Ambiguous pronouns processing in coherent texts reading

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Discourse coherence is usually achieved via connecting a pronoun to a previously mentioned linguistic expression. Sometimes there is a possibility to interpret the pronoun in favor of several referents, which leads to ambiguity. Several approaches describing ambiguous pronoun processing may be defined: (a) immediate interpretation of the pronoun in favor of the most activated referent; (b) construction of two alternative interpretations that are kept in working memory unless the context allows to choose one of them; (c) delayed or shallow processing, i.e. temporal or total absence of any interpretation as a result of insufficient activation level of both referents. These approaches do not exclude each other but reflect different processing strategies depending on the task at hand. If each experimental item is followed by a question requiring pronoun resolution, two alternative interpretations are created and then one of them is selected while the absence of such questions may lead to shallow processing. In both cases the processing of ambiguous pronouns differs from unambiguous ones, and this is also supported by EEG-studies. However, these effects were found for the processing of separate sentences when readers were not required to establish discourse coherence.

The aim of our eye-tracking study was to test which of the three approaches describes ambiguous pronoun processing in coherent texts. We created short stories with characters familiar to participants; each of them contained an ambiguous pronoun that could be assigned to any of the two referents mentioned in the previous sentence. The last sentence contained information that either disambiguated the pronoun (I) or supported the ambiguity (II). For both versions of the story a control text with characters of different gender and an unambiguous pronoun was created. Thus, it was a 2x2 design with pronoun type (ambiguous vs. unambiguous) and type of context (resolving ambiguity vs. neutral) as factors. The task of 41 Russian-speaking participant was to read 42 texts at normal pace and answer questions that tested general understanding of the story and followed ½ of the stimuli. Gaze duration, go-past time, and total reading time for three interest areas in the sentence with the pronoun and two interest areas in the last contextual sentence were analyzed.

We suggested that the construction of several alternative interpretations would lead to an increased processing time of the pronoun region (due to working memory load), as well as of the last sentence in the contexts where the ambiguity is preserved (II). Delayed pronoun assignment does not predict any slowdowns in the pronoun region but should lead to increased processing times of the last sentence in both ambiguous conditions (I, II), irrespectively of the context type, as a result of establishing reference and creating coherent discourse representation. If the immediate pronoun assignment to the most activated referent takes place, we expect factor interaction for go-past reading time of the last contextual sentence: slowdown should occur only in the condition where the ambiguity is resolved (I). This effect would reflect a text reprocessing, which occurs in case of the wrong initial interpretation. Finally, shallow processing does not predict any slowdowns; therefore, any of the aforementioned effects could be considered as evidence against this kind of processing.

The results of a 2x2 RM ANOVA did not reveal any significant difference in gaze duration or go-past reading time for the sentence with the pronoun ($ps>.05$), and only total reading time was affected by the ambiguity ($p<.05$). A significant factor interaction for go-past reading time of the last contextual sentence was found ($p<.05$) with a significant slowdown in ambiguous condition only in the context (I) where ambiguity was resolved ($p<.05$).

The results of our study suggest that in case of coherent texts ambiguous pronoun is immediately assigned to the most activated referent. If this initial interpretation turns to be incorrect, readers must reprocess the text to build its coherent representation. No evidence for shallow or postponed processing, as well as for the construction of the two alternative interpretations was found.

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Example stimuli translated to English

Neutral context, ambiguous
The summer has finally come to the city, it was a pleasant sunny day.
Krosh was calmly moving down the street when Barash suddenly came off the corner on rollerblades.
Fortunately, he managed to stop (P1)* almost immediately (P2), because [he] had a good reaction (P3).
In the end, Krosh was very happy (N1), that the crash was avoided (N2).

Control to neutral context, unambiguous
The summer has finally come to the city, it was a pleasant sunny day.
Nyusha was calmly moving down the street when Krosh suddenly came off the corner on rollerblades.
Fortunately, he managed to stop (P1) almost immediately (P2), because [he] had a good reaction (P3).
In the end, Krosh was very happy (N1), that the crash was avoided (N2).

Resolving ambiguity context, ambiguous
The summer has finally come to the city, it was a pleasant sunny day.
Krosh was calmly moving down the street when Barash suddenly came off the corner on rollerblades.
Fortunately, he managed to stop (P1) almost immediately (P2), because [he] had a good reaction (P3).
In the end, Krosh moved on quietly (N1) without event recognizing the possibility of a crash (N2).

Control to resolving ambiguity context, unambiguous
The summer has finally come to the city, it was a pleasant sunny day.
Krosh was calmly moving down the street when Nyusha suddenly came off the corner on rollerblades.
Fortunately, she managed to stop (P1) almost immediately (P2), because [she] had a good reaction (P3).
In the end, Krosh moved on quietly (N1) without event recognizing the possibility of a crash (N2).

*(P1), (P2), (P3), (N1), (N2) – areas of interest for which eye-tracking measures were analyzed

Example stimuli in Russian

Neutral context, ambiguous
В городе наконец наступило лето, был прекрасный солнечный день.
Крош спокойно ехал по улице, когда Бараш неожиданно вылетел из-за угла на роликах.
К счастью, он затормозил (P1) почти моментально (P2), потому что обладал хорошей реакцией (P3).
В итоге Крош очень обрадовался (N1), что столкновения удалось избежать (N2).

Control to neutral context, unambiguous
В городе наконец наступило лето, был прекрасный солнечный день.
Нюша спокойно ехала по улице, когда Крош неожиданно вылетел из-за угла на роликах.
К счастью, он затормозил (P1) почти моментально (P2), потому что обладал хорошей реакцией (P3).
В итоге Крош очень обрадовался (N1), что столкновения удалось избежать (N2).

Resolving ambiguity context, ambiguous
В городе наконец наступило лето, был прекрасный солнечный день.
Крош спокойно ехал по улице, когда Бараш неожиданно вылетел из-за угла на роликах.
К счастью, он затормозил (P1) почти моментально (P2), потому что обладал хорошей реакцией (P3).
В итоге Крош проехал мимо (N1), даже не заметив угрозы столкновения (N2).

Control to resolving ambiguity context, unambiguous
В городе наконец наступило лето, был прекрасный солнечный день.
Крош спокойно ехал по улице, когда Нюша неожиданно вылетела из-за угла на роликах.
К счастью, она затормозила (P1) почти моментально (P2), потому что обладала хорошей реакцией (P3).
В итоге Крош проехал мимо (N1), даже не заметив угрозы столкновения (N2).

Background information
Overall, there were 4 different characters in our stories (Krosh, Barash, Nyusha, and Pandy). These are spherical animal-like speaking creatures - the characters of a cartoon series ‘Smeshariki’ that is well-known among Russian audience.