

Pronouns over gaps in parsing?

Relative clause processing in Santiago Laxopa Zapotec

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The subject gap advantage

SUBJECT-GAP ADVANTAGE (SGA): the language processor prefers subject gaps to non-subject gaps.

E.g.:

SUBJECT RELATIVE CLAUSES (SRCs) are easiest to process in unambiguous relative clauses.

- (1) The reporter [_{RC} who __ attacked the senator] disliked the editor. SRC
- (2) The reporter [_{RC} who the senator attacked __] disliked the editor. ORC

The subject gap advantage

...And ambiguous RCs give rise most readily to
SRC interpretations.

Frazier (1987)

Verb-initiality and SGA

The SGA has been observed in a few studies of
verb-initial languages (V1):

- Ch'ol, Q'anjob'al (Mayan)
- Chamorro, Tagalog, Niuean* (Austronesian)

In many instances, there are morphological means to create unambiguous RCs, such as **case marking** on the noun and
verbal morphology

Mayan: Clemens, Coon, Mateo Pedro, Morgan, Polinsky, Tandet, & Wagers (2015); **Chamorro:** Wagers, Borja, & Chung (2018); and **Tagalog:** Pizarro-Guevara (2014), Pizarro-Guevara & Wagers (2018); **Niuean:** Polinsky & Longenbaugh (2016), cf. Tollan & Heller (2018)

Today

We investigated **Santiago Laxopa Zapotec (SLZ)**,
a V1 language **without visible case or agreement.**

SLZ thus presents:

- a strong test case for SGA, in the absence of morphological information
- a window into what else speakers might recruit as a cue in the absence of case and agreement

Results (Preview)

We found that SLZ comprehenders:

- **show the SGA for ambiguous RCs**
= a consistent preference to interpret as SRCs
- **prefer to interpret a subject pronoun as a resumptive pronoun (RP)**
instead of positing a gap in object position
- **show great variation with (optional) object RPs**



Essential features of Santiago Laxopa Zapotec



Features in preview

1. **Rigidly VSO:**

V - N - N is unambiguous

2. **Movement creates ambiguity:**

N - V - N: gap in SUBJ or OBJ position

3. There are **resumptive pronouns** (RPs)

- which look like regular pronouns:
- ... SUBJ pronouns obligatorily cliticize on verb
- ... OBJ pronouns cannot cliticize across NP subject
- therefore, **can potentially disambiguate**

① Rigid VSO word order

SLZ is rigidly **VSO** (like other Zapotec languages).

	Verb	Subject	Object
(4)	Tsyill <i>pinch.CONT</i>	bene' nu'ulhe=nh <i>CL</i> <i>woman=DEF</i>	bene' xyage'=nh. <i>CL</i> <i>man=DEF</i>

‘The woman is pinching the man.’

NOT ‘The man is pinching the woman.’

② Movement creates ambiguity

Movement to the left \rightsquigarrow **AMBIGUITY**

E.g., in **focus position**

	Subject or Object	Verb	Subject or Object
(5)	Bene' nu'ulhe=nh <i>CL woman=DEF</i>	tsyill <i>pinch.CONT</i>	bene' xyage'=nh. <i>CL man=DEF</i>

'THE WOMAN is pinching the man.'

OR 'The man is pinching THE WOMAN.'

Schematized

N V — NP **Subj_{Foc}**
N V NP — **Obj_{Foc}**

② Movement creates ambiguity

Or, in **relative clauses** (RCs)

	Head noun		Relative clause
(6)	Shlhe'eyd=a' bene' nu'ulhe=nh <i>see.CONT=1SG CL woman=DEF</i>	tsyill <i>pinch.CONT</i>	bene' xyage'=nh. <i>CL man=DEF</i>

'I see the woman that __ is pinching the man.'

OR 'I see the woman that the man is pinching __.'

Schematized



③ Pronouns

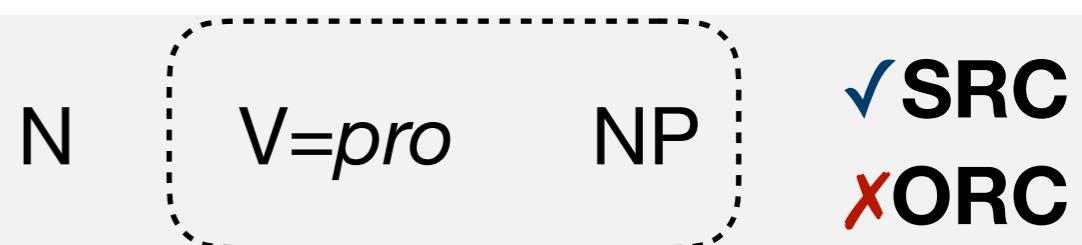
Resumptive pronouns (RPs) can eliminate ambiguity.

	Head noun	Relative clause
(7)	Shlhe'eyd=a' bene' nu'ulhe=nh <i>see.CONT=1SG CL woman=DEF</i>	tsyill=e' bene' xyage'=nh. <i>pinch.CONT=3EL CL man=DEF</i>

'I see the woman that she is pinching the man.'

~~'I see the woman that the man is pinching her.'~~

Schematized



③ Pronouns

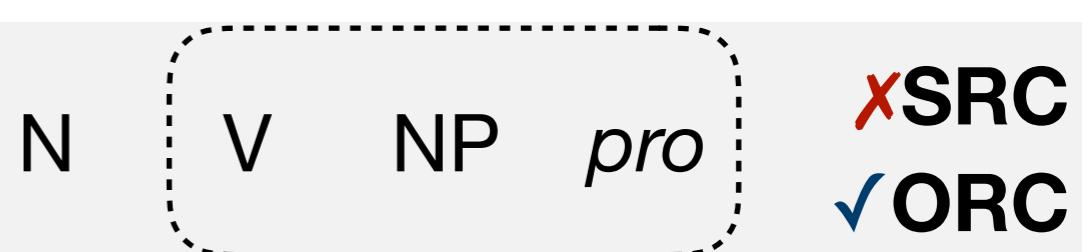
RP_s can eliminate ambiguity.

	Head noun	Relative clause	
(8)	Shlhe'eyd=a' bene' nu'u'lhe=nh <i>see.CONT=1SG CL woman=DEF</i>	tsyill <i>pinch.CONT CL</i>	bene' xyage'=nh le'. <i>man=DEF 3EL</i>

'I see the woman that she is pinching the man.'

'I see the woman that the man is pinching her.'

Schematized



③ Pronouns

Pronouns(/RPs) encode animacy and person but are **invariant for grammatical relation**.

Table 1: 3rd PERSON pronoun inventory

	Clitic	Strong	
$3_{EL}(DER)$	$=(n)e'$	le'	 Source of disambiguation
$3_{HU}(MAN)$	$=ba'$	$leba'$	Subject pronouns must cliticize.
$3_{AN}(IMAL)$	$=(e)b$	leb	Object pronouns cannot cliticize across R-expressions; they are realized as strong.
$3_{IN}(ANIMATE)$	$=(e)nh$	$lenh$	

Toosarvandani (2017), Sichel & Toosarvandani (2018)

③ Pronouns

RPs can't eliminate ambiguity in the absence of an R-expression co-argument.

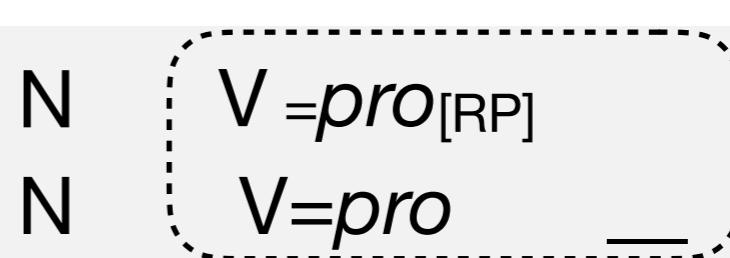
	Head noun	Relative clause
(10)	Shlhe'eyd=a' bene' nu'ulhe=nh	tsyill=e'. <i>pinch.CONT=3EL</i>

see.CONT=1SG CL woman=DEF

'I see the woman that **she_{RP}** is pinching (*someone/something*).'

OR 'I see the woman that s/he is pinching ____.'

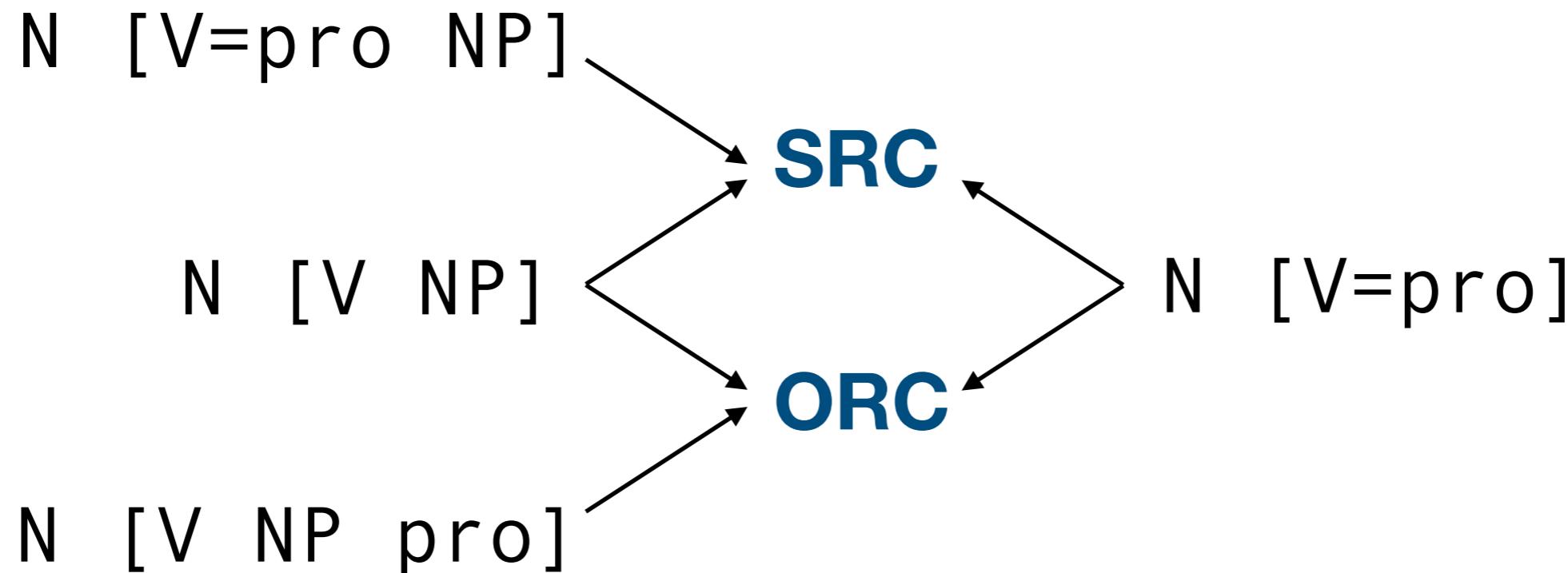
Schematized



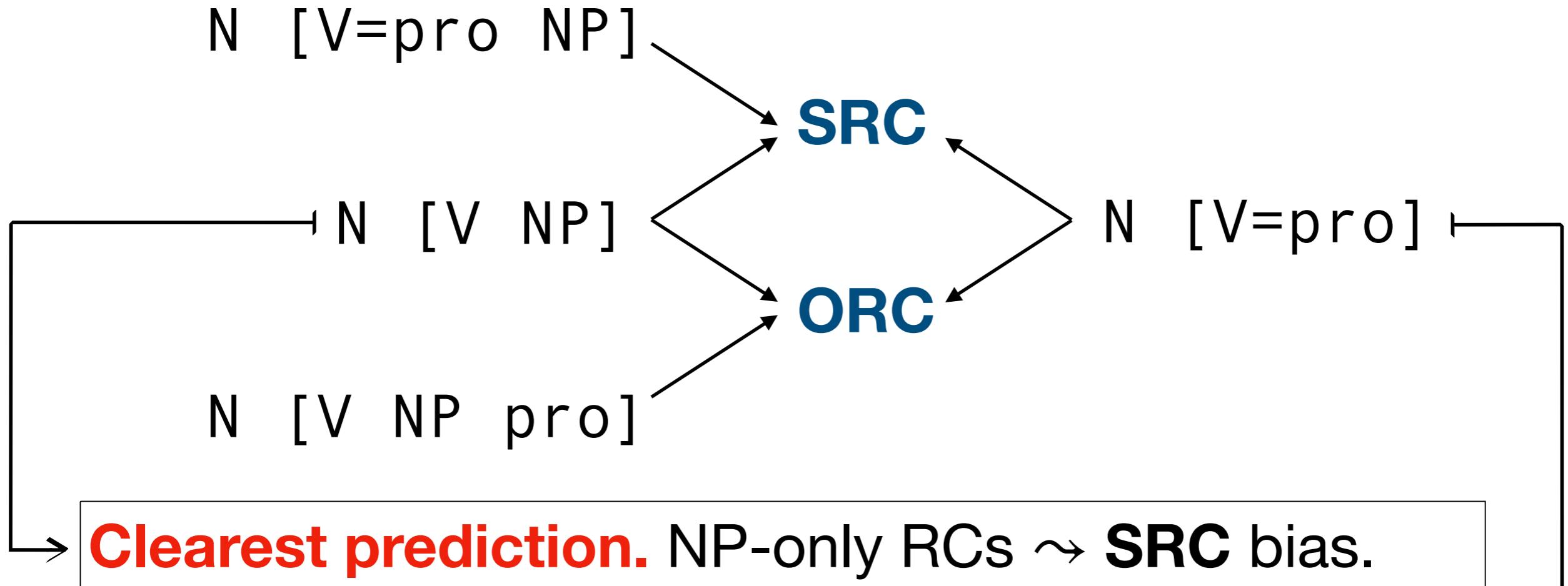
SRC
ORC

Features, recapped

1. **Rigidly VSO:** V-N-N is unambiguous
2. **Movement creates ambiguity:**
N-V-N: gap in SUBJ or OBJ position
3. **Resumptive pronouns** (RPs) can disambiguate.



Subject gap advantage in SLZ?



Less-clear prediction.

Will speakers prefer a **subject RP > object gap**?

SRC: ✓ local ✗ pronoun ✗ null indefinite object

ORC: ✗ non-local ✓ gap ✗ req. discourse antecedent

Experiment design

Design

1. **Picture matching + auditory presentation**
on tablet computers
2. **Trial structure**
scene setting + carrier phrase + critical RC

Trial structure



(11) Ni ze tu bez=e'nh na tu beku'=nh.

here is one fox=DEF and one dog=DEF

‘Here is a fox and a dog.’

Schematized

“Here is one N and one N.”



Trial structure

Scene setting

Carrier phrase

+
N-RC

(12) Bta belhje'=nh ga shlhe'eyd=u'...
move.comp star=DEF where see.CONT=2SG

‘Move the star to the place where you see...’



Schematized

Move the [STAR/LEAF/] to the
place where you see...

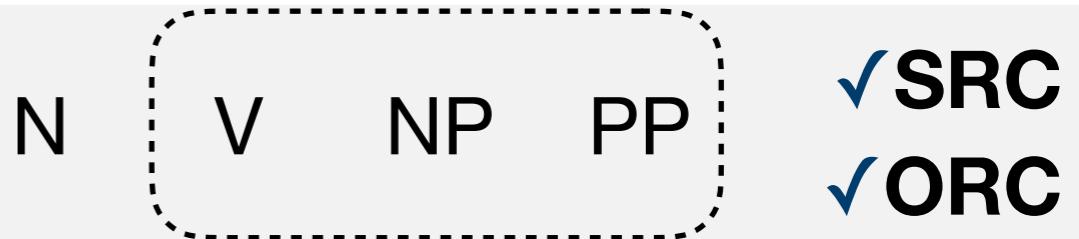
Trial structure

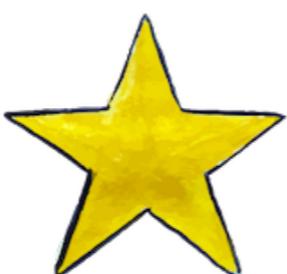
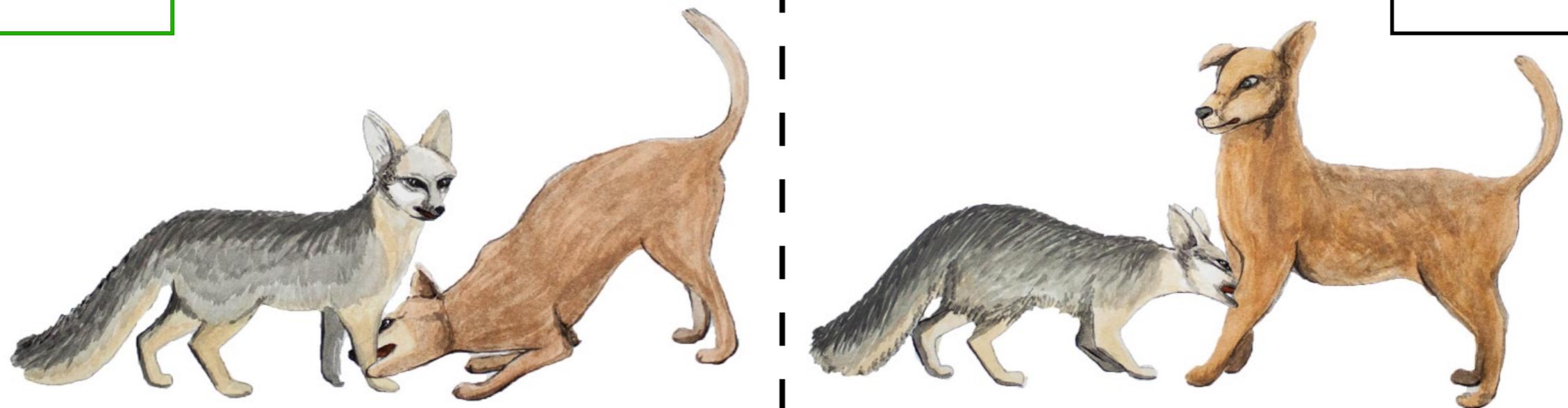
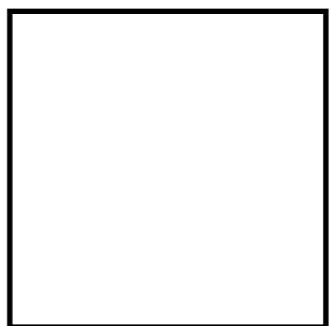
Scene setting

Carrier phrase
+
N-RC

- (13) bez=e'nh tsyi'in **beku'=nh** xhan yage'=nh.
fox=DEF *bite.CONT* *dog=def* *under* *tree=DEF*
'the fox that __ is biting the dog under the tree.'
'the fox that the dog is biting __ under the tree.'

