It has long been pointed out that Korean three-way stop contrast (lax vs. tense vs. aspirated) might be difficult to acquire as L2 for language learners whose L1 has only binary distinction in stops (e.g., L1 with voiceless vs. voiced or L1 with highly aspirated vs. weakly aspirated). It has been known that Mongolian stops have voiced and voiceless distinction (Poppe 1954) or highly- and weakly-aspirated system (Svantesson et al. 2005, Chang and Jeong 2009). Given that an increasing number of Mongolian speakers are learning Korean, it might be interesting to probe whether/how Mongolian L2 learners acquire Korean 3-way phonation types of stops. There have been rare studies to reveal Mongolian stop consonants and to examine how Mongolian learners produce and perceive Korean stop differences. Thus the current study addressed two issues concerning Mongolian L1 phonology and Mongolian L2 learners’ acquisition of Korean stops. First, we aimed to explore the various phonetic correlates related to Mongolian stop distinction and provide an insight for the classificatory system for Mongolian stops. Second, we examined how Mongolian learners of Korean produce and perceive the subtle differences of Korean 3-way phonation types.

Production and perception tasks proceeded in two blocks. In block I, twenty Mongolian learners of Korean in low-level were asked to produce the so-called voiced-voiceless stops in word initial position (/p, b, t, d, k, g/). The subjects have been learning Korean on average 1.1 year, and their self-rating English proficiency was on average 2.5 out of 10 point scales. They produced 48 real words beginning with /p,b,t,d,k,g/ followed by a vowel /i,e,u,a/ three times. In total, 2880 Mongolian tokens were obtained. In block II, the identical subjects performed production task where 36 Korean real words beginning with lax, tense or aspirated stops followed by a vowel /i, æ, u, a/ were recorded. After production, they identified the word-initial stops when they heard the Korean words. In total, 720 tokens were obtained for production data and perception data.

To reveal acoustic correlates of Mongolian stops and Mongolian speakers’ production of Korean stops, three acoustic parameters were measured and analyzed (VOT, F0 of the following vowel, intensity at the starting point of the following vowel). In addition, for perception data, accuracy of identification was obtained.

(1) Mongolian stimuli: пийшин /pʃan/, бичиг /bʲitʃig/, титэм /tʲətʃm/, дийлдэх /dildsh/….
(2) Korean stimuli: pilo, p’ik’i, philo, títim, t’ita, thínun, kita, k’ita, khis….

First, as for Mongolian consonants produced by Mongolian native speakers, the results showed that VOT was 21 ms longer for voiceless than for voiced stops ($F[1,19]=220.5$, $p=.000$), F0 of the following vowel was 9 Hz higher for voiced than for voiceless stops ($F[1,19]=26.25$, $p=.000$), and intensity in transition from a stop to the following vowel was 23 dB louder for voiceless than for voiced stop condition ($F[1,19]=236.9$, $p=.000$). As shown in (3), this finding provides more comprehensive revelation concerning the phonetic correlates of Mongolian word-initial stops than Chang and Jeong’s (2009) showing only VOT values. However, similarly to their study, the present study shows that word-initial voiced stops are phonetically realized as voiceless as to VOT values (37 ms), providing additional evidence for the idea that Mongolian stops should be classified into highly- and weakly aspirated stops rather than [±voice].

(3) Mongolian consonants

<table>
<thead>
<tr>
<th></th>
<th>VOT (ms.)</th>
<th>F0 (Hz)</th>
<th>Transition intensity (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voiceless</td>
<td>58</td>
<td>185</td>
<td>80.2</td>
</tr>
<tr>
<td>Voiced</td>
<td>37</td>
<td>176</td>
<td>57.3</td>
</tr>
</tbody>
</table>

What is of interest is that VOTs for voiced stops were much longer in our study than in Chang and Jeong (2009) (37 ms vs. 14.6 ms) and VOTs for voiceless stops were shorter in our study than in theirs (58 ms vs. 81.5ms). Thus, taking into other phonetic correlates, it seems that F0 of the following vowel and transition intensity may compensate for (or trade-
off) the closer VOT values as to stop distinction although Mongolian stops may be
categorized as voiceless ones.

Next, as seen in (4a), Korean 3-way stops were differently pronounced statistically in
all of the phonetic correlates, i.e., VOT, F0 of the following vowel, and intensity for
Mongolian L2 learners. This indicates that Mongolian learners exploit three acoustic cues to
distinguish Korean 3-way stops on the production side. However, compared with the
properties of native Korean speakers in previous studies (4b), Mongolian speakers’ mean
VOT and their ranges are quite different from Koreans’. In particular, VOTs for lax stops
were even longer for Mongolian than for Korean speakers. Considering VOTs for Mongolian
stops in (3), VOTs for Korean lax stops seem to be influenced (or transferred from) by those
for L1 Mongolian voiceless stops. Furthermore, F0 values seem to have been transferred
from L1 Mongolian to L2 Korean. Finally, differences in amplitude were not large among the
three phonation types. This indicates that Mongolian learners’ production of stops seem to lie
in the phonetic cues between L1 Mongolian and L2 Korean.

Finally, as in (5), the result of perception task showed that Mongolian speakers
perceived Korean lax stops as either lax or tense (46% vs. 47%), tense stops were most
accurately identified (59%), and aspirated ones were perceived as aspirated by 55%. This
indicates that the distinction between lax and tense stops was most confusing, while the
identification of tense stops was comparatively easy. Such difficulty in distinguishing lax
from tense stops might be due to the very similar values of VOT, F0 and amplitude found in
their production in (4). However, comparatively higher accuracy for tense and aspirated stops
might facilitate further probe into other potential crucial acoustic cues.

In conclusion, our findings provide interesting implications concerning the phonemic
status of Mongolian voiced/voiceless stops and Mongolian learners’ stage of development of
L2 Korean. First, our study offers additional evidence for the claim that Mongolian stops
should be classified along the dimension of aspiration ([spreadglottis]) rather than the
[voicing] feature phonologically. Second, Mongolian stops are realized in binary opposition
along many phonetic cues such as F0 of the following vowel and amplitude. Finally, despite
the similar [aspiration] criterion to Korean, Mongolian beginner learners still might undergo
difficulty in production and perception of Korean 3 phonation types due to the transfer from
L1 Mongolian.

**Selected references**
Linguistics* 45: 269-292.
Linguistics* 13, 59-104.

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Phonation</td>
<td>VOT (ms)</td>
<td>F0 (Hz)</td>
</tr>
<tr>
<td>Lax</td>
<td>62 (56-68)</td>
<td>187</td>
</tr>
<tr>
<td>Tense</td>
<td>51 (44-56)</td>
<td>185</td>
</tr>
<tr>
<td>Aspirated</td>
<td>74 (67-81)</td>
<td>190</td>
</tr>
</tbody>
</table>

<table>
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<tr>
<th>(5)</th>
<th>Phonation type of listening stimuli in Korean (accuracy %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response type</td>
<td>Lax</td>
</tr>
<tr>
<td>Lax</td>
<td>46</td>
</tr>
<tr>
<td>Tense</td>
<td>47</td>
</tr>
<tr>
<td>Aspirated</td>
<td>6</td>
</tr>
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