Does sentence complexity interfere with intelligibility in noise?

Evaluation of the OLACS Sentence Test

Verena Uslar, Thomas Brand, Mirko Hanke, Rebecca Carroll, Esther Ruijendijk, Cornelia Hamann & Birger Kollmeier, Universität Oldenburg
contact: verena.uslar@uni-oldenburg.de

MOTIVATION

Linguistic complexity seems to be an important factor in speech recognition and seemingly interacts with other factors, such as age or hearing impairment [1,2], possibly because of their relation to cognitive factors such as working memory or attention, which seem to play a vital role in understanding speech [3]. The material used in German speech intelligibility tests does not have the controlled and graded linguistic complexity needed for studying the effect of linguistic complexity on speech recognition. Thus, we developed a speech intelligibility test containing seven test lists with graded linguistic complexity, the Oldenburg Linguistically and Audiolinguistically Controlled Sentence Test (OLACS).

AIM: Establishing test lists for each sentence type, while making sure that all differences in intelligibility across the different sentence types originated from the different sentence structures and not from differences in sensory/acoustic factors.

HYPOTHESES:
1. There should be differences between sentence types regarding their intelligibility.
2. There should be differences between listeners based on their individual cognitive capabilities.

METHODS

Sentences or sentence fragments were presented in a random order via headphones. After the presentation of each sentence, the participant was asked to repeat what she/he had just heard. Participants were explicitly allowed to guess.

PHASE 1
- 7 fragments
- 7dB SNR noise (65 dB SPL)
- 720 sentences
- 12 subjects (NH)

PHASE 2
- whole sentences
- +7dB SNR
- 560 sentences
- 12 subjects (NH)

PHASE 3
- whole sentences
- two sentence specific SNRs
- 360 sentences
- 12 subjects (NH)

calculation of sentences discrimination functions for the remaining sentences

RESULTS

Differences between fragment and sentence presentation (see Tab. 2)

<table>
<thead>
<tr>
<th>Fragments (PHASE 1)</th>
<th>W1</th>
<th>W2</th>
<th>W3</th>
<th>W4</th>
<th>W5</th>
<th>W6</th>
<th>W7</th>
<th>overall</th>
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<tbody>
<tr>
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<td>69</td>
<td>72</td>
<td>68</td>
<td>66</td>
<td>65</td>
<td>67</td>
<td>66</td>
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<tr>
<td>amb-OVS</td>
<td>60</td>
<td>62</td>
<td>61</td>
<td>61</td>
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<td>72</td>
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<tr>
<td>OR</td>
<td>76</td>
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<td>64</td>
<td>63</td>
<td>48</td>
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<td>72</td>
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<tr>
<td>amb OR</td>
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<td>27</td>
<td>27</td>
<td>72</td>
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<tr>
<td>Whole Sentences (PHASE 2)</td>
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</tbody>
</table>

Differences across listeners (see Fig. 2)

Each listener performed either good or bad in any condition.

Conclusions

• For each of the seven sentence types a list of 40 sentences is established.
• Through the presentation of sentence fragments in the first evaluation step, it is possible to distinguish between the effect of the respective acoustical representation and the effect of the syntactical structure, which turn enabled us, to reliably discard sentences based on their acoustical divergence.
• Differences of up to 3 dB in SRT occurred for the different sentence types, confirming our first hypothesis, that the sentence structure indeed has an influence on speech recognition in noise. This effect should be further studied with different groups of listeners.
• Interindividual differences of up to 30% in overall recognition rate support our second hypothesis that individual cognitive capability may play an important role in the processing of speech in noise. This effect allows the test to be used for diagnostic purposes, e.g. to differentiate between individual listeners.


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