Schematized





Design

1. **Picture matching + auditory presentation**
on tablet computers
2. **Trial structure**
scene setting + carrier phrase + critical RC
3. **Conditions:** 4 argument realizations

Conditions

Table 2: Summary of experimental conditions and their possible interpretations

Condition	Schema	Possible interpretations
NP only	N [V NP PP]	SRC and ORC
Pro-only	N [V= <i>pro</i> PP]	SRC and ORC
NP + subj. pro	N [V= <i>pro</i> NP PP]	SRC only
NP + obj. pro	N [V NP <i>pro</i> PP]	ORC only

※ **Full design: Argument realization (4) × Classifier (2)**

Optional classifier (≈relative pronoun?) at left edge of RC.

There was no effect of classifier, so we (mostly) omit from discussion.

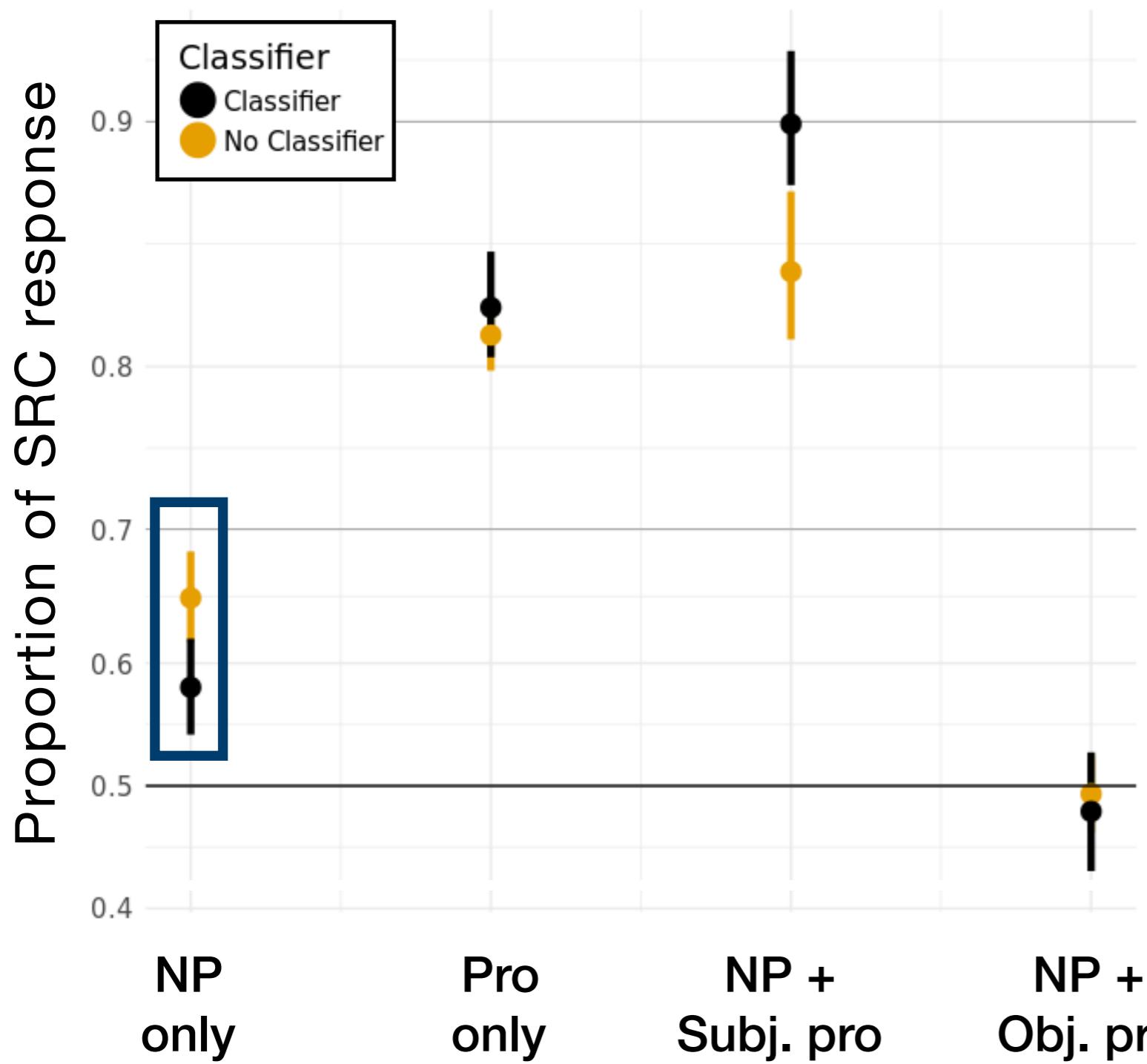
Design

1. **Picture matching + auditory presentation**
on tablet computers
2. **Trial structure**
scene setting + carrier phrase + critical RC
3. **Conditions:** 4 argument realizations
4. **Participants:**
105 speakers living in Santiago Laxopa, ages 18-78

