I. Background & Objective

- When speech perception and intelligibility tests utilize a range of signal-to-noise ratios (SNRs), SNR is usually manipulated by changing noise levels relative to constant target levels or vice versa.
- Example: the HINT test uses a constant noise level with changing target levels.
- These manipulations entail changes in the overall amount of energy delivered to the ear across SNRs.
- Problem: overall energy changes may be partially responsible for behavioral differences observed across SNRs in basic research and in clinical testing.

Approach: compare behavioral results on a speech-in-noise task using two different SNR manipulation techniques:

- **Method 1**: changing noise level only
  - Overall energy increases with decreasing SNR

- **Method 2**: changing noise level re-leveling resultant stimuli to a given rms amplitude
  - Overall energy is consistent across SNRs

II. Experiment 1: Speech intelligibility in speech noise (SNR method 1)

Sentence recognition in native- and foreign-language multi-talker background noise (Van Engen and Bradlow, 2007)

**English sentence intelligibility by native English listeners in:**
- 6-talker vs. 2-talker babble: English vs. Mandarin babble: SNRs of +5, 0, and -5 dB
- Procedure: 66 native English participants listened to 4 blocks of 16 target sentences (50 keywords/block) mixed with babble and wrote down what they heard.

**Primary results**
1. 6-talker babble is more difficult than 2-talker babble (top vs. bottom panels at right).
2. English babble is more difficult than Mandarin (Mandarin vs. English within conditions 3 & 4 – bottom panels at right).

**Conclusion**
The effectiveness of a given speech masker depends not only on its spectral and temporal characteristics, but also on the linguistic content of the noise with respect to the language of the target speech and/or the linguistic experience of the listeners.

III. Experiment 2: Comparison of SNR manipulation methods

- In the present study, the effect of SNR manipulation technique was investigated by replicating Condition 4 from Experiment 1 using re-leveled stimuli.
- Perception Participants: 17 native English speakers from the Northwestern University Linguistics Department subject pool.
- Materials: Sentences and noise from Experiment 1
  - BKB sentences spoken by a female native English talker (Barnford and Wilson, 1979)
  - Babble constructed from semantically anomalous sentences spoken by female native talkers of the two languages (Smiljanic and Bradlow, 2005)
- SNRs were generated as follows:
  1. All sentences leveled to a given rms amplitude (65 dB)
  2. All noise tracks leveled the rms amplitudes required to produce 0 and -5 dB SNRs (65 dB, 70 dB)
- In the present study, these sentences and noise tracks were mixed, and the resultant files were equated for rms amplitude

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Block 1</th>
<th>Block 2</th>
<th>Block 3</th>
<th>Block 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condition 1 (6-talker babble)</td>
<td>SNR 0</td>
<td>SNR 0</td>
<td>SNR 0</td>
<td>SNR 0</td>
</tr>
<tr>
<td>Condition 2 (2-talker babble)</td>
<td>SNR 0</td>
<td>SNR 0</td>
<td>SNR 0</td>
<td>SNR 0</td>
</tr>
<tr>
<td>Condition 3 (2-talker babble)</td>
<td>SNR +5</td>
<td>SNR +5</td>
<td>SNR -5</td>
<td>SNR -5</td>
</tr>
<tr>
<td>Condition 4 (2-talker babble)</td>
<td>SNR 0</td>
<td>SNR 0</td>
<td>SNR 0</td>
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</table>

% keywords identified (converted to RAU following Studebaker, 1985) across SNRs and noise languages.

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<tr>
<th>Method 1 vs. Method 2: no significant differences in performance.</th>
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Experiments replicated Experiment 1, showing that English 2-talker babble is more detrimental than Mandarin 2-talker babble for native English listeners listening to English sentences.

IV. Discussion

- For young adult listeners with normal hearing, behavioral results on sentence intelligibility in 2-talker babble are not affected by the SNR manipulation method.
- The interaction of the noise language effect with SNR observed in the previous study and the general difference across “easy” (0 dB) and “hard” (-5 dB) SNRs cannot be attributed to overall energy changes across SNRs, but rather reveal speech-in-noise processing effects.
- More generally, these findings suggest that behavioral results with normal-hearing young adults are relatively stable across different methods of manipulating SNR.

V. References