The role of presentation modality in sentence processing

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Abstract

The question whether listening comprehension is more or less costly than reading comprehension remains open. We investigate whether the effects of grammar complexity are same in reading and listening sentences. We show that presentation mode has no effect on comprehension accuracy but affects response times. In both modes the most difficult constructions to comprehend and the longest constructions to process were the same which demonstrates that the cost of syntactic processing is not affected by presentation modality.

Keywords: syntactic complexity, sentence comprehension, Russian language.

Introduction

The question whether listening comprehension is more or less costly than reading comprehension remains open. From one point of view, reading a more complicated and costly activity than oral language comprehension because reading ability is acquired later in ontogenesis than oral speech, and orthographic processing is mapped onto phonological representations, which makes reading a more complicated and costly activity than oral language comprehension; moreover, in listening comprehension we can use prosodic cues which we do not have in reading comprehension. From the other point of view, reading is less costly than listening because in most modern Indo-European languages word boundaries are demarcated in written text unlike in spontaneous speech, where there is a problem of segmentation into words; moreover, in natural reading we can process words as long as we choose, refixate and make regressions, so oral language comprehension can be considered more demanding because the processing pace is regulated by the speaker, not by the hearer.

Some research has been done on the effect of modality for grammaticality judgment tasks. Vetter, Volovecky and Howell (1979) compared visual and auditory presentation, both normal and monotone, as well as simultaneous visual and auditory presentation, and found no overall effect of modality. As for neurocognitive research on the modality of sentence processing, there is neurological evidence for supramodal language system that integrates linguistic

input from speech to print and activates a common code (Braze et al. 2011, Constable et al. 2004, Shankweiler 2008).

Our study was aimed to investigate whether the effects of grammar complexity are same in reading and listening modes of the sentence comprehension task.

Material

We chose 6 grammatically complex constructions which had been shown in previous studies to be especially difficult for syntactic processing and comprehension in Russian (see Chernova, Novozhilov, Slioussar 2021).
The list included object relative clauses, locative constructions with prepositions, temporal constructions with «before-clauses» and «after-clauses», sentences with high and low modifier attachment to a complex noun phrase (participial constructions where attachment ambiguity was resolves by case agreement) and complex comparative constructions. We had 10 sentences for each construction type, so there were 60 target sentences as well as 40 fillers with simpler syntactic structure.

For every sentence, we created a comprehension question with a choice of two answers aimed to assess syntactic structure comprehension. Both response options were mentioned in the sentence but only one was the correct answer to the question. All the sentences were semantically reversible and unbiased, so both response options referred to equally plausible interpretations, which means that the syntactic structure of the sentence had to be analyzed to give a correct answer.

The test consisted of two parts: reading mode and listening mode.

In the reading part the sentences were presented in a non-cumulative self-paced reading mode. Such type of presentation was chosen in order to make the task less trivial and to avoid ceiling effect accuracy. In the listening part the sentences were presented as audio recordings. The stimuli were recorded by a male native-Russian speaker who read with a natural and consistent pace and volume and was unaware of the purpose of the study. The comprehension question followed each stimulus in both modes.
The test had a within-subject design.

Participants

98 native speakers of Russian (48 male/ 50 female) aged 19–63 volunteered to take part in the experiment which was run online using PCIbex platform, https://farm.pcibex.net/ (Zehr & Schwarz 2018). The subjects did not have any reported language or reading disorders and were unaware of the purpose of the study.

The experiment was carried out in accordance with the Declaration of Helsinki and existing regulations concerning ethics in research. All the participants provided informed consent.

Procedure

We counterbalanced the tasks in four experimental lists: in the first one, half of the sentences was presented in the listening mode and the second half in the reading mode, in the second experimental list it was vice versa, while the third and fourth lists included the same materials as the first and the second respectively, but the reading part preceded the listening one.

The participants were asked to read or listen to the sentence and then answer a comprehension question. It was possible to read or listen to the sentence only once. After that the participant was presented a comprehension question on the screen and chose a response option by mouse click.

Answer accuracy and response times were registered.

Results

We analyzed participants' question answering times and accuracy.

As for accuracy, no significant differences in comprehension accuracy between reading and listening mode was found: $\beta=0.1$, $z=0.8$, $p=0.3$.

We also analyzed the comprehension accuracy of the construction types separately. Low attachment sentences were processed the least accurately both in reading and listening mode, $p<0.01$ for most pairwise comparisons, while temporal constructions were the easiest to interpret in both modes, $p<0.01$ for most pairwise comparisons.

As for response times, it took significantly more time to answer the questions in listening mode compared to reading mode: $\beta=703.1$, $t=4.5$, $p<0.001$.

As for response times analyzed for the construction types separately, complex comparative constructions and locative constructions turned out to be the longest to give an answer both in reading and listening modes, $p<0.01$ for most pairwise comparisons. The shortest answering times were registered for high and low attachment constructions and temporal constructions.

Discussion

As we see, the presentation mode has no effect on overall comprehension accuracy but it affects response times: it takes significantly more time to answer a question if the sentence was presented orally than if the sentence was presented in the written form. However, this effect may be caused by the experimental procedure: the comprehension questions response options were always presented in the written form in both parts of the experiment, so the

increasing response times in listening mode may reflect the modality switch effect.

What is more important, the most and the least difficult constructions to process coincide in both modes: constructions with low attachment of the modifier to a complex noun phrase caused significantly more comprehension errors while temporal constructions caused significantly less errors both in reading comprehension task and listening comprehension task. As for online measures, complex comparative and locative constructions took the longest time to give a response also in both modalities.

These data gives evidence for common mechanisms of syntactic processing system in oral and written modalities as the effects of syntactic complexity are the same in both modes; in other words, our data gives evidence for the supramodal nature of syntactic processing.

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