Results

Results

SRC Proportion



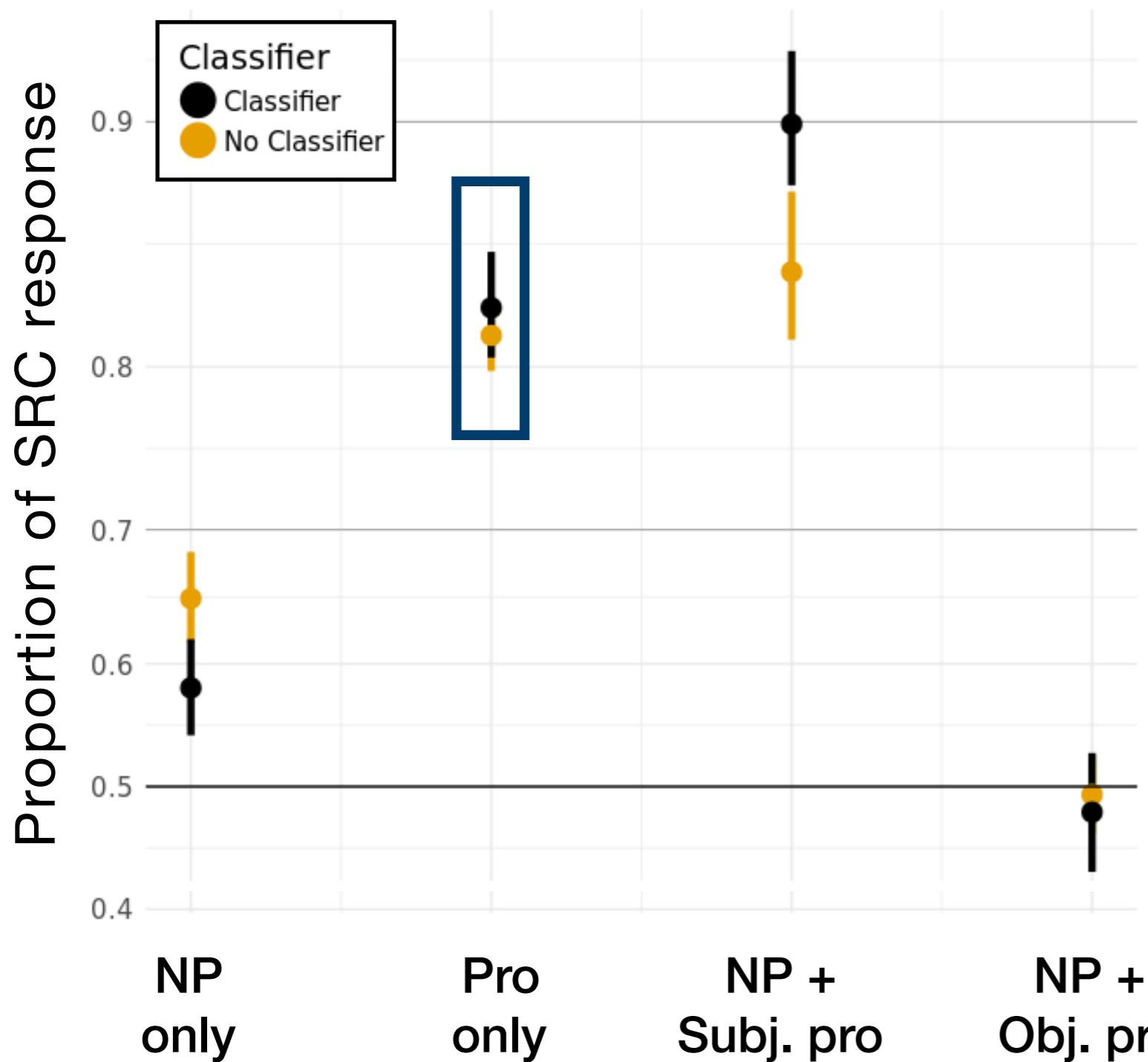
Condition	Schema	Possible interpretations
NP only	N [VP NP PP]	SRC and ORC
Pro-only	N [VP=pro PP]	SRC and ORC
NP + subj.	N [VP=pro NP PP]	SRC only
NP + obj. pro	N [VP NP pro PP]	ORC only

NP-only

This **ambiguous** RC
showed a SRC bias
(62% ± 3%)
– weak but significant

Results

SRC Proportion

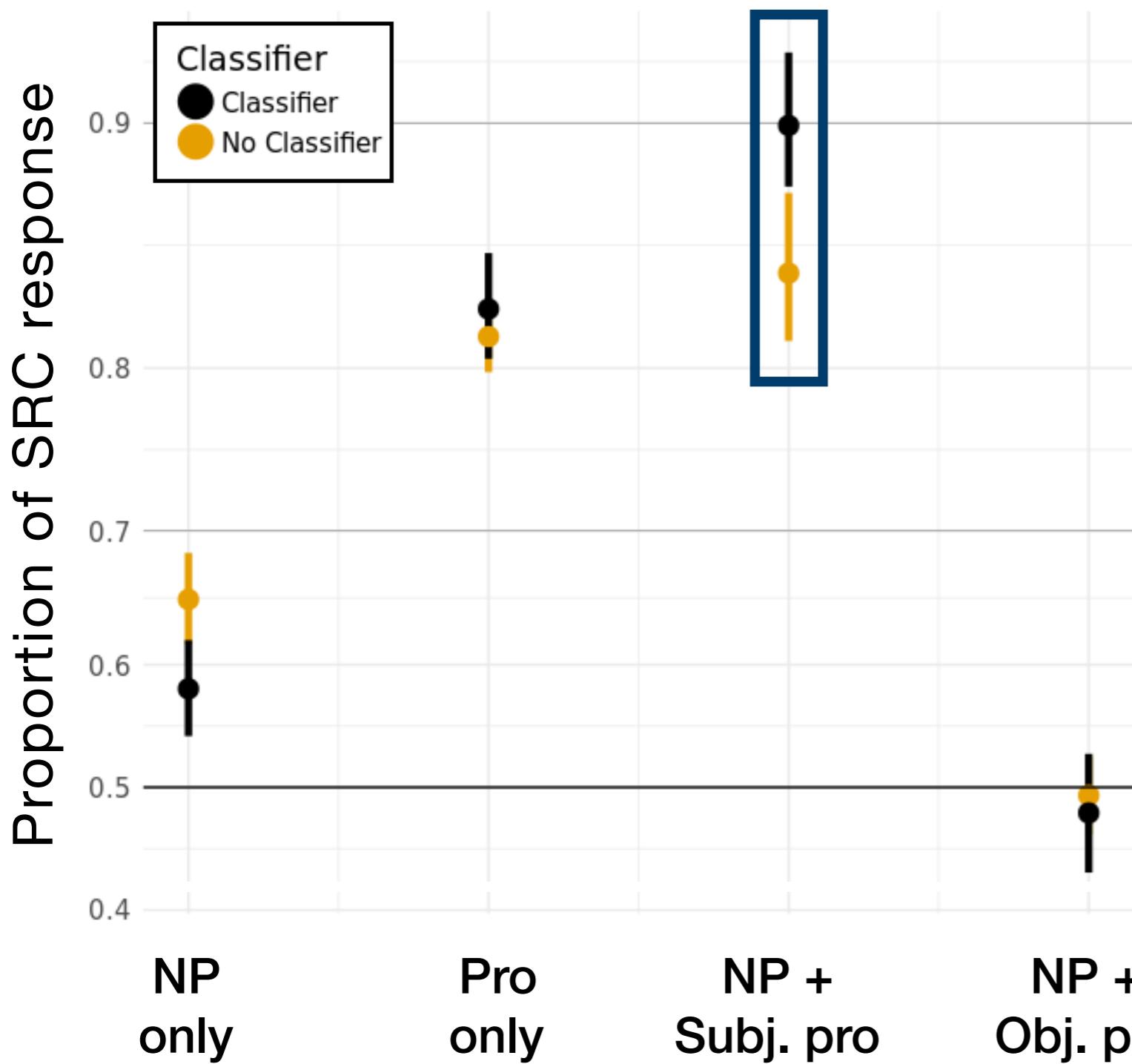


Condition	Schema	Possible interpretations
NP only	N [VP NP PP]	SRC and ORC
Pro-only	N [VP=pro PP]	SRC and ORC
NP + subj.	N [VP=pro NP PP]	SRC only
NP + obj. pro	N [VP NP pro PP]	ORC only

Pronoun-only
This **ambiguous** RC,
had a **high** SRC bias
(82% ± 2%)

Results

SRC Proportion



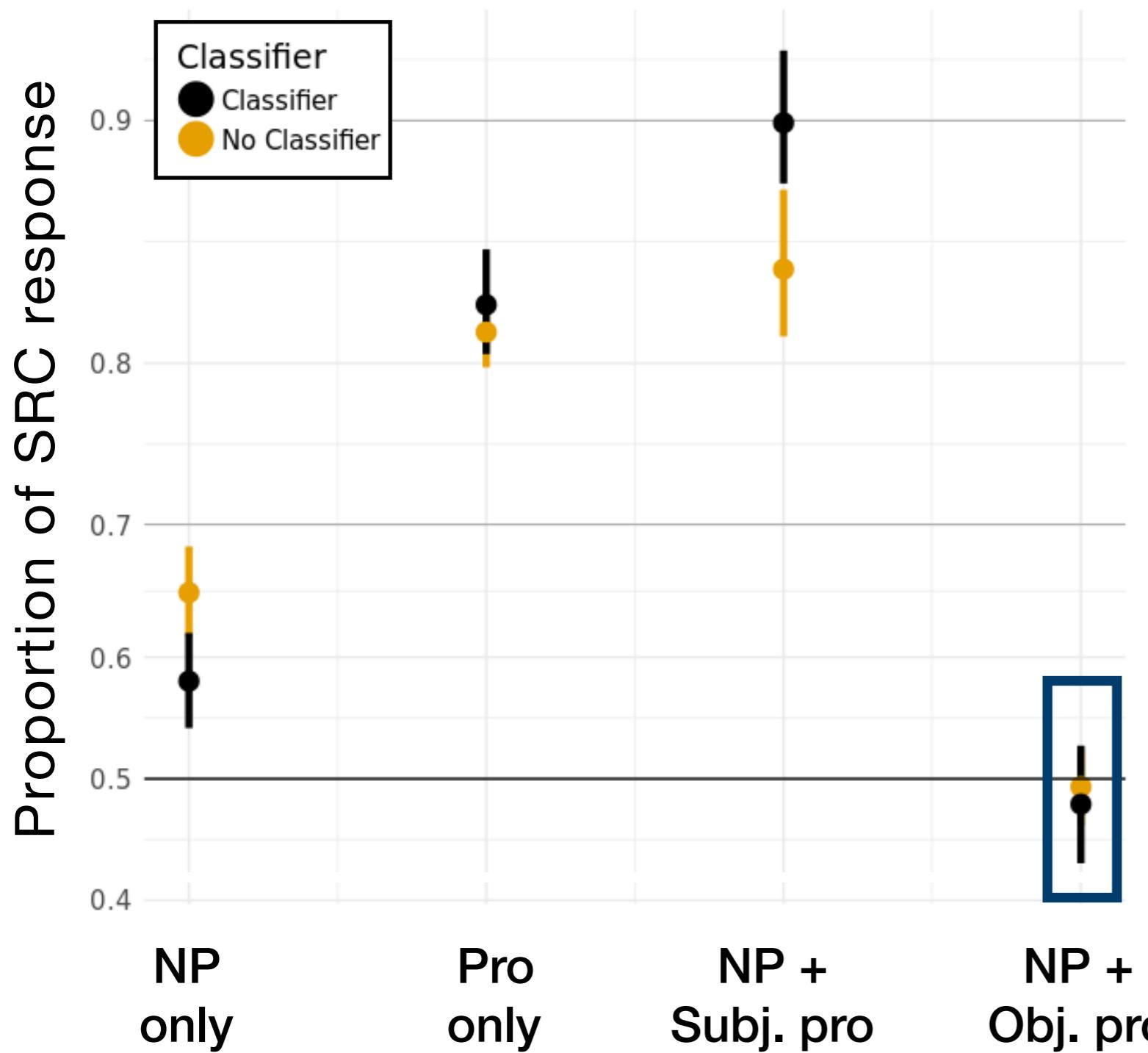
Condition	Schema	Possible interpretations
NP only	N [VP NP PP]	SRC and ORC
Pro-only	N [VP=pro PP]	SRC and ORC
NP + subj.	N [VP=pro NP PP]	SRC only
NP + obj. pro	N [VP NP pro PP]	ORC only

NP + Subj pronoun

This unambiguous RC had the highest SRC rate (**87% ± 2%**)

Results

SRC Proportion

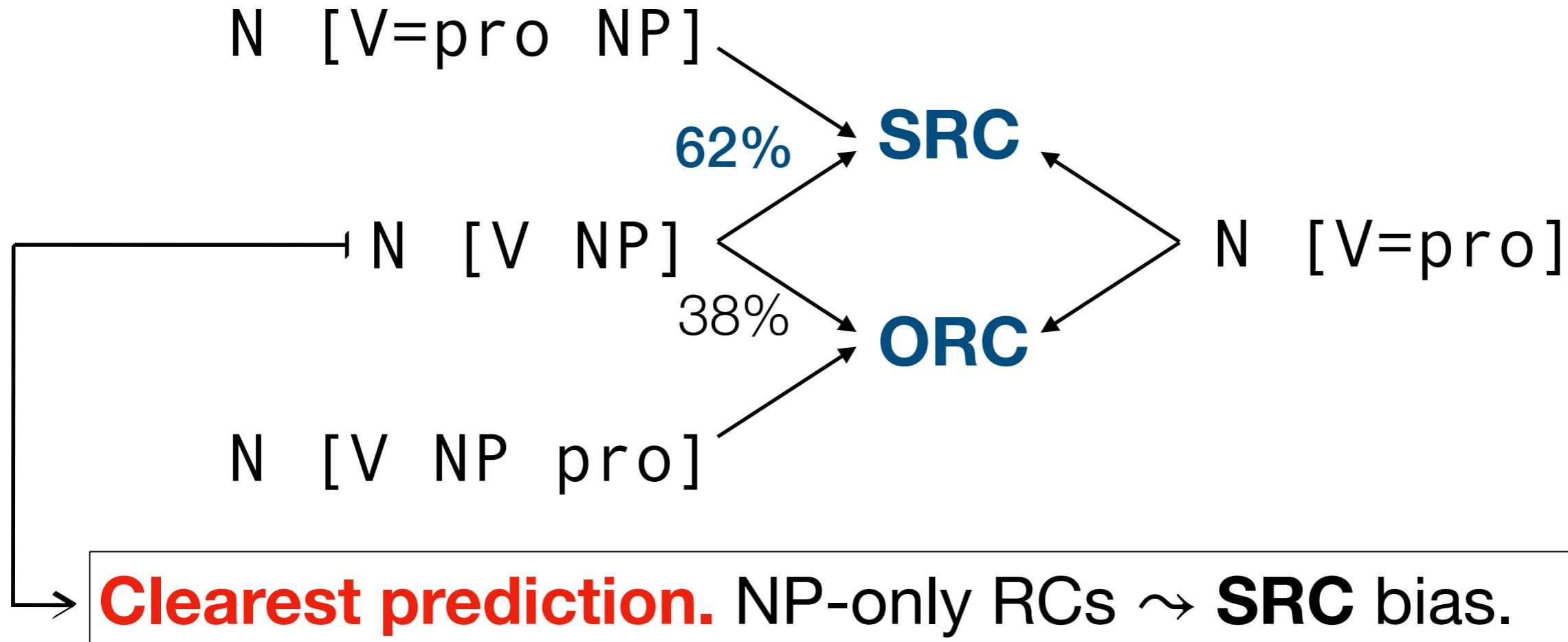


Condition	Schema	Possible interpretations
NP only	N [VP NP PP]	SRC and ORC
Pro-only	N [VP=pro PP]	SRC and ORC
NP + subj.	N [VP=pro NP PP]	SRC only
NP + obj. pro	N [VP NP pro PP]	ORC only

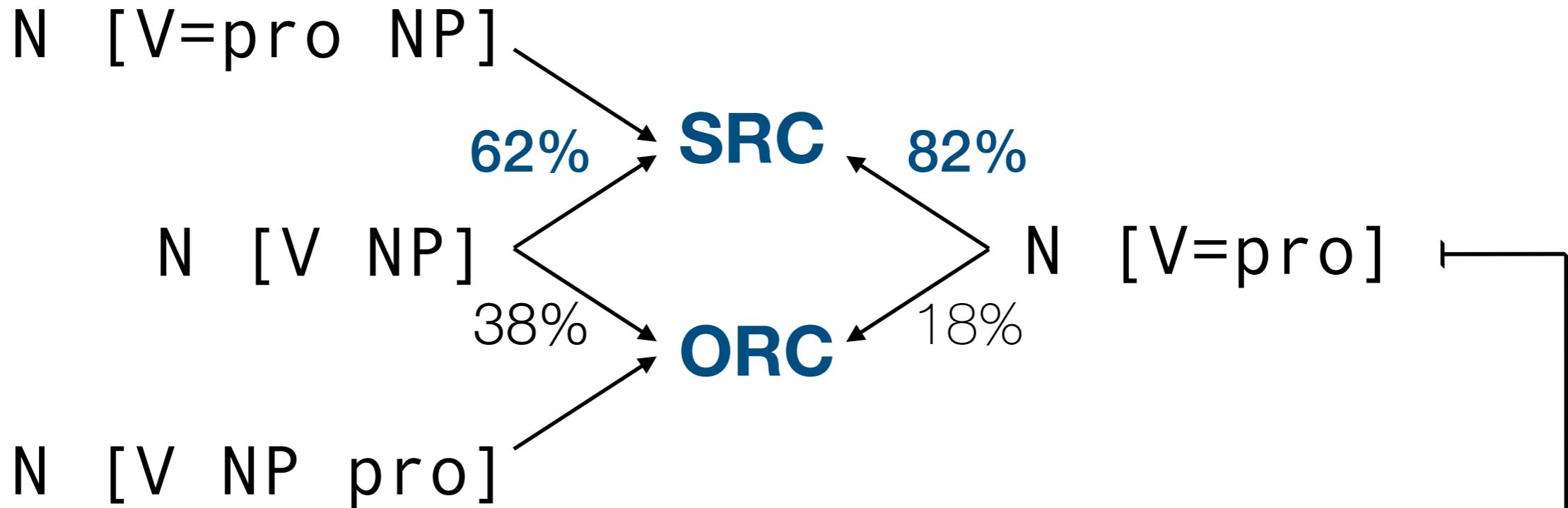
NP + Obj pronoun

This unambiguous ORC gave rise to SRC interpretations in nearly half the trials (**48% ± 3%**)

Subject gap advantage in SLZ



Subject gap advantage in SLZ



Less-clear prediction.

Speakers do prefer a **subject RP** to **object gap**.

SRC: ✓ local ✗ pronoun ✗ null indefinite object

ORC: ✗ non-local ✓ gap ✗ req. discourse antecedent

RP v. gaps in SLZ

The presence of a subject clitic reliably boosted SRC interpretation rate

Table 3: Summary of findings

Condition	Schema	Possible interpretations	Proportion(SRC)
NP-only	N [VP NP PP]	SRC and ORC	62% ($\pm 3\%$)
Subj pro-only	N [VP= <i>pro</i> PP]	SRC and ORC	82% ($\pm 2\%$)
NP + subj. pro	N [VP= <i>pro</i> NP PP]	SRC	87% ($\pm 2\%$)

RP v. gaps in SLZ

Pronoun-only condition

Interpretation of the **Pro-only condition**:

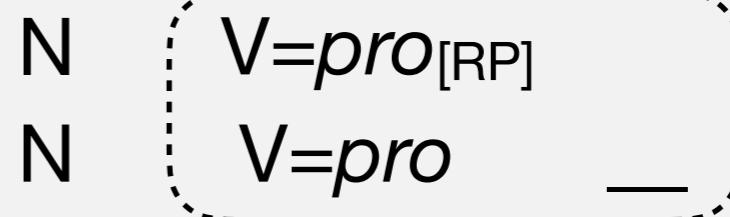
- SRC response: subject clitic must be an RP, and no overt obj.
- ORC response: subject clitic is a discourse-bound pronoun with an object gap downstream.

