Revisiting laryngeal features with a dynamic approach

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This paper questions the phonological analyses of laryngeal features at the segmental and suprasegmental levels. We address the limits of a static and synchronic analysis of phonological features. We instead propose a dynamic approach taking into account positional variation and diachronic evolution. Empirical data come from Tokyo Japanese. Acoustic investigations were conducted on a total of 2664 utterances produced by 9 female speakers aged 20 to 27.

1. [voice]: when phonetic evidence contradicts phonological arguments

In languages with a two-way laryngeal contrast based on VOT as a main cue for plosives, [voice] is employed as a distinctive feature in a classic approach (hereafter Approach A) (Keating, 1984). This embraces at least two types of languages: (1) "aspiration", realized mainly as a long-lag vs. short-lag or negative VOT contrast, such as English or German; (2) "true voicing", realized mainly as a short-lag vs. negative VOT contrast, such as French and Italian. In this approach, the different realizations are viewed as language-specific phonetic implementations of the same phonological [voice] contrast.

Another approach (hereafter Approach B) consists in using different and privative phonological features, [spread glottis] vs. ∅ for (1), and ∅ vs. [voice] for (2) (Iverson & Salmons, 1995). ∅ represents the short-lag plosive series in both types, which is underspecified (or unmarked).

Phonetic and phonological criteria have been put forward to determine whether a language belongs to type (1) or (2). One of the phonetic criteria is passive vs. active voicing (Beckman et al., 2013). If one plosive series is consistently and robustly voiced in all contexts, as in French, the active feature is [voice]. If, for example, one plosive series is usually voiceless in utterance-initial position, but (variably) voiced in utterance-medial position, this voicing is considered as "passive voicing". This is the case in English and German, hence [spread glottis] is proposed to be an active feature.

Japanese has long been analyzed as a type (2) language. The most widely accepted phonological argument is the active use of [voice] in different phonological rules involved in compounding, or *Rendaku* (Itô and Mester, 1986). Phonetically, it has been assumed by many that Japanese has a short-lag vs. negative VOT contrast (e.g., Iverson & Salmons, 1995).

Our study revisited VOTs of the two plosive series in Tokyo Japanese, referred to as voiced and voiceless plosives. The target plosives were elicited in three prosodic positions: utterance-initial (UI), utterance-medial & word-initial (UM), and word-medial (WM), and in two pitch-accent contexts: L and H. We found that voiceless plosives have medium-lag VOTs in UI and UM (mean at 36, 33, 55 ms for labial, dental, velar plosives, respectively), in line with Riney et al., (2007), but short-lag VOTs in WM (14, 15, 22 ms). We also found that voiced plosives are almost always voiced in WM, less often voiced in UM, and very often (67%) devoiced in UI. This result corroborates Takada and collaborators' (2015) cross-generational study on word-initial voiced stops in Japanese, suggesting a trend towards devoicing these stops. Meanwhile, in UI, VOTs overlap between the two series, but remain significantly different. Therefore, in modern Tokyo Japanese, unlike a "true voicing" language, word-initial voiceless plosives are moderately aspirated, and voiced plosives are not robustly voiced in utterance-initial position. Their voicing in word-medial position may be considered as *passive voicing*. This phonetic evidence contradicts the phonological arguments in favor of a [voice] analysis.

2. F0 perturbation

Onset-induced F0 perturbation is attested in many languages. It is viewed in Approach A as part of a [voice] feature, including both type (1) and (2) languages, in that F0 at the vowel onset is lowered by /b,d,g/ compared to /p,t,k/ (Kingston & Diehl, 1994). Approach B considers that [spread glottis] raises F0 and [voice] lowers F0 (Iverson & Salmons, 1995), leading to the same relative F0 difference.

F0 perturbation is also reported briefly in Japanese in word-initial position (Shimizu, 1996). This study revisits F0 perturbation by illustrating F0 curves in the prosodic positions mentioned above. In UI (Fig. 1, left two panels) and UM (same pattern), F0 is remarkably higher after voiceless than voiced plosives, whether the latter are phonetically voiced or not, and this effect lasts till the final part of the moraic vowel following the onset. However, WM (Fig. 1, right two panels) plosives have much less effect on the following F0. The position-dependent F0 perturbation pattern in Tokyo Japanese suggests that F0 perturbation is neither a purely automatic effect of the phonetic voicing, (otherwise, it would disappear with a "devoiced" stop), nor phonologically involved in [voice] or [spread glottis] feature, (otherwise, we would expect similar F0 perturbation effect across all positions).

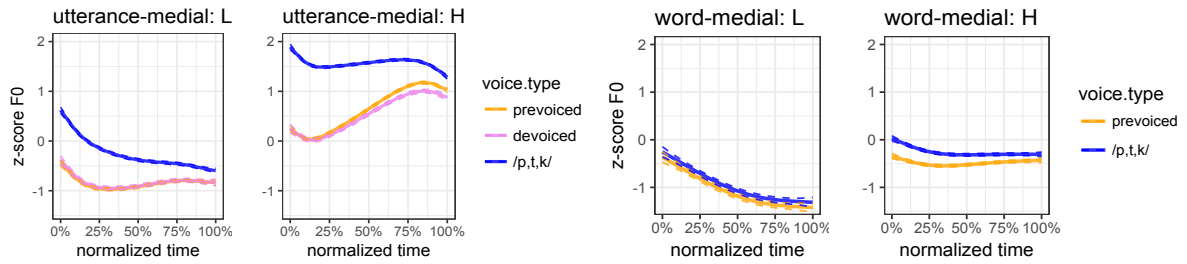

Fig. 1: Normalized F0 curves using z-score transformation after /p,t,k/, prevoiced /b,d,g/, and devoiced /b,d,g/, in UI and WM, in two pitch-accent contexts (L and H), computed by SS-ANOVA.

3. Proposal: a dynamic approach

3.1. Positional variation

Modern Tokyo Japanese exhibits a differential use of cues to distinguish its two plosive series, depending on the prosodic positions: F0 (with overlapping short- vs. medium- lag VOTs) in word-, especially utterance-initial position, and short-lag vs. negative VOTs in word-medial position. We question the use of [voice] as a phonological feature, which does not account for the utterance/word-initial realization. We may of course propose a phonological rule which aspirates /p,t,k/ and devoices /b,d,g/ while lowering the following F0 in word-initial position. But, what prevents an analysis in the other way around: voicing of an L syllable in word-medial position? As a comparison, the three plosive series in Seoul Korean are all voiceless in word-initial position. One of them have lower F0 on the following vowel in word-initial position, and are voiced in word-medial position. Contrary to Japanese, in Seoul Korean, [voice] has been long avoided as a phonological feature, while word-medial voicing is considered as a phonological rule or a phonetic effect.

In Tokyo Japanese, F0 and VOT cues do not have a classic trading relation or perceptual equivalence because their use is first conditioned by position. But at the current stage, the differential use of these two cues mapped in different prosodic positions points to a same phonological category.

3.2. Diachronic evolution

While this proposal sounds similar to the [voice/L] feature proposed by Bradshaw (1999), our proposal is more dynamic in terms of diachronic evolution. We believe that multiple cues of one phonological categories are not bound to be tied together forever. The diachronic evolution from [voice] to L has taken place in Vietnamese, Thai and many Chinese languages. In these languages, when the evolution has been completed, L is completely dissociated from [voice].

From a diachronic point of view, in utterance-initial position, the devoicing of voiced plosives, the aspiration of voiceless plosives, and the remarkable F0 difference might suggest that Tokyo Japanese is undergoing one of the following sound changes: (a) Germanic shift: $p > p^h > f$; (b) tonogenesis (if "pitch-accent" is not considered as tone), as proposed for Seoul Korean (e.g., Silva, 2006). During the transitional stage of a sound change, phonological categories are, we believe, characterized by a bundle of cues (Mazaudon, 2012), difficult to sort out using a purely static and synchronic approach.

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