Anaphora resolution by adult L2 speakers of English and Russian at the intermediate level of L2 proficiency

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APRAR 2021

Theoretical Motivation

This language processing study investigates

- whether native and non-native processing is sensitive to certain linguistic cues (1)
- whether the participants react to a given linguistic cue differently in their native and non-native languages (2)

Theoretical Motivation: *Linguistic Cues*

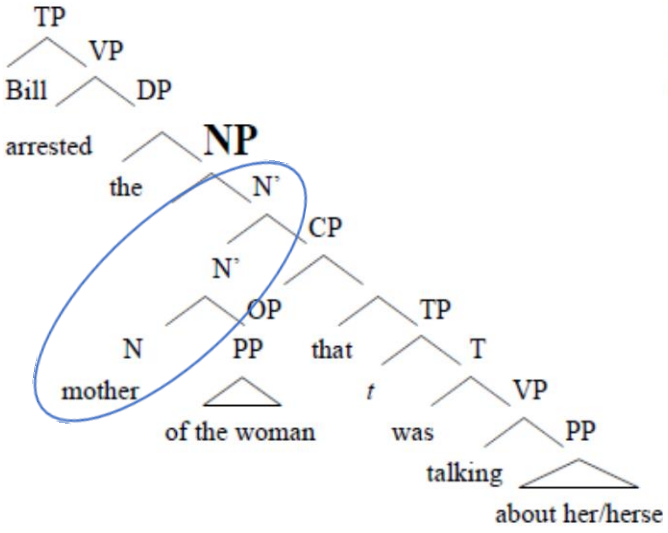
- Restrictive relative clauses (RC) whose antecedent is ambiguous can inform multiple research questions
  - Having the anaphora at the end of the RC and a perception verb in the matrix clause allows to take a closer look at the mechanisms of sentence parsing in the course of its processing

Bill *saw / arrested* the mother of the woman
[RC that was talking about *herself / her* in the yard].

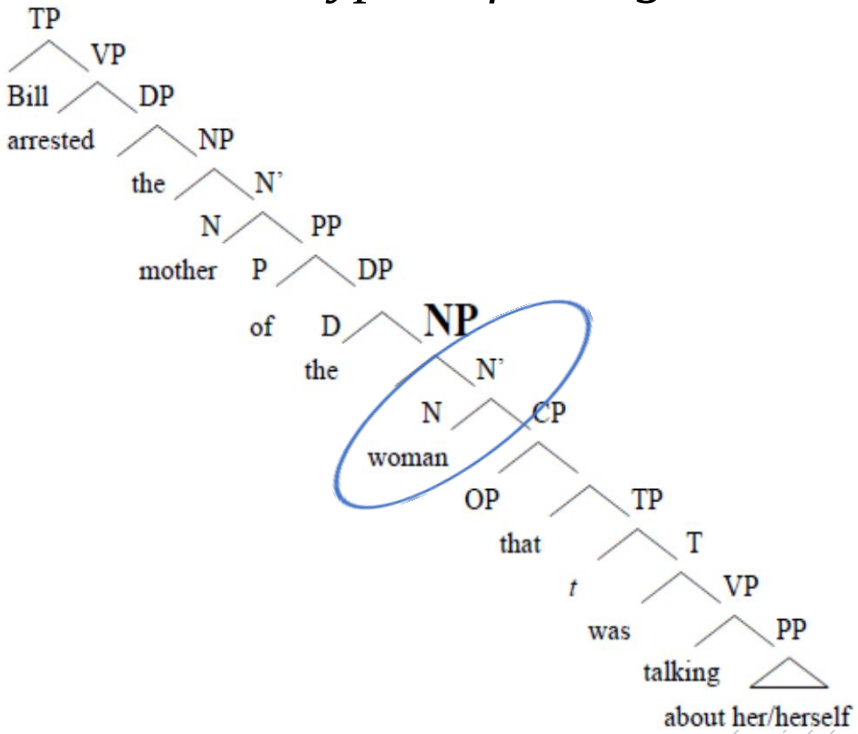
Theoretical Motivation: *Linguistic Cues*

Bill *saw* the mother of the woman [RC that was talking …].

High Attachment (HA)
typical for Russian



Low Attachment (LA)
typical for English



See Fodor, 2002 for full review

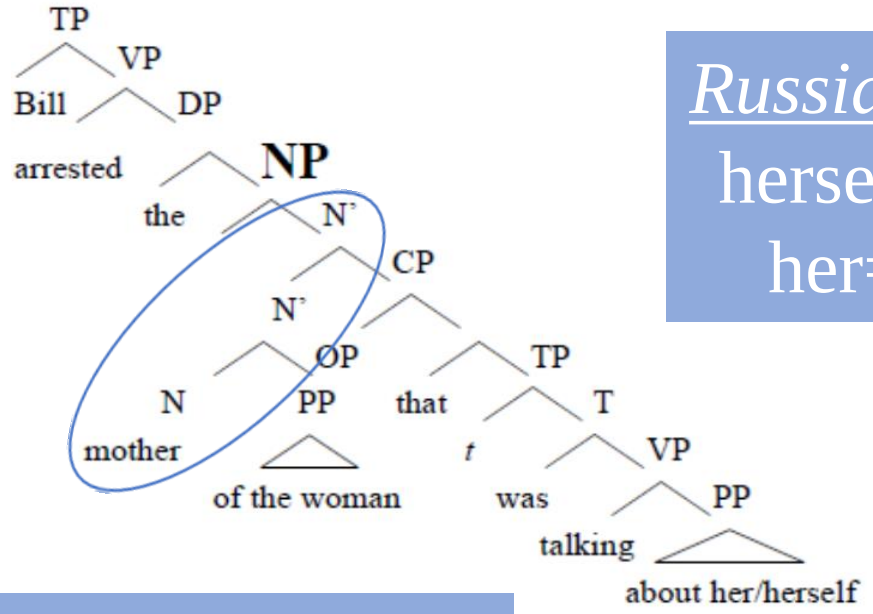
Theoretical Motivation: *Linguistic Cues*

- RC attachment defines the nearest c-commanding element for the anaphora
  - Principle A: the reflexive must be bound within its binding domain (Chomsky, 1981)
  - Principle B: the pronoun must be free within its binding domain (Chomsky, 1981)

Theoretical Motivation: *Linguistic Cues*

Bill *saw* the mother of the woman [RC that was talking …].

High Attachment (HA)
typical for Russian



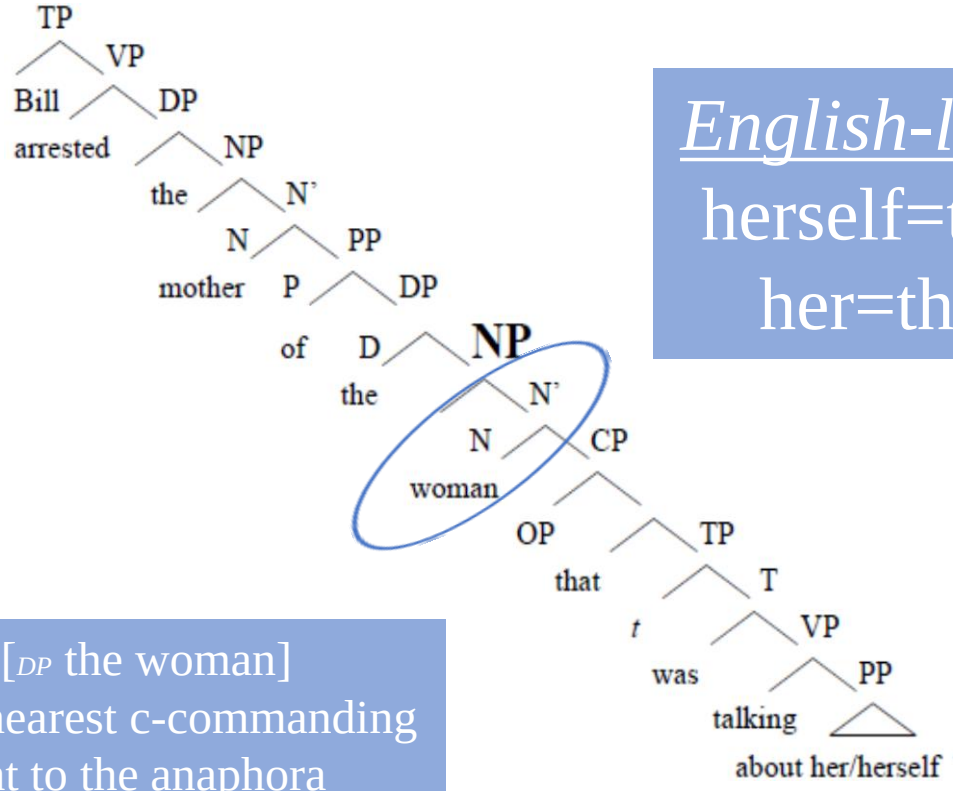
Russian-like pattern:
herself=the mother
her=the woman

[*DP* the mother of the woman] is the nearest c-commanding element to the anaphora

Theoretical Motivation: *Linguistic Cues*

Bill *saw* the mother of the woman [RC that was talking …].

Low Attachment (LA)
typical for English



English-like pattern:
herself=the woman
her=the mother

[DP the woman]
is the nearest c-commanding element to the anaphora

Theoretical Motivation: *Linguistic Cues*

Bill saw the mother of the woman that was talking about *herself / her* in the yard.

This person was talking about:
a) the mother b) the woman

Russian-like pattern:
herself=the mother
her=the woman

HA: The mother (of the woman) was talking

English-like pattern:
herself=the woman
her=the mother

LA: The woman was talking

Theoretical Motivation: *Sensitivity to Linguistic Cues*

- Anaphora resolution is a proxy for RC resolution and demonstrates cross-linguistic variation:
  - Russian-like anaphora resolution in Russian
  - English-like anaphora resolution in English

Theoretical Motivation: *Linguistic Cues*

Perception verb in the matrix clause favors HA of the RC (Grillo & Costa, 2014)

- perception verb triggers an anticipation for the eventive complement alongside the DP complement *[the mother of the woman]*

Event-related interpretation:

Bill saw – *what event* – the event of talking about cosmetics by the mother of the woman

- The eventive complement is the parser's first hypothesis (Grillo et al., 2015, Pozniak et al., 2019)

Theoretical Motivation: *Linguistic Cues*

Eventive Complement

- English and Russian:
  - Bill saw [CP **(that)** the mother of the woman was talking about…]
  - Bill videl [CP **chto** mama zhenshchiny govorila o…]

- English only:
  - Bill saw [SC the mother of the woman talking about…]

Target Sentence:

Bill saw the mother of the woman ***that*** was talking about herself / her in the yard

Theoretical Motivation: *Sensitivity to Linguistic Cues*

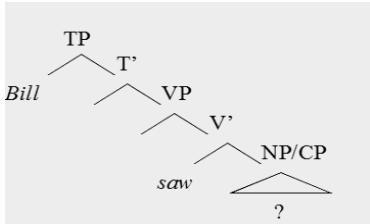
- Human parser is sensitive to selectional properties of the matrix verb
  - processing time at the embedded verb should slowdown in English
    - Bill saw the mother of the woman ***that*** was talking about herself / her in the yard
  - processing time at the embedded verb should not slowdown in Russian
    - Bill saw____the mother of the woman that was talking about herself / her in the yard

Theoretical Motivation: *Parsing Algorithms*

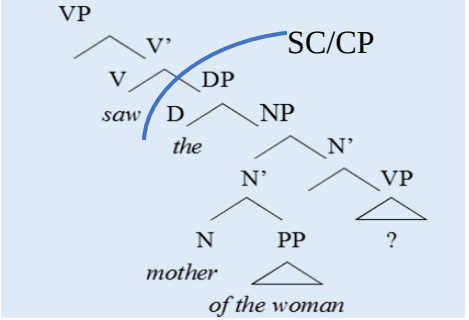
- Perception verb favors HA of the RC **only** if sentence parsing is performed in the top-down manner

Bill saw the mother of the woman that was talking about herself / her in the yard

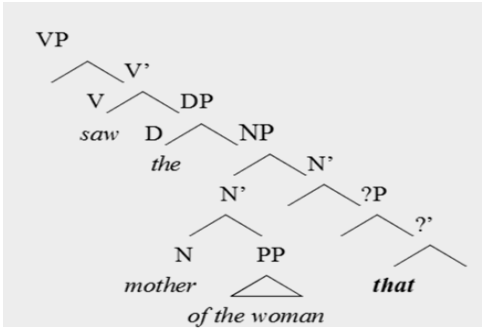
(1) Bill **saw** [**DP/CP**…]



(2) Bill **saw** [SC [**DP** [PP]] [**VP**…]]



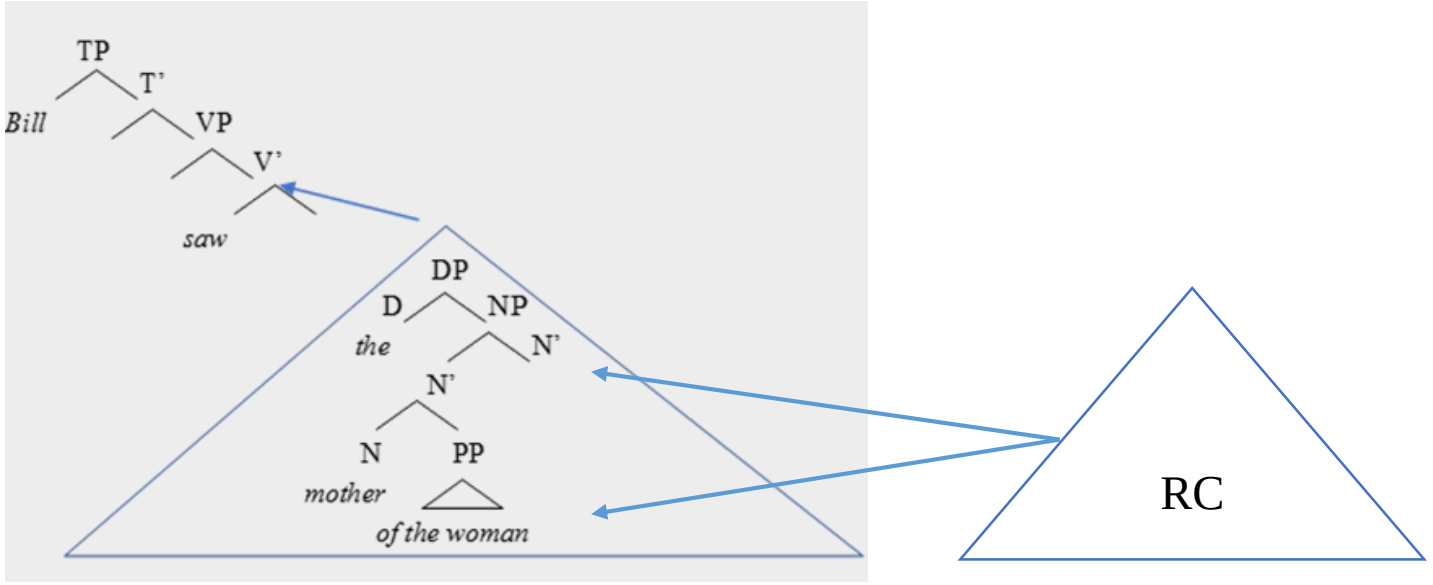
(3) Bill **saw** [DP [PP]] [?P…]



Theoretical Motivation: *Parsing Algorithms*

- Cross linguistic variation in anaphora resolution is a result of bottom-up parsing

  Bill saw the mother of the woman that was talking about herself / her in the yard



Theoretical Motivation: *Sensitivity to Linguistic Cues*

Native and Non-Native processing is sensitive to certain linguistic cues

- anaphora resolution

	English	**Russian**
Top-down ***perception verb only***	herself=the mother her=the woman	herself=the mother her=the woman
Bottom-up	herself=the woman her=the mother	herself=the mother her=the woman

- reading time at the embedded verb

	English	**Russian**
Top-down ***perception verb only***	slowdown at the embedded verb	**no** slowdown at the embedded verb
Bottom-up	no slowdown	no slowdown

Theoretical Motivation: *Sensitivity to Linguistic Cues*

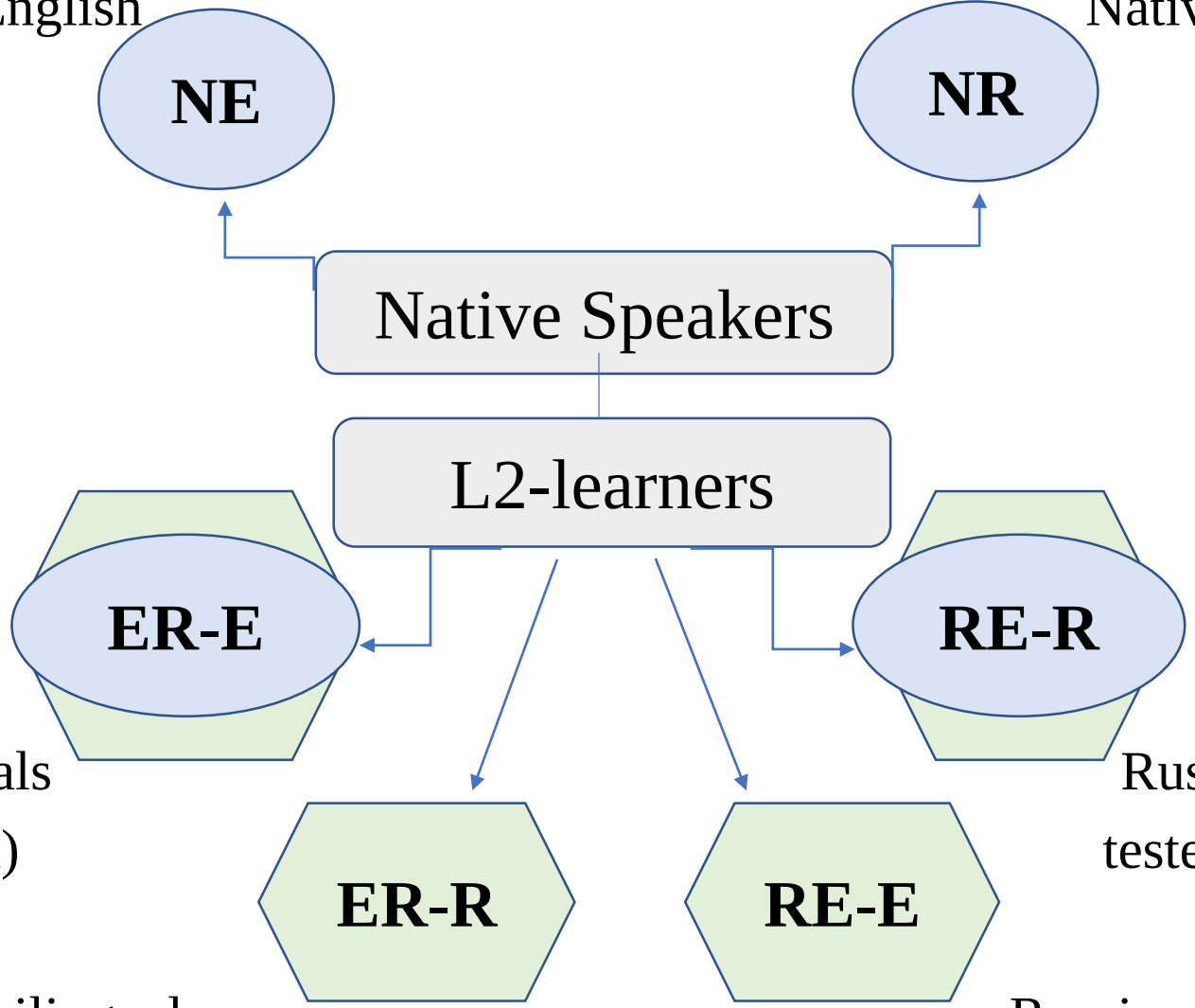
Participants react differently to a given linguistic cue in their native and non-native languages

- L2 processing shows a strong influence of L1 at the intermediate level of proficiency
  - L2 acquisition depends on "the recognition of a mismatch between the current state of syntactic knowledge, which is used in processing, and Target Language input being processed" (Dekydtspotter et al 2006, p. 35)
  - L1 remains the main parsing hypothesis while the parser is waiting for enough unambiguous input to add L2-specific norms to the Grammar (based on Fodor 1998)
- There are instances of sensitivity to salient parsing prompts typical for L2

Participants

Native speakers of English

Native speakers of Russian



English-Russian bilinguals
tested in the L1 (English)

Russian-English bilinguals
tested in the L1 (Russian)

English-Russian bilinguals
tested in the L2 (Russian)

Russian-English bilinguals
tested in the L2 (English)

Participants (2)

Proficiency Score

Group characteristic	NE n = 20	NR n = 20	ERE n = 20	ERR n = 20	RER n = 20	REE n = 20
C-test , % correct	n/a	n/a	53% (range 50)	48% (range 37)	47% (range 27)	46% (range 35)
Length of exposure to the L2	no	no	2-4 years in college	2-4 years in college	3-4 years in college	3-4 years in college
Mean age	34	34	25	26	26	24

There is no statistically significant difference between bilingual groups,

$p = .739$

Stimuli

Bill **saw** the mother of the woman *that was talking about **herself** in the yard*.

Bill **saw** the mother of the woman *that was talking about **her** in the yard*.

Bill **arrested** the mother of the woman *that was talking about **herself** in the yard*.

Bill **arrested** the mother of the woman *that was talking about **her** in the yard*.

This person was speaking about:

a) the mother *b) the woman*

Experiment: procedure

- Computerized self-paced reading task administered through a flexible platform for linguistic experiments Linger
  - read a set of sentences in a moving window presentation
    - one word appears at a time
    - press the “space” key to call a new word
  - answer a comprehension question after every sentence
    - two answer choices appear on the screen
    - press the “F” or “J” keys to choose the answer
- The program records the answers and the time a participant spends reading the word
- Statistical analysis was performed with software package R

Data Analysis

R statistics: Mixed Linear Models

- HA is a reference category

Dependent variables:

- Noun choice:
  - Pattern of anaphora resolution
- Reading Time:
  - *talking* – an effect of structural prediction

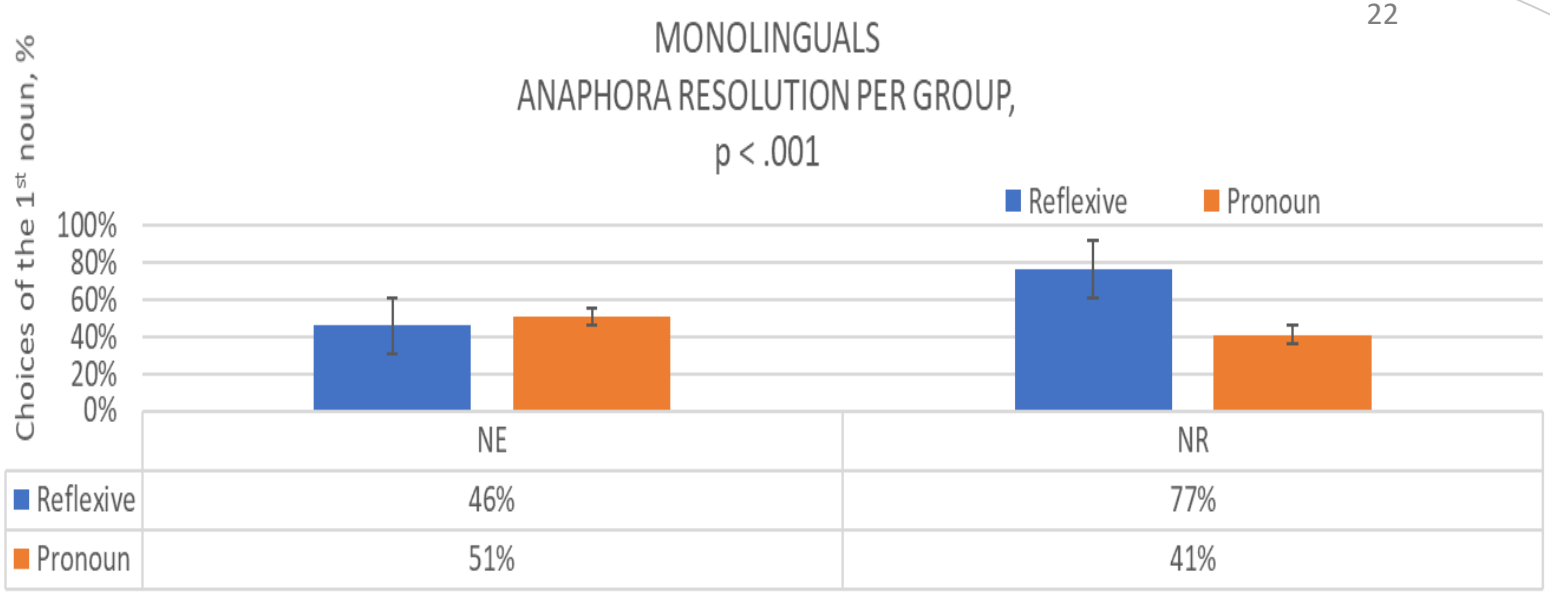
Factors:

- VerbType effect
- AnaType effect
- Group effect

Additional analysis:

- Language (of testing): RER+ERR vs. ERE+REE
- Native Language: RER+REE vs. ERE+ ERR
- Reading time at the last word yard
- Response time

Results

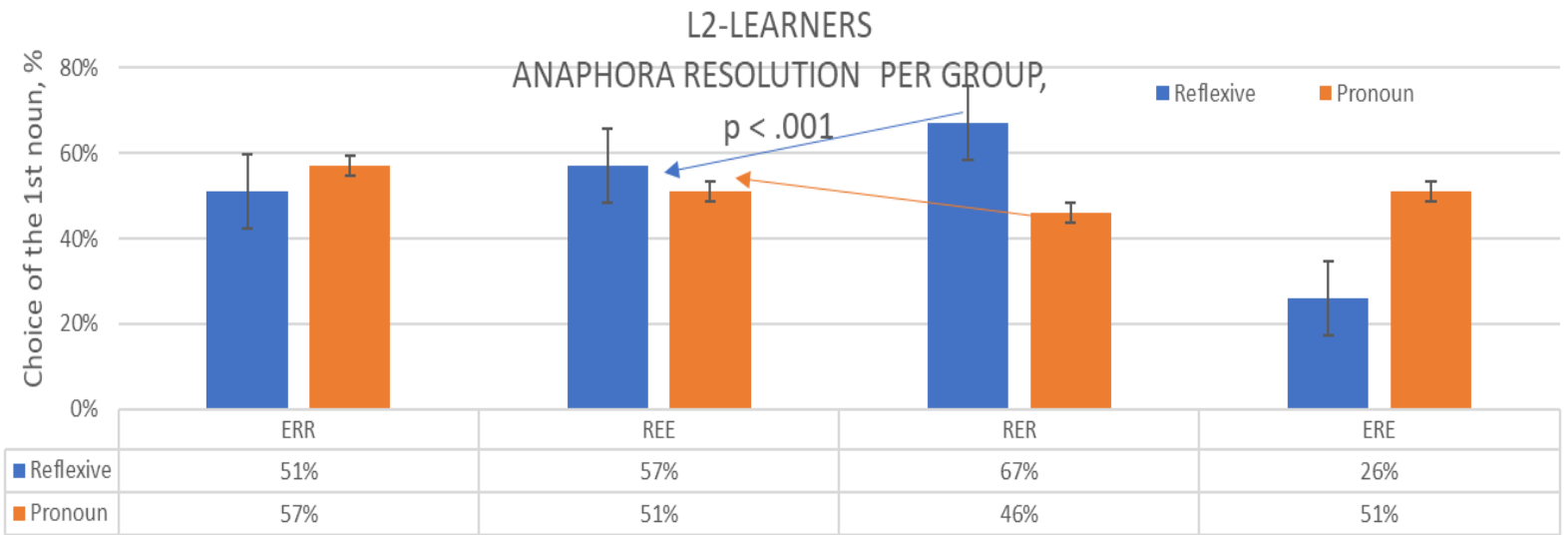


herself=the woman
her=the mother

herself=the mother
her=the woman

Verb type is significant for anaphora resolution in NE

Results



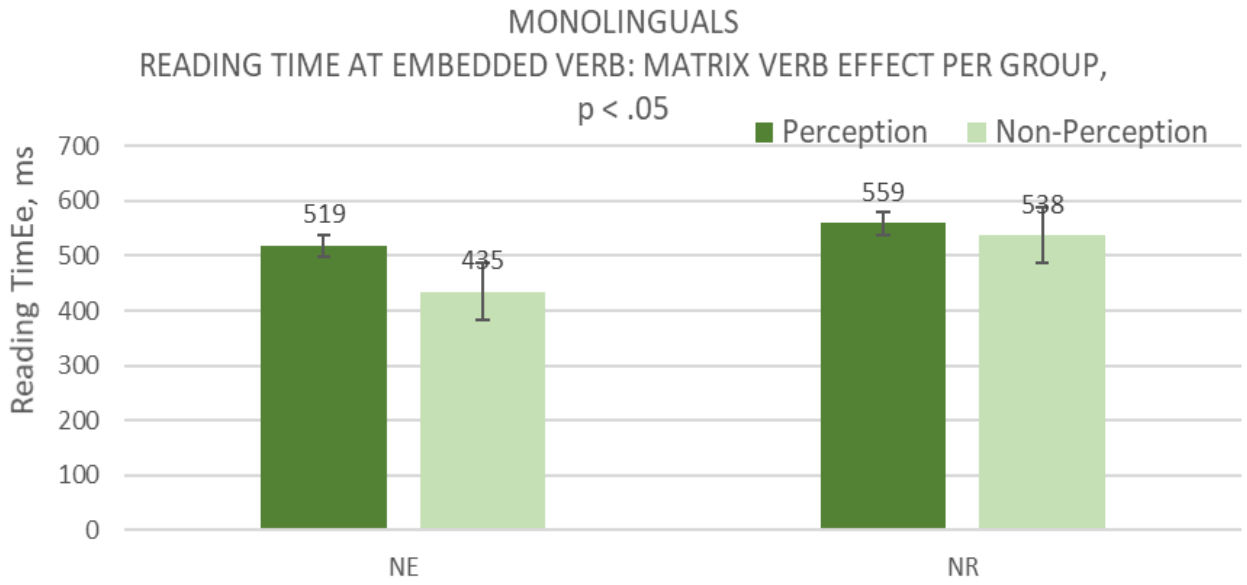
	ERR	REE	RER	ERE
Reflexive	51%	57%	67%	26%
Pronoun	57%	51%	46%	51%

English-like Russian-like English-like

L2 speakers preserve L1-like pattern of anaphora resolution

There is a tendency to switch to the target language pattern

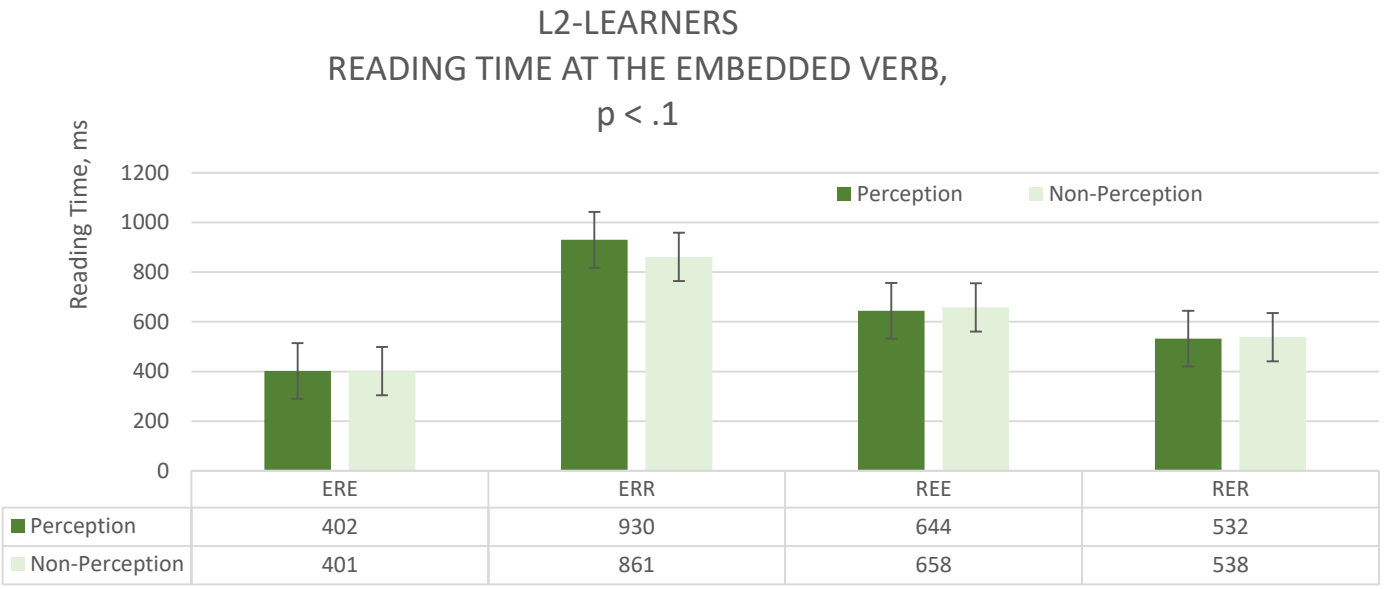
Results



English-like Russian-like

English monolinguals read the embedded verb slower when there is a perception verb in the matrix clause

Results

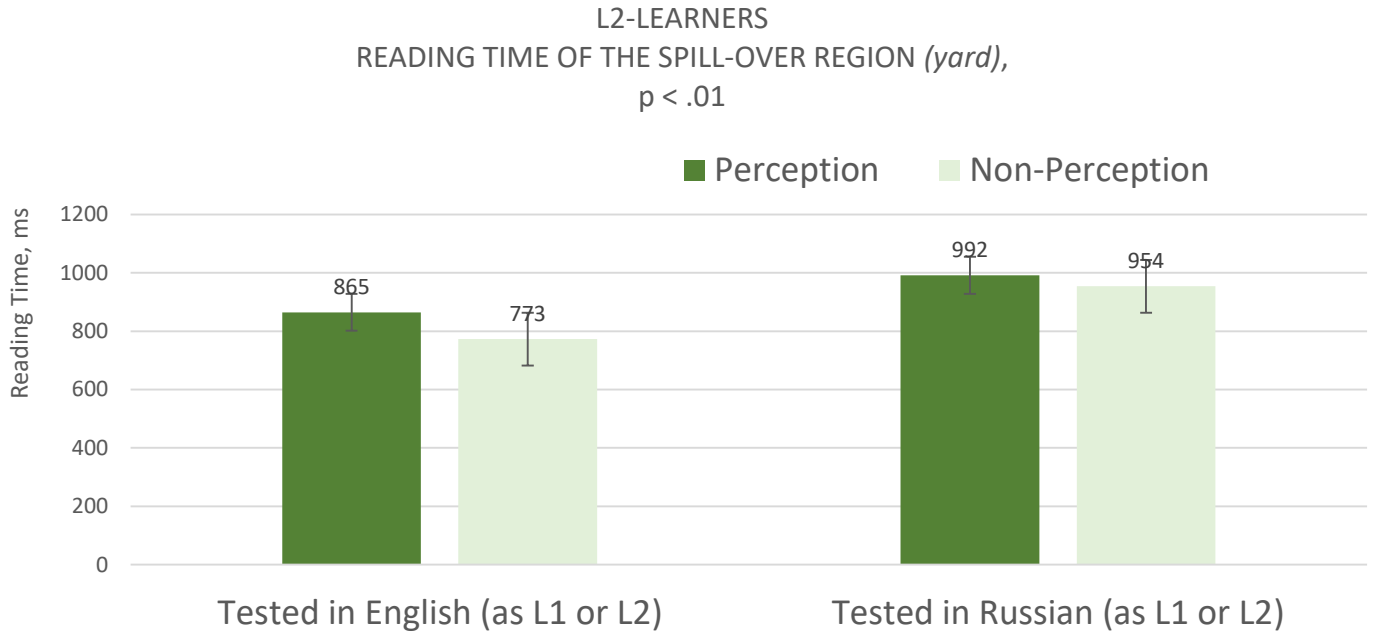


Only marginally significant

Russian-like English-like Russian-like

Group ERE (tested in their L1 English) demonstrate Russian-like absence of processing effects of a perception verb

Results



English-like

Russian-like

Participants tested in English, be it their L1 or L2 demonstrate English-like sensitivity to the effect of a perception verb

- Language (of testing): RER+ERR vs. ERE+REE

Summary of Results

Native processing is sensitive to certain linguistic cues

- anaphora resolution

	English	**Russian**
Top-down *perception verb only*	herself=the mother her=the woman	herself=the mother her=the woman
Bottom-up **confirmed but PercV in English**	herself=the woman her=the mother	herself=the mother her=the woman

- reading time at the embedded verb

	English	**Russian**
Top-down *perception verb only* **confirmed**	slowdown at the embedded verb	**no** slowdown at the embedded verb
Bottom-up	no slowdown	no slowdown

Summary of Results

Non- Native processing is sensitive to certain linguistic cues

anaphora resolution

	English	**Russian**
Top-down *perception verb only*	herself=the mother her=the woman	herself=the mother her=the woman
Bottom-up **confirmed** **L1-like in L2**	herself=the woman her=the mother	herself=the mother her=the woman

reading time at the embedded verb

	English	**Russian**
Top-down *perception verb only* **confirmed** **L1-like except for ERE**	slowdown at the embedded verb **TL-like at the last word**	**no** slowdown at the embedded verb **TL-like at the last word**
Bottom-up	no slowdown	no slowdown

Discussion

Native and Non-native processing is sensitive to certain linguistic cues (1)

- Top-Down and Bottom-Up parsing complement each other
  - anaphora resolution demonstrates cross-linguistic variation (bottom-up parsing)
  - reading time at the embedded verb is affected by a perception verb in English (top-down parsing)
  - perception verb preserves is effect till the end of the sentence in English (additional support for top-down)

Discussion

Participants react to a given linguistic cue differently in their native and non-native languages (2)

- L2 parsing is predominantly L1-like
  - anaphora resolution demonstrates L1-like cross-linguistic variation (bottom-up parsing)
  - reading time at the embedded verb is not affected by a perception for native speakers of Russian (top-down parsing)
  - reading time at the embedded verb is affected by a perception for 50 % native speakers of English (top-down parsing, *loss of L1-like parsing*)
  - perception verb preserves is effect till the end of the sentence in English, be it L1 or L2 (additional support for top-down, *developing TL-like parsing*)

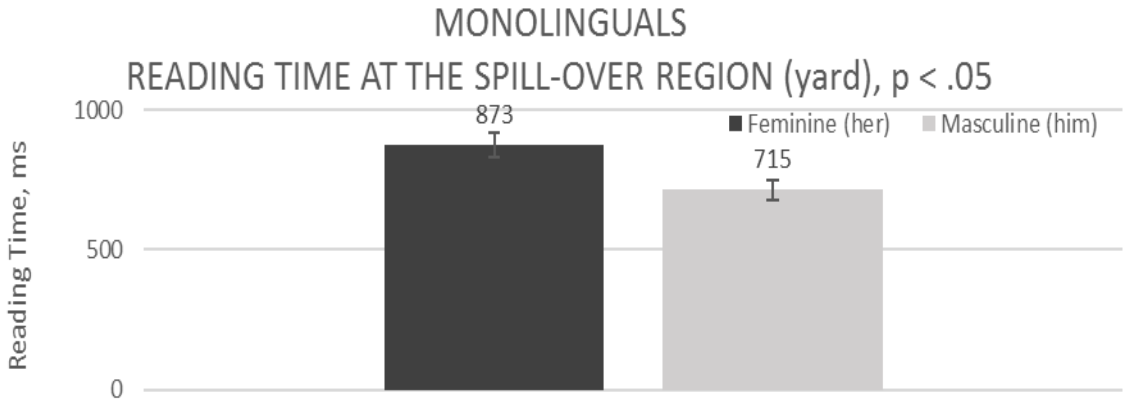
Conclusion

Human sentence parsing, native and non-native, relies on the combination of top-down and bottom-up strategies

- Sentence processing begins with a top-down structural prediction.
- This prediction is subject to regular bottom-up checks.
- If the incoming constituent causes a structural conflict, the structure is amended.
- A new projection is generated, the cycle repeats.


Thank
you

General Complexity: Additional Evidence

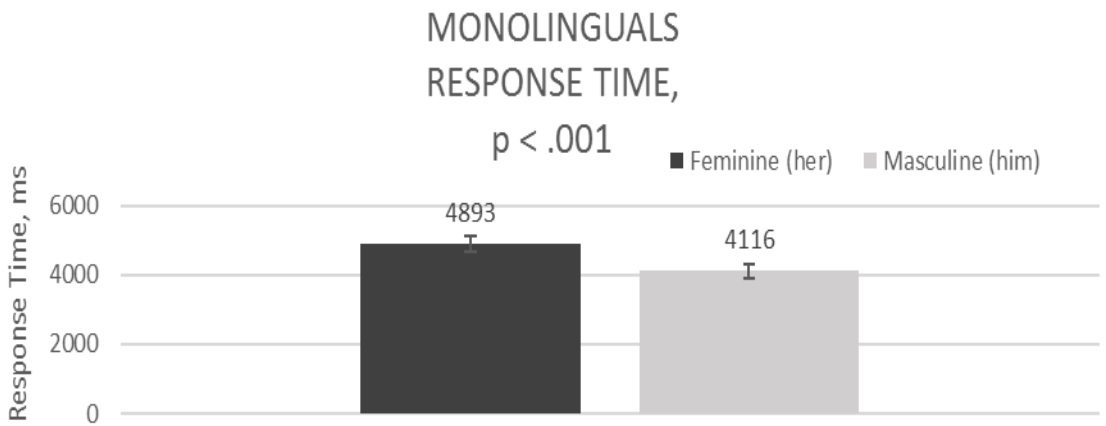


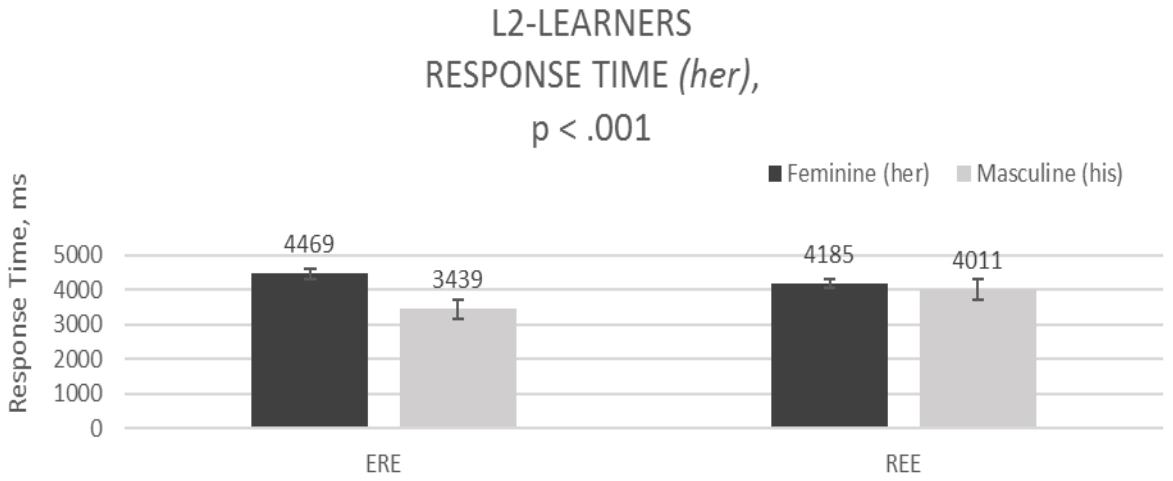
The feminine pronoun *her* triggers a structural prediction for a possessive phrase, which creates temporal structural ambiguity

The possessive phrase is disregarded at the level of the preposition *in (in the yard)*

The feminine pronoun *her* is an English-specific effect: homonymy with the possessive pronoun *her*

L2 speakers of English are sensitive to the effect of the pronoun *her*





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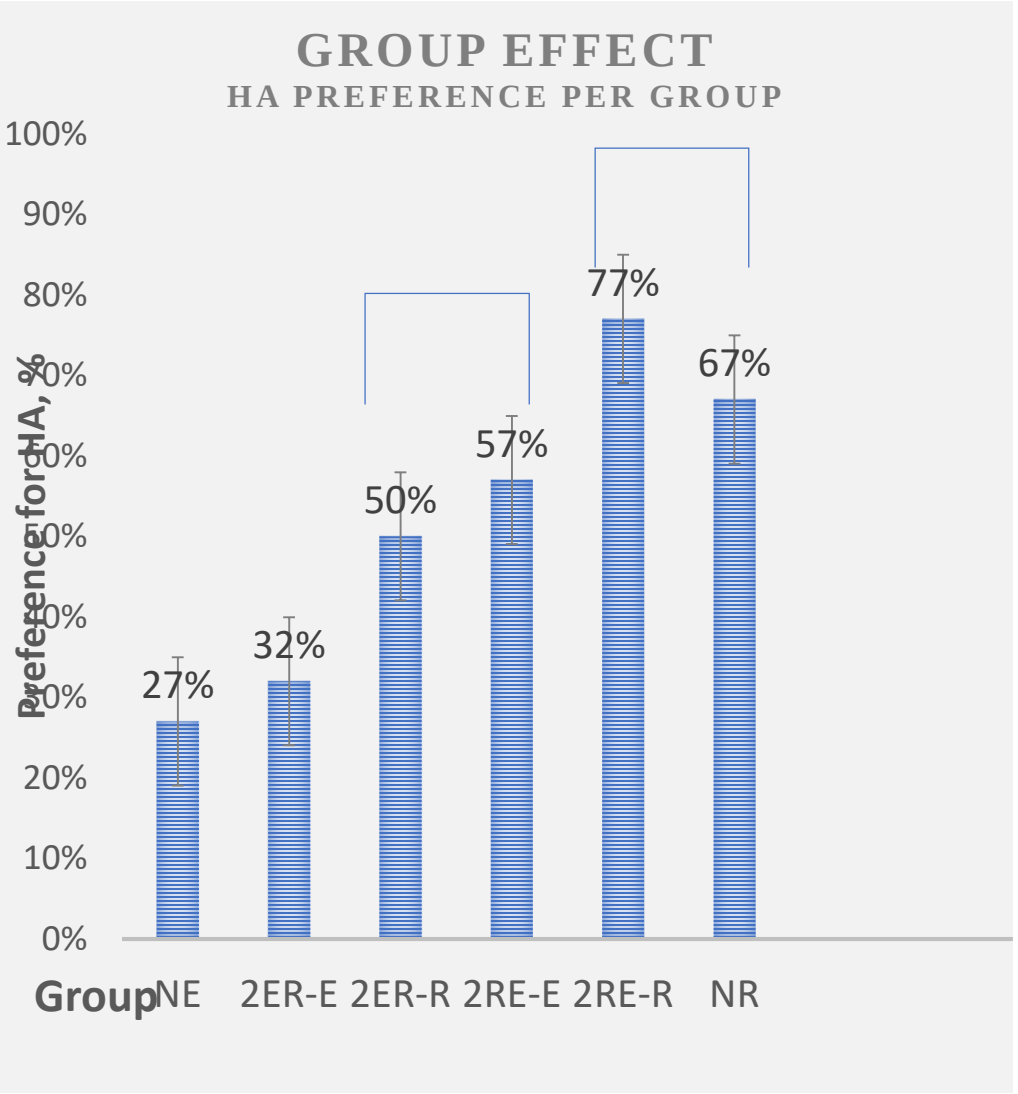

Current