BACKGROUND

• **Beatboxing**: a musical art form that uses the vocal tract to mimic percussion
• Not extensively studied scientifically
• Previous studies only examine one subject each

METHODS

• **Five beatboxers** scanned with rtMRI (Table 1)
• **Midsagittal** plane scanned
• **High frame rate** (83 fps)
• **Three basic beatboxing sounds** compared (Table 2)

**Table 1: Scanned Subjects**

<table>
<thead>
<tr>
<th>Skill Level</th>
<th>Gender</th>
<th>Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced</td>
<td>Male</td>
<td>5 years</td>
</tr>
<tr>
<td>Advanced</td>
<td>Female</td>
<td>9 years</td>
</tr>
<tr>
<td>Intermediate</td>
<td>Female</td>
<td>3 years</td>
</tr>
<tr>
<td>Novice</td>
<td>Male</td>
<td>6 years</td>
</tr>
<tr>
<td>Novice</td>
<td>Female</td>
<td>3 years</td>
</tr>
</tbody>
</table>

**Table 2: Isolated Sounds Studied**

<table>
<thead>
<tr>
<th>Sound</th>
<th>IPA*</th>
<th>SBN**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kick Drum</td>
<td>/pf/</td>
<td>B</td>
</tr>
<tr>
<td>Closed Hi-Hat</td>
<td>/t/</td>
<td>t</td>
</tr>
<tr>
<td>PF Snare</td>
<td>/p’f:/</td>
<td>pf</td>
</tr>
</tbody>
</table>

*IPA = International Phonetic Alphabet    **SBN = Standard Beatbox Notation

RESULTS

A) All subjects except the novice female moved the larynx

B) The tongue tip or front can both be used to make this sound

C) Only advanced male did not move larynx, he used a different airstream

• This sound was produced similarly across all five subjects

CONCLUSIONS

• The ways in which beatboxers make a given sound **vary**
• Sound closest to native **language** (t) varied the least
• There are essential closures for production of each sound
• Advanced beatboxers have more control over the larynx
• Ejectives (rapid upwards movement of larynx) sound more percussive
• Articulator and airstream control define **artistry**

FUTURE DIRECTIONS

• Quantify differences between subjects
• Study more sounds from data set
• Combine with acoustic analysis

These results offer insights into how articulators can be trained and used for specific acoustic goals.

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