

INTERPRETATION OF AMBIGUOUS PRONOUNS IN RUSSIAN: CANONICAL AND NON-CANONICAL WORD ORDER

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Interpretation of ambiguous pronouns in Russian: canonical and non-canonical word order

Outline:

- Theories on anaphora/ pronoun resolution
 - Eye tracking studies
 - The study
 - Design
 - Preliminary results
 - Discussion, open questions

Pronoun resolution

- resolving pronouns is crucial for language comprehension

disambiguation cues

- gender, number, animacy:

e.g. Paul₁ meets Anna₂. He₁ kisses her₂. She₂ kisses him₁. They_{1/2} go to his₁ house₃. It₃ is next to the sea... etc

- discourse semantics, e.g. coherence relations (Kehler 2007)

Pronoun resolution

no disambiguation cues → pronouns refer to most accessible referent:

- *First mention* bias: pronouns co-refer with the NP which was mentioned first (Gernsbacher & Hargreaves 1988)
- *Subjecthood*: pronouns co-refer with subject-NP (Crawley et al. 1990)
- *Parallelism*: subject pronouns co-refer with the subject-NP and object pronouns co-refer with the object-NP (Smyth 1994, Chambers & Smyth 1998)

Pronoun resolution

Lev i slon nesutsja k vodopou. Lev govonaet slona. On_{lev/slon} bezhit izo vseh sil.

lion and elephnat are rushing to watering place. lion is catching up elephant. he_{lion/elephant} is running quickly

S

V

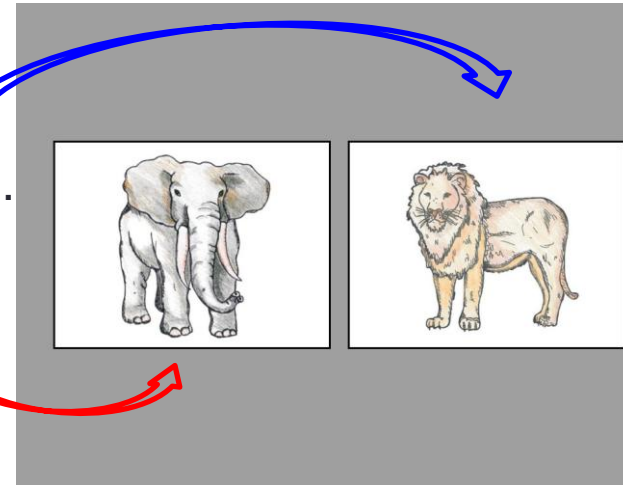
O.

Er_{lev/slon}

Predictions

Centering (Brennan et al. 1987) _____ SVO. Er ...

Recency (Lappin/Leass 1994; Hobbs 1978) __ SVO. Er ...



Pronoun resolution

Eye tracking studies:

Arnold et al. (2000) adults; looking at pictures with two cartoon characters (Donald and Minnie/ Mickey) and listening to different sentences:

1. pronouns disambiguated by gender:

Donald is bringing some mail to {Minnie}, while a violent storm is beginning. {She} is carrying an umbrella, and it looks like they are both going to need it.

2. ambiguous pronouns:

Donald is bringing some mail to {Mickey}, while a violent storm is beginning. {He} is carrying an umbrella, and it looks like they are both going to need it.

+ gender information → target character (1: Minnie)

- gender information → first-mentioned character (2: Donald)

Pronoun resolution

Similar results with English speaking children;
after ambiguous pronouns children from around 2 years → first mentioned
character (similar to adults, although slower)

2 year olds: 3000-4000 ms after pronoun onset (Song & Fisher 2007)

3 year olds: 1000-2000 ms after pronoun onset (Song & Fisher 2005)

5 year olds: 1200-1400 ms after pronoun onset (Hartshore et al. 2011)

Adults: 200 ms after pronoun onset (z.B. Arnold et al. 2000, Arnold et al. 2007)

→ First mention bias/ Subjecthood

both are heavily confounded in English; the grammatical subject is usually also
the first mentioned referent

Pronoun resolution

Eye tracking studies in Finnish (Järvikivi et al. 2005, Kaiser & Trueswell 2008)

- flexible word order:
SVO (canonical, non-marked), OVS (marked)
- grammatical role indicated morphosyntactically
- subject pronoun *hän* (he/ she)
- object pronoun *hänet* (him/ her)

Pronoun resolution

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Adults listened to SVO and OVS sentences, then a sentence with an ambiguous pronoun: SVO + *hän* vs. OVS + *hän*

- after hearing the ambiguous pronoun (*hän*) -> pictures with the subject character: SVO + *hän* vs. OVS + *hän*
- no preference for the first-mentioned character in OVS
- Subjecthood

Pronoun resolution

Pyykkönen & Järvikivi et al. (2010)

- implicit causality effect in Finnish
- subject- and object pronouns (*hän/* he and *hänet/* him) with SVO

report an effect of parallelism „significantly more looks to the object antecedent with the pronoun *hänet* than with the subject pronoun *hän* and marginally more looks to the subject antecedent with *hän* than with *hänet*“ (S.7-8)

→ syntactical parallelism?

Interpretation of ambiguous pronouns in Russian

Target Russian:

- flexible word order: SVO and OVS
- subject pronoun *on* (he), object pronoun *ego* (him)

Research questions:

- A subject or parallelism strategy in the pronouns resolution in Russian?
- How is the subject (*on* ,he') vs. the object (*ego* ,him') pronoun resolved and is there any word order impact on pronoun resolution?
- Any variation in the pronoun resolution in different populations?
 - adults vs. children
 - TD vs. SLI children

Interpretation of ambiguous pronouns in Russian

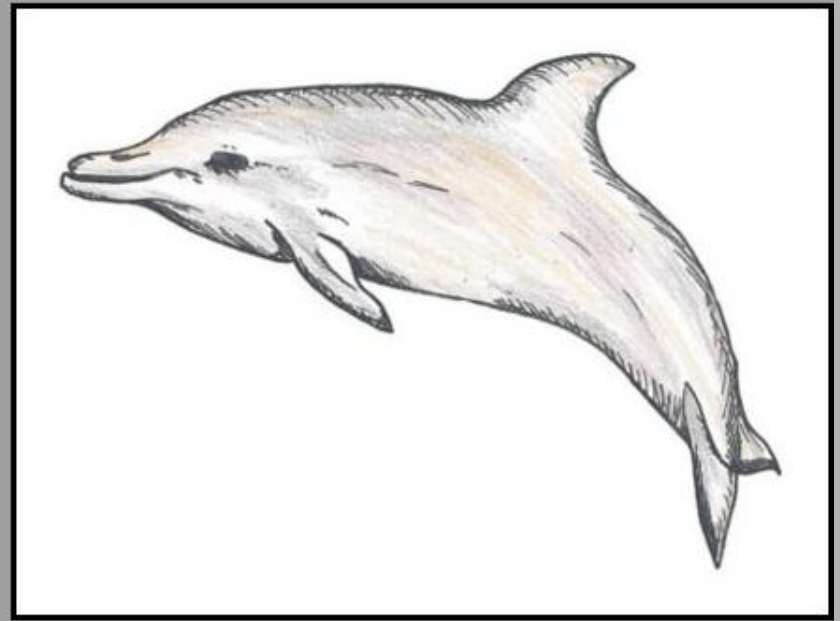
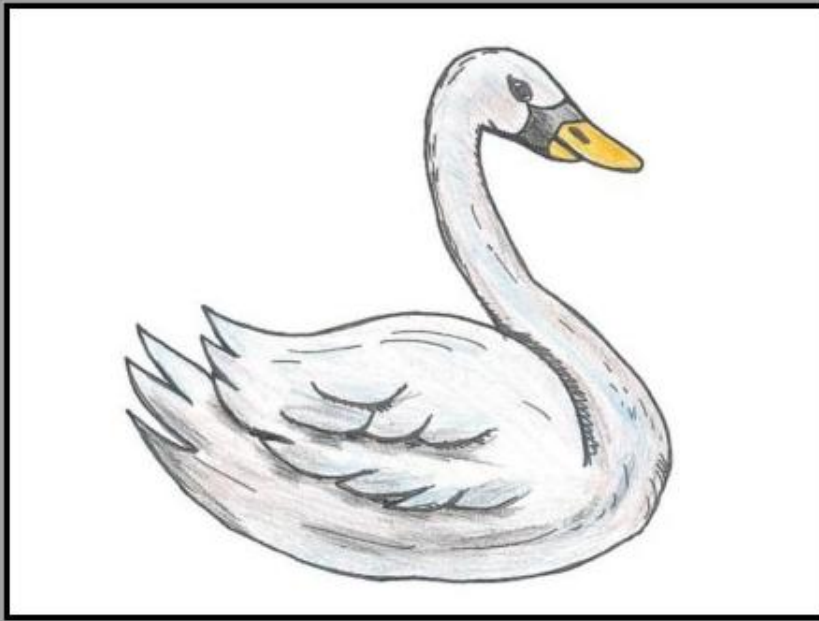
Examples:

- SVO. *On*...: Тигр видит льва. *Он* зовет жирафа.
The tiger sees the lion. *He* calls the giraffe.
- SVO. *Ego*...: Тигр видит льва. *Его* зовет жираф.
The tiger sees the lion. *Him* calls the giraffe.
- OVS. *On*...: Льва видит тигр. *Он* зовет жирафа.
The lion{OBJ} sees the tiger {SUBJ}. *He* calls the giraffe.
- OVS. *Ego*...: Льва видит тигр. *Его* зовет жираф.
The lion{OBJ} sees the tiger {SUBJ}. *Him* calls the giraffe.

Interpretation of ambiguous pronouns in Russian

The experiment:

- Visual World Paradigm (VWP): a participant listens to sentences while looking at pictures, eye movements are recorded
- pictures of 16 masculine animals, each trial = a new pair of animals
- 32 sentences/ 8 sentences in each condition:
 - SVO. *On ...*
 - SVO. *Ego ...*
 - OVS. *On ...*
 - OVS. *Ego*
- each animal served as subject or object referent
- position of referents (verbal stimuli) and animals (picture stimuli) were counterbalanced across all items (4 different lists)
- an introduction sentence was inserted: short discourse/text
- aspect/tense were controlled for consistency



Лебедь и дельфин искупались в речке. Лебедь вытирает дельфина после купания. Он ----- поёт песню.

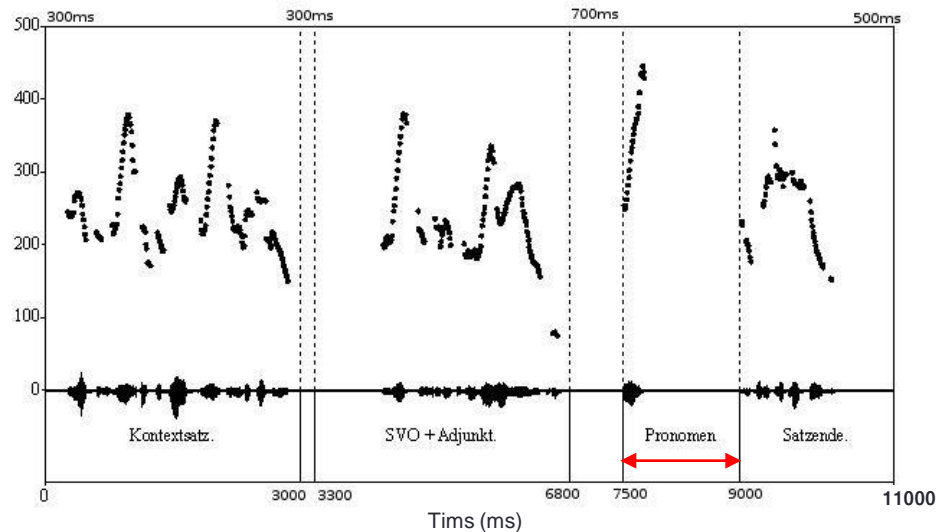
swan and dolphin has bathed in the river. swan is towelling dolphin after swimming.
he ----- is singing a song.

Interpretation of ambiguous pronouns in Russian

Auditory Stimuli:

0 – 3000 ms: introduction sentence	<i>Лебедь и дельфин искупались в речке.</i>
3300 – 6800 ms: SVO/OVS + adjunct	<i>Лебедь вытирает дельфина после купания.</i>
7500 – 9000 ms: Pronoun	<i>Он ...</i>
9000 – 11000 ms: end amb. sentence	<i>поёт песню.</i>

a pause of 1.5 sec was included after pronoun onset to measure eye movements before additional information was available

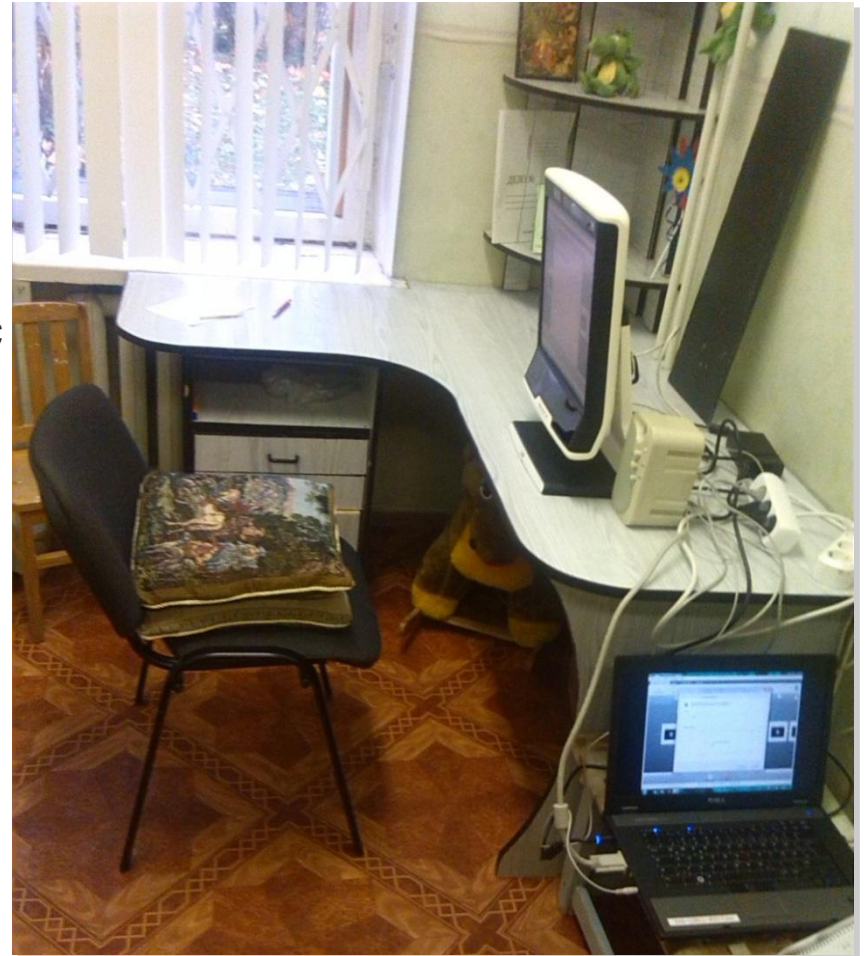


Interpretation of ambiguous pronouns in Russian

Participants:

- 20 adults (ADU)
- 27 typically developing children (TDC)
(mean: 5;5, range: 4;10-5;11)
- 18 children pre-diagnosed with specific
language impairment (SLI)
(mean: 5;3, range: 4;10-5;10)

- St. Petersburg
- Tobii Eye Tracker T60 (60 Hz)



Interpretation of ambiguous pronouns in Russian

Preliminary Results:

Log Linear Models/ Logistic Regression Analysis (vgl. Knoeferle et al. 2005)

~ Felix Golcher ~

- Data was analysed in 16 ms steps after pronoun onset (7500–11000 ms)
- Analysis was performed for each time point separately to take heavy correlation between time points into account
- From the full model (with group, word order, pronoun and all interactions) to the reduced model formula until AIC (Akaike information criterium, 1973) was minimal (BIC bayesian information criterium)

Interpretation of ambiguous pronouns in Russian

Preliminary Results:

Log Linear Models/ Logistic Regression Analysis (vgl. Knoeferle et al. 2005)

~ Felix Golcher ~

AIC (Akaike information criterium, 1973):

k-ln(L)

k – the number of the Parameters

L – the probability (Wahrscheinlichkeit) that the model reproduces the data

ln – the natural Logarithmus

AIC = <number of P> - <data probability>

Interpretation of ambiguous pronouns in Russian

Statistically significant effects across all groups:

- not at pronoun onset (group, pronoun, word order at 7500-8200 ms)
- pronoun effect at around 9000 - 9600 ms, at the end overlaid with an interaction with group; pronoun-group effect (1.5 sec after pronoun onset; on → Subject, ego → Object)
- group differences: effect was more pronounced in adults than in TDs, no effects for SLI

Adult fixations after pronoun onset

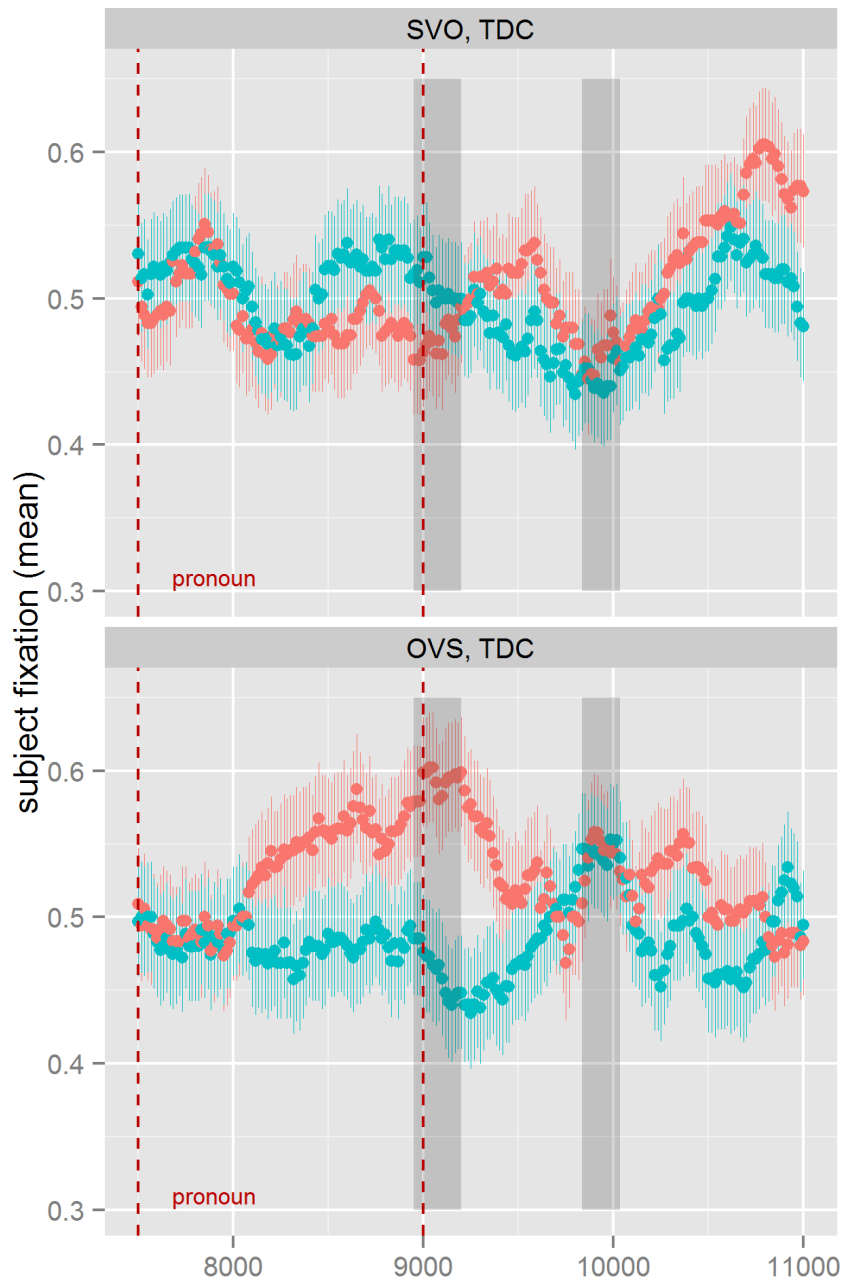


Statistically significant effects for adults:

- pronoun effect at 8950-9700 ms (after *on* participants looked at the subject referent, after *ego* – at the object referent)
- no word order effects

→ syntactic parallelism

TD-children fixations after pronoun onset

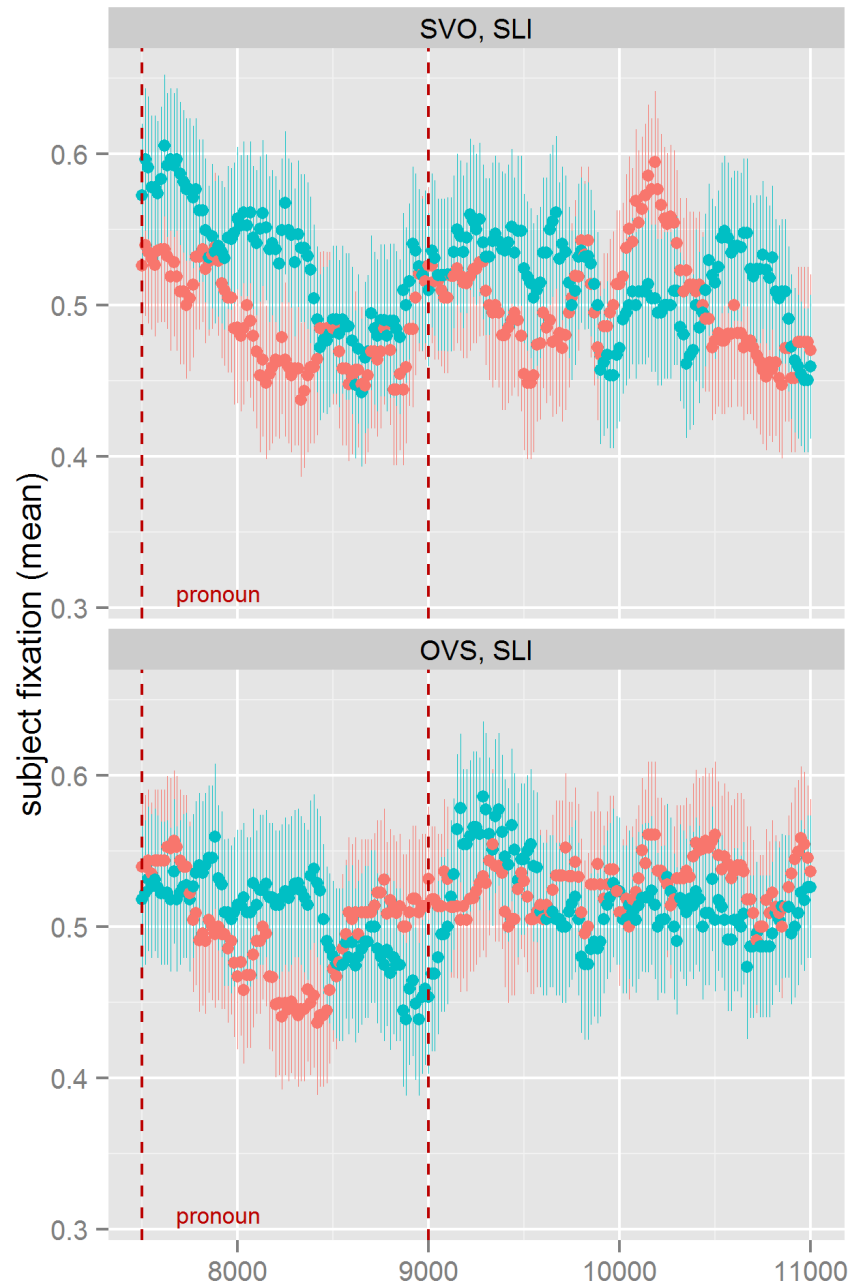


Statistically significant effects for TD children:

- word order-pronoun effect at 8950-9200 ms (pronouns differ in word order: *OVS on* → subject, *ego* → object, *SVO* no difference between *on* and *ego*)
- word order effect at 9833-10033 ms (independently of pronoun, children look at the last mentioned character after *SVO* and *OVS* sentences)

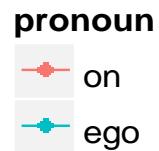
pronoun
— on
— ego

SLI-children fixations after pronoun onset



SLI children:

no statistically significant effects



Interpretation of ambiguous pronouns in Russian

Summary of preliminary results:

- until ca. 1.5 sec after pronoun onset – no preferences
- Adults:
 - Pronoun effect regardless of word order (syntactic parallelism)
 - after *on* (he) → subject referent
 - after *ego* (him) → object referent
- TD-children - different behaviour:
 - Parallelism only in non-canonical sentences (OVS)
 - at ca. 2.3 sec after pronoun onset – word order effect independently of pronoun type, children look at the last mentioned character
- SLI-children
 - no preferences

Interpretation of ambiguous pronouns in Russian: canonical and non-canonical word order

Discussion:

- adult listeners rely on grammatical information (syntactical role)
- 5 year old TD-children rely on this only in OVS (non-canonical word order)
- at a later time point TD-children show a preference for the last mentioned character (recency)
- 5 year old SLI-children - slower processing times or limited working memory capacities

~ THANKS ~

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The hare hugs the rabbit. He is white ... Who is white?

Pronominal anaphora in Russian

The hare hugs the rabbit. He is white ... Who is white?

Pronominal anaphora in Russian

F

Type of sentence	Type of subject	Type of object	Type of pronoun
A	Animate Subject	Animate Object	1. Personal 2. Demonstrative 3. Zero
B	<u>Inanimate Subject</u>	<u>Animate Object</u>	1. Personal 2. Demonstrative 3. Zero
C	<u>Inanimate Subject</u>	<u>Inanimate Object</u>	1. Personal 2. Demonstrative 3. Zero
D	<u>Animate Subject</u>	<u>Inanimate Object</u>	1. Personal 2. Demonstrative 3. Zero

L

The hare hugs the rabbit. He is white ... Who is white?
 Pronominal anaphora in Russian

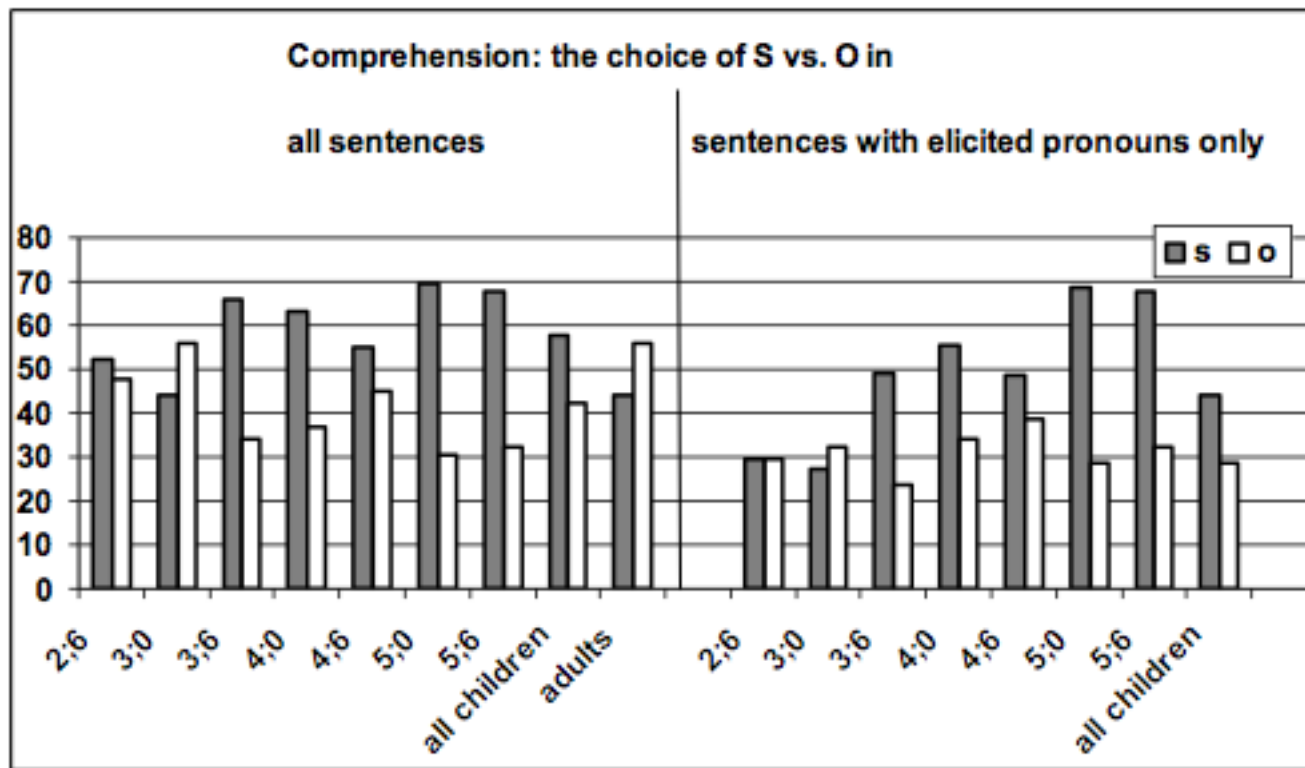


Figure 1: Resolution of anaphoric pronouns into subjects vs. objects in all data from Russian⁸

The hare hugs the rabbit. He is white ... Who is white?
 Pronominal anaphora in Russian

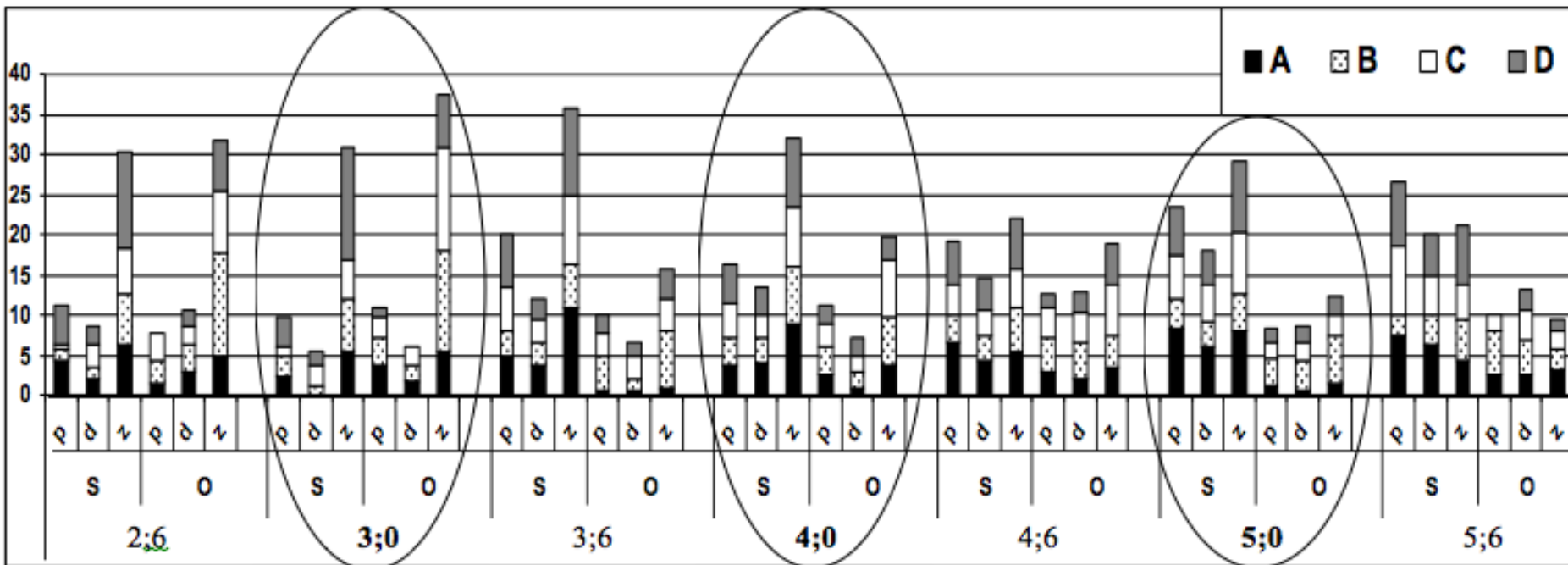


Figure 4: Resolution of anaphoric pronouns into subjects vs. objects in all data from Russian