The perception of stop/sibilant clusters in Modern Hebrew

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Metathesis, a linear reordering of segments within a word, may be random and idiosyncratic, as in speech errors, or it can be a structured part of a language’s grammar (Ultan 1978). In Modern Hebrew, metathesis occurs systematically in *bin*yan hitpa’el, the reflexive, reciprocal, and inchoative verbal pattern, which consists of a prefix /hit-/ attached to a verbal stem, as in *[hitnaʃek]* “kissed each other,” from the stem *[naʃak]* “kiss.” However, when the stem begins with a sibilant fricative, either /s/, /z/, /ʃ/, or /t͡s/, the /t/ of the /hit-/ prefix categorically metathesizes with the following sibilant. Instead of an expected form like *[hitʃadə]* “went crazy,” the form present in the language is *[hiʃtadea]*.

Researchers on metathesis have proposed two different theories explaining phenomena like this. Hume (2004)’s indeterminacy/attestation model of metathesis proposes that metathesis is perceptual and occurs because of indeterminacy in the speech signal, indeterminate sounds being reordered linearly by listeners. The order into which listeners metathesize indeterminate sounds is the more common attested word order in the language, listeners using their knowledge of their native languages to guess at the correct order of the sounds. For Modern Hebrew, Hume (2000) suggests that metathesis occurs to enhance the perceptibility of the /t/ in the /hit-/ prefix, which is one of the main morphological markers of *bin*yan hitpa’el. The most important identifier of a stop consonant is its burst, which is obscured in fricative noise in the sequence /t/ + sibilant. Metathesis repairs such a sequence by moving the /t/ to a pre-vocalic position; this perceptual optimization ensures the important stop burst can be clearly perceived.

On the other hand, Blevins & Garrett (2004) suggest a four-way typology of metathesis, based on different mechanisms for the resulting metatheses. Blevins & Garrett (2004) propose that sibilant metathesis is not perceptual, but auditory, resulting from “auditory-stream decoupling,” the tendency for a sibilant’s frication to become disassociated from the rest of the sound and reinterpreted by listeners in a different linear order (Blevins & Garrett 2004, 127-128). For Blevins & Garrett (2004), sibilant metathesis occurs because of acoustic properties of sibilants, not because of perceptual optimization; their theory is, thus, not one which predicates sibilant metathesis on individual language phonotactics or a teleological goal.

In order to investigate the two theories, I devised a speech perception identification task using English speakers. Because English and Modern Hebrew have different phonotactics, if English speakers were shown to metathesize in the same direction as Modern Hebrew speakers, this should support Blevins & Garrett (2004)’s account, owing to the universal properties of phonetics. If they did not metathesize in the same direction, this should support Hume (2004)’s phonotactic explanation.

Fifteen native English speakers listened to eighteen non-words designed to replicate metathesized and unmetathesized hitpa’el verbs. Non-words were grouped in three groups and recorded by a native speaker of Modern Hebrew: Six stop/sibilant combinations ([hitʃə], [hiʃə], [hidζa], [hizda], [hίtʃa], [hίtsta]); six stop/stop combinations ([hitkə], [hiptə], [hitpa], [hitda], [hίtɛ], [hidta]); and six stop/fricative combinations ([hitʃa], [hίfta], [hίdva], [hίvda], [hίxta], [hixta]). The non-words were embedded in multi-talker babble manipulated using a Praat (Boersma & Weenink 2015) formula to increase the sound level of the babble to two times the sound level of the non-words. These non-words were then presented randomly to listeners in four
blocks in a Praat multiple forced choice experiment with the computer’s sound level turned down to 10%, both for the safety of listeners and to increase the difficulty of the task. Listeners selected between two different buttons; for example, if the presented non-word was [hizda], listeners could choose a button saying “hidza” or a button saying “hizda.” These responses were recorded by Praat and totaled 1080 responses.

The overall confusion rate was 11.20% (121/1080). Out of 360 stop/sibilant pairs, 7.5% (27/360) were misperceived; [hitsa] was misperceived as [hista] 63.64% of the time (7/11), and [hidza] was misperceived as [hizda] 100% of the time (3/3). Results with /t͡s/ were mixed, with [hittsa] being misperceived as [hitsta] only 53.85% of the time (7/13). I suggest that the /t͡s/ results are mixed because of the absence of the phoneme in English; English speakers interpret the phonemes as two sounds, leading to the ambiguous perception results.

Stop/fricative combinations were misperceived at a rate of 7.22% (26/360), slightly less than sibilants. [hivda] was misperceived as [hidva] 50% (8/16) of the time, while [hitfa] was misperceived as [hifta] and [hitxa] was misperceived as [hixta] 80% of the time (4/5, respectively).

Interestingly, listeners had the highest difficulty with stop/stop combinations, 18.89% of which were misperceived (68/360). [hitka] was misperceived as [hikta] 57.89% of the time (11/19), and [hidta] was misperceived as [hitda] 60% of the time (18/30), while [hitpa] was misperceived as [hpta] a stunning 89.47% of the time (17/19). These misperceptions are the opposite of what occurs in Modern Hebrew (with the exception of [hitda], which does occur in forms like [hitdaʁdeʁ], when speakers do not completely assimilate the /t/ of the prefix to [d]), but they occur in directions (TK > KT and TP > PT) which Blevins & Garrett (2004) claim are universal. They may not be quite universal, but these universal tendencies suggest that language phonotactics are not an adequate explanation for the facts.

Together, these findings support Blevins & Garrett (2004)’s theory that sibilant metathesis is a special type of metathesis separate from perceptual metathesis. English speakers metathesize in similar directions, for the most part, to Modern Hebrew speakers, which suggests that this type of metathesis owes more to universal properties of sibilants than it does to language-specific phonotactics. Blevins & Garrett (2004) do note that there can be language-specific differences in which way stop + sibilant or sibilant + stop clusters metathesize, but they believe that this has to do with prosodic patterns. More research needs to be conducted on this hypothesis, but Modern Hebrew, owing to its status as a revived language, has prosodic patterns similar to the languages that its first speakers spoke, namely Yiddish and Russian, which are similar to English prosodic patterns.

References: