with Other Languages," *Hebrew Studies* 39 (1998) 143-179.

voiceless.[16] The following examples illustrate this clearly:

(8) דְּקִירָה /*dkira*/ 'prickle' > [*tkira*] בְּקָעִים /*bka`im*/ 'faults, fissures' > [*pkaim*]
זְכוּכִית /*zxuxit*/ 'glass' > [*sxuxit*], in very fast speech [*suxit*], and less commonly [*zexuxit*]
זְכוּתוֹ /*zxuto*/ 'his right' > [*sxuto*] זְחוּחָה /*zxuxa*/ 'pleased with self (f)' > [*sxuxa*]

Although it appears that the constraint works independently of place and manner of articulation, it is hard to determine fully whether this is indeed the case, since Israeli Hebrew does not seem to have any initial clusters such as [*#zt*], [*#vt*], or [*#gt*].[17]

5. **Very fine transitions in the manner and place of articulation**

The difficulty of producing obstruent clusters that violate the casual speech voicing constraint discussed above is usually resolved by voicing assimilation, e.g., דְּקִירָה /*dkira*/ 'prickle' > [*tkira*]. In formal speech, splitting such clusters with *e* is also possible, e.g., /*dkira*/ > [*dekira*], but it is not the preferred option. There are, however, cases in which splitting is the **preferred** solution in casual speech, even though voicing assimilation is still an option:

(9) בְּטִיחוּת /*btixut*/ 'safety' (cf. סְבִירוּת *svirut* 'feasibility') > [*betixut*] ~ [*ptixut*] ([**btixut*])
בְּתוּלָה /*btula*/ 'virgin' (cf. שְׁבוּרָה *švura* 'broken, f.s') > [*betula*] ~ [*ptula*] (**btula*)
בְּטֵלִים /*btelim*/ 'idle; annulled, m.pl' (cf. כְּבֵדִים *kvedim* 'heavy, m.pl') > [*betelim*] ~ [*ptelim*] ([**btelim*])
פְּדוּת /*pdut*/ 'salvation' > [*pedut*] ~ [?*bdut*] ([**pdut*])

Preference for splitting, e.g., for [*betixut*] over [*ptixut*], may be attributed to the tendency to maximize semantic transparency, so as to maintain the distinction between potential homonyms, in this case between *ptixut* and the homonymous item פְּתִיחוּת meaning 'openness.' Furthermore, as pointed by Asher Laufer,[18] the splitting option is preferred when two successive **stops** are involved, which are harder to articulate in the syllabic onset. But there is another factor that must be considered: the two stops are produced at relatively close points of articulation – labial and dento-alveolar. In the case of forms like דְּקִירָה *dkira* above, in which splitting is less likely, the dento-alveolars and velars involved are considerably farther apart in place of articulation. The transition from one

[16] Asher Laufer informs me (personal communication) that sequences like the initial *#zk* in זְקוּף *zkof* were actually observed by students of his in spontaneous speech. I could not find such clusters in my own recordings; I believe that to the extent that they occur in formal speech, it happens rather rarely.

[17] Although this constraint is simple as well as obvious, and probably applies in many languages, I am not ware of any earlier description of it in the literature on Hebrew phonotactics.

[18] Personal communication.

to stop to another in forms like *btixut* involves minute, almost simultaneous adjustments that are difficult to perform: voicing, ceasing voicing, and immediately restarting voicing for the following vowel, and at the same time maneuvering two successive stops that are too close to each other to produce as distinct segments.

Manner and place of articulation generally designate major articulatory categories. Manner of articulation usually refers to categories like plosive, affricate, or fricative articulation; place of articulation usually designates categories such as labial, alveolar, palatal, velar, pharyngeal, glottal. Alongside these, however, there are smaller, finer categorial variations – such as **apical**, articulated with the tip of the tongue, **laminals**, articulated with the blade of the tongue, **slit** vs. **grooved** tongue articulation, etc. – which refer to the part of the tongue involved in production, and/or to the degree, width or spread of the tongue contact or narrowing. These variations may increase the complexity of co-articulation, particularly when the points of articulation of consecutive segments are close, and the manner of articulation is the same, similarly to בְּטִיחוּת */btixut/* > [*betixut*] above. Thus, articulation of dento-alveolar apicals with palatal laminals involves complex transitions too close and thus too minute to manipulate, resulting in the cluster being split:

(10) שְׁזוּפָה */šazufa/* 'tanned, f.s' > **šzufa* > [*šezufa*]
שְׁזִיפִים */šzifim/* 'plums' (cf. *crifim* 'shacks') > **šzifim* > [*šezifim*] (or even [*šizifim*], by vowel assimilation)

The complexity of such transitions is actually **greater** than that those necessitated by בְּטִיחוּת */btixut/* etc., owing to the greater closeness/similarity between the two sibilants, which is why the sequence is split regardless of whether the two segments agree in voicing or not:

(11) שְׁסוּעָה */šasu`a/* 'cleft f.s' > **šsua* > [*šesua*]

For the same reason, tongue twisters in many languages involve sequences of dento-alveolar apicals and palatal laminals,[19] as in:

(12) שָׂרָה שָׂרָה שִׁיר שָׂמֵחַ *sára šára šir saméax* 'Sarah sings a happy song'
Sister Suzie sells sea-shells on the seashore
The Leith police dismisseth us

This is also why speech errors in general often involve such clusters. The claim that such sequences are indeed very hard to articulate is further supported by the fact that they are problematic even in medial position, where syllable division is normally expected to facilitate articulation:

(13) הַשְׁזִיפִים */ašzifim/* 'the plums' > **ašzifim* > [*ašezifim ~ ašizifim*]

[19] Shmuel Bolozky, "A Note on Sibilant Fricatives," *Glossa* 12:2 (1978) 205-216.

4. **Conclusion**

It appears, then, that the basic difficulty in producing initial consonant clusters is in co-articulating a sequence of tauto-syllabic consonants that are too close or too similar to each other, and in maintaining the distinction between them in conditions when one would expect (natural) assimilation or splitting. At the same time, it is also hard to effect radical transitions in such clusters if the change involves radical shifts in vocal tract opening (as in the case of sonority hierarchy violations), or to initiate voicing and cease it right away within the same cluster, when voicing has to be initiated again in anticipation of the following vowel.