

F0 enhancement in younger speakers of Standard Seoul Korean in internal and initial phrase position

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Introduction

Standard Seoul Korean (SSK) has a unique three-way voiceless laryngeal stop contrast in word-initial position. For speakers born after 1965, there appears to be F0 enhancement coupled with a reduction of VOT in aspirated stops [1, 2]. This suggests that F0 is replacing VOT as the contrasting cue for the lenis-aspirated stop distinction. Despite these findings, some questions remain. Firstly, what happens to the third stop type, fortis, is unclear. Secondly, few studies have investigated other positions phrase-internally, with the majority testing only phrase-initial tokens. Finally, research has tended towards hyper-speech analysis [1, 2, 3] that may not reflect actual patterns in ‘natural’ speech.

The data observed here are partial results of an ongoing larger study of the *Korean Corpus of Spontaneous Speech* [4]. The larger study focuses on comparisons across generations of F0 production, with the results here the findings for male and female speakers of the youngest group. This group should have a strong enhancement effect of F0 when distinguishing between stop types, as all were born after 1965. It was expected that, particularly for lenis and aspirated stops, there should be a clear F0 distinction between the two with aspirated increasing, and lenis remaining low. VOT was expected to be overlapping between lenis and aspirated stops, suggesting that VOT is losing status as the contrasting factor between the two.

Method

The results presented here are for participants aged 15-19 ($N = 10$). F0 was measured in PRAAT [5] using a script that measured the mean F0 value per 50ms intervals throughout the vowel. VOT was measured manually through visual inspection of the spectrogram. Tokens were found using the script *Search, View & Save* [4] that allows selection of the token within in the phrase by gender and age group. A statistical analysis was performed using the *lme4* package [6] in *RStudio* [7]. A model was created for VOT and F0 respectively, with contrast coding applied to stop type (-a, +f, -l at -1/3, +2/3, -1/3 and +1/2, 0, -1/2), gender (+F-M at +1/2, -1/2) and sentence position (initial vs medial at +1/2, -1/2). An interaction was modeled between stop type, gender, and sentence position. Sentence position*StopType was coded as the random slope, with participant as a random factor. Visualisations were created using the *ggplot2* package [8].

Statistically, F0 demonstrated a distinction between lenis and aspirated stops with aspirated being higher than lenis by on average 28Hz ($p = >0.01$). Sentence position also was observed to be significant, with stops in initial position being on average 8Hz higher than medial stops ($p = 0.02$). Sentence position did not interact with gender or any stop type significantly. VOT demonstrated a significant effect for fortis stops, with an average of 45ms shorter than other stop types ($p = >0.01$). No significant effect was observed between lenis and aspirated stops. An interaction effect was observed between sentence position and aspirated stops, with initial aspirated stops being on average 19.7ms ($p = 0.02$) shorter in initial position compared with internally. Female speakers were also seen to bear a shorter aspirated stop than male speakers, at 18ms shorter ($p = 0.04$).

These results suggest that the lenis-aspirated distinction is maintained by F0, and that this is stronger in initial position compared to phrase-internal. Fortis remains distinguished by VOT, with no suggestion of a difference dependent of phrase position. That aspirated stops are shorter in initial

position suggests a reduction in the length of aspirated stops, thus assimilating further with lenis, particularly for younger female speakers. Prosodic effects may be the cause of sentence internal lengthening, requiring further investigation.

Graphical results suggest that aspirated stops remain higher in F0 and longer in VOT compared to other stops across phrase positions. In medial position, however, lenis does not remain stable but rather shows an overlap with fortis, especially in F0. This was not observed statistically due to the nature of the contrast coding (as fortis was compared rather than lenis). How these are distinguished in medial position is not clear from initial evaluation, and further implies that F0 enhancement is unequal across the phrase. The reasons for this could possibly be due to another cue not tested here providing the distinction, or the prosodic structure of SSK impacting F0 enhancement. Additionally, it is important to consider the small sample size, and to evaluate how this changes upon introducing more participants. Female speakers show an inconsistent F0 in their fortis stops, which could be either due to underpowering of the data or possibly due to bimodality; fortis has no need to alter its F0 and relies only on VOT. This could imply the development of a bimodal contrast system, possibly as an alternative to full tonogenesis. As younger female speakers are often given as the drivers of linguistic change [9], this warrants further investigation with a larger pool of participants.

In summary, these results imply that F0 enhancement is occurring, more so in initial than internal position. Aspirated stops appear to be stable with a consistently high F0 and long VOT in both positions. VOT remains significant, suggesting that it is not redundant but possibly a secondary cue. The indication that there is some degree of overlap between fortis and lenis stops in medial position requires further investigation into other cues (e.g. voice quality) and more in-depth analyses of the prosodic structure of SSK. A larger pool of female participants would also be beneficial to study, to assess if a bimodal contrast system has formed fully in younger speakers. Finally, to truly evaluate if F0 is replacing VOT as the primary cue, a perception experiment is required across different phrase positions.

References

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