(14)	bez=e'nh	tsyi'in=eb	xhan	yage'=nh
	<i>fox=DEF</i>	<i>bite.CONT=3.AN</i>	<i>under</i>	<i>tree=DEF</i>

‘the fox that it_{RP} is biting (something) under the tree’

‘the fox that it (the dog) is biting __ under the tree’

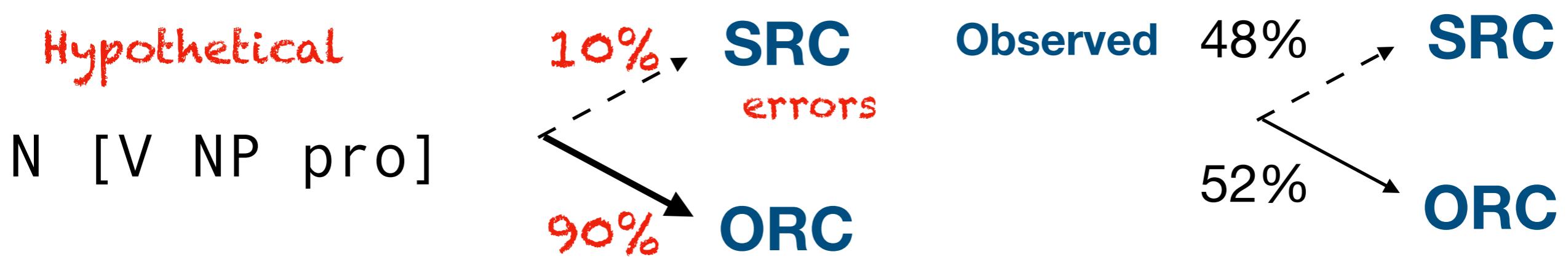
Schematized



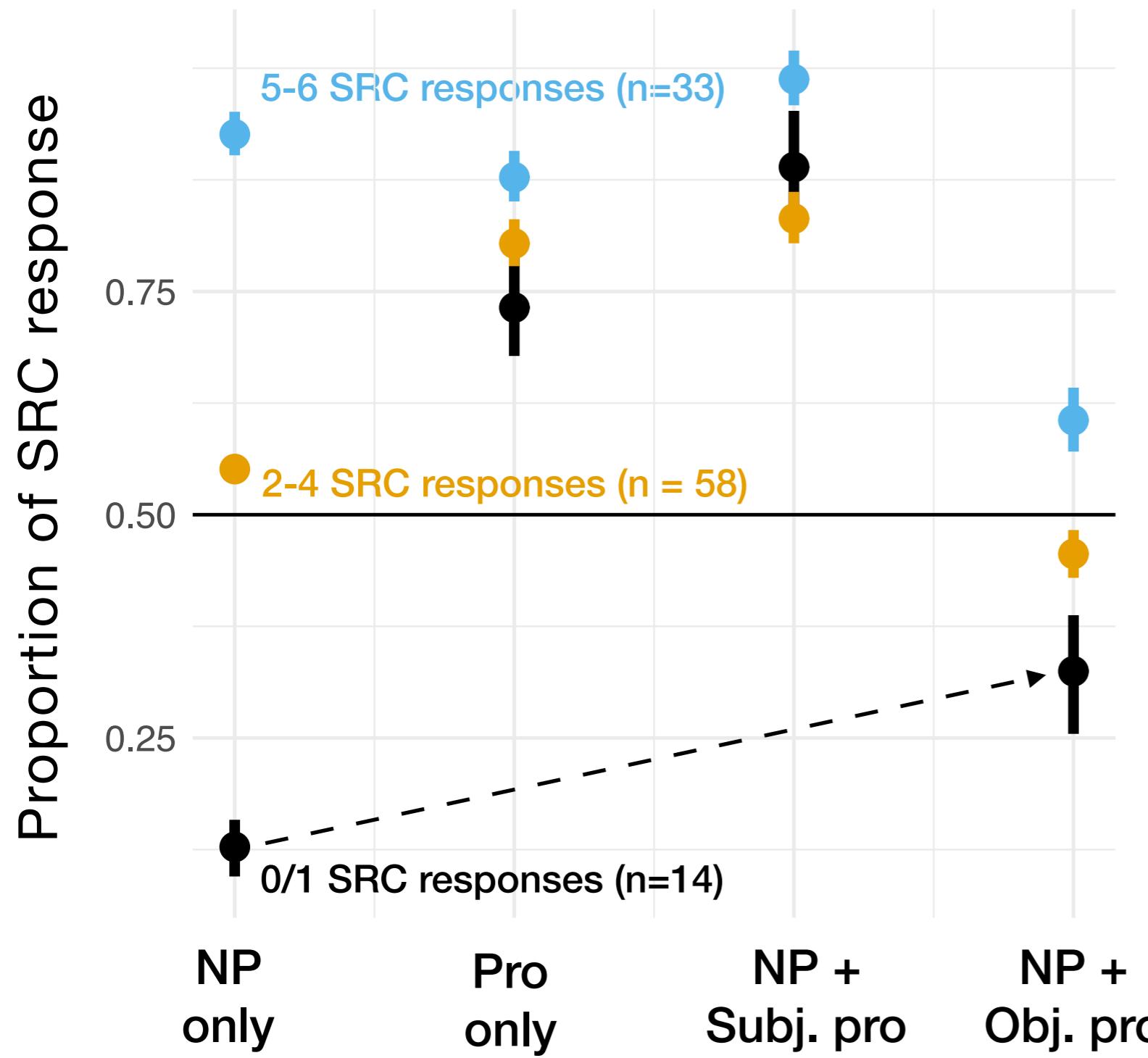
SRC
ORC

RP v. gaps in SLZ

- SLZ is evidently not constrained by the **Highest Subject Restