Factors affecting resolution of anaphora with collective nouns in Russian

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https://doi.org/10.36505/ExLing-2024/15/0022/000647

Abstract

It is assumed that anaphoric agreement is more sensitive to semantic rather than grammatical information of an antecedent. Higher linear distance between a pronoun and its antecedent has proven to trigger semantic agreement, yet hierarchical distance is hardly examined in the research field. In the eye-tracking experiment, we investigated factors of linear and rhetorical (hierarchical) distance as well as the factor of working memory volume in their ability to facilitate interpretation of the number feature of a collective noun in Russian. The results indicate that linear distance is of great importance in interpreting pronouns, and the same is true for hierarchical distance.

Keywords: anaphoric agreement, rhetorical structure, collective nouns, eye-tracking, experimental linguistics

Introduction

The dualistic nature of collective nouns (holistic and distributive interpretations) is considered a source of variable patterns in noun-pronoun agreement in terms of number feature. One of the key factors influencing the preference for number is linear distance (Levin 2001). In a multi-factorial approach to referential choice (Kibrik 1996), one of the main discourse factors influencing referent activation in the listener's cognitive system is rhetorical distance, consisting of elementary discourse units that convey communicative information. The activation correlates with the probability of being pronominalized by the speaker.

In a normal case, morphosyntactic number on an agreement target corresponds to the number morphologically expressed on a controller, but there are cases where a violation of such alignment can be due to the influence of conceptual number on the controller. The extent to which number value is prone to inherit conceptual plurality correlates with the type of dependency according to Corbett's Agreement Hierarchy (Corbett 1979).

Hypotheses

The aim of this study is to understand the effects of linear and rhetorical distance and verbal working memory (VWM) in relation to the resolution of

anaphora with collective nominals. For this purpose, an eye-tracking experiment has been carried out to reveal the significance of these factors.

In the present study, the following hypotheses have been established:

1. An increase in rhetorical distance leads to a better processing of plural pronouns, and the opposite is true for singular pronouns.
2. An increase in linear distance leads to a better processing of plural pronouns, and the opposite is true for singular pronouns.
3. Rhetorical distance plays a greater role in pronoun processing than linear distance.
4. For participants with smaller VWM volume, it will take more time to process singular pronouns with an increase in rhetorical and/or linear distance.

Methodology

Thirty-two native speakers of Russian (students of MSU) participated in the experiment. The experiment was constructed in PsychoPy-2022.2.5., and the eye-tracking data have been collected with the help of eye-tracker Tobii Pro Spectrum 600. Participants were presented with composed texts using self-paced reading technique (non-cumulative). They had to read the texts silently and press the space button to proceed further. About 30% of texts were followed by a comprehension question alluding to one of the text constituents. The subjects were to respond out loud. Each of the 8 experimental lists contained 32 experimental items as well as 32 filler texts. All items were organized according to Latin Square Design.

Stimuli

The experiment has 2x2x2 design, and the following independant variables: rhetorical distance, linear distance, and number feature of the pronoun. The experimental texts have the same rhetorical structure (with an accuracy of relation direction) for all 8 conditions in one block. No plural noun phrases, nouns with variable gender, comitative phrases, animate referents, and nouns with the same gender as the collective noun are present in the texts (except the clause containing pronoun). The linear and rhetorical distance units represent finite clauses. The pronoun and its antecedent take the direct object position of the indefinite-personal clause.

An example of rhetorical structures for the experimental block is shown in Table 1, where four of eight conditions are given in one cell representing singular and plural pronoun cases.

	RhetD = 1	RhetD = 2
LinD = 1	1-5 | 1-2 ← 3-5 | | 1← 2 **3** ← 4-5 | **4** ← 5	1-5 | 1-2 ← 3-5 | | 1← 2 **3** ← 4-5 | **4** → 5
LinD = 2	1-5 | 1-2 ← 3-5 | | 1← 2 **3** ← 4-5 | 4 → **5**	1-5 | 1-2 ← 3-5 | | 1← 2 **3** ← 4-5 | 4 ← **5**

Table 1. Example of experimental block. RhetD and LinD stand for rhetorical and linear distance accordingly.

Results

In this paper, only mean fixation durations of the second-pass pronoun reading are considered (Table 2). Confirmations of the hypotheses based on the metric of second-pass reading of the pronoun are demonstrated in Table 3.

A crucial disparity between singular and plural pronoun conditions was demonstrated with an increase in one distance and the other one being invariably high. The most challenging condition for a singular pronoun turned out to be the highest distance, both rhetorical and linear (178.7 ms), and the easiest one was when both distances were small (74.8 ms). The opposite is true in the case of a plural pronoun.

The verbal working memory factor did not exert any influence on the processing, thus statistics are not provided here. Irrelevant, not up-to-date assessment of VWM volume is deemed to be a potential reason for such a result.

Table 2. Mean duration of fixations (ms) for second-pass reading of a pronoun region.

Conditions	RhetD = 1, LinD = 1	RhetD = 1, LinD = 2	RhetD = 2, LinD = 1	RhetD = 2, LinD = 2
singular pronoun	74.8	83.9	117.6	178.7
plural pronoun	120.6	75.6	118.3	84.7

Table 3. Confirmation of the hypotheses. T, U stand for confirmation of a hypothesis by t-test or U-test respectively. The significance level for statistical tests is .05 (*) and .01 (**).Time() stands for reading time of singular or plural pronouns. >,< stand for more or less reading time accordingly.

LinD ↑ → time(sg) ↑	RhetD↑ → time(sg) ↑	LinD↑ → time(pl)↓	RhetD↑ → time(pl) ↓	RhetD>LinD → time(sg) > time(pl)	RhetD<LinD → time(sg) < time(pl)
No (RhetD=1), Yes (RhetD=2) (T*)	Yes (LinD=1) (T*, U*), Yes (LinD=2) (T**, U**)	Yes (RhetD=1) (T*), Yes (RhetD=2) (U**)	No (LinD=1), No (LinD=2)	No	No

Discussion

In the current study, an eye-tracking experiment has been conducted to investigate factors influencing resolution of anaphora with collective nominals, namely the factors of rhetorical and linear distance and the verbal working memory factor.

Linear distance facilitated less cognitive effort in the processing of plural pronouns, whereas rhetorical distance was found to cause overall cognitive load on the process of interpretation. The results have shown that a significant increase in reading time in the case of a singular pronoun was demonstrated when both distances were high, and no such effect was observed otherwise. The working memory effect has not been revealed in the experiment. The experimental findings also suggest that, apart from the type of dependency, the preference for conceptual or grammatical information correlates with the distance between a pronoun and its antecedent.

Acknowledgements

The research has been carried out as a part of a Bachelor's thesis at Lomonosov Moscow State University. I would like to express gratitude to my supervisor, professor Olga V. Fedorova, for the helpful guidance and provision of the eye-tracking equipment. I also thank all the participants who took part in the experiment for their valuable contribution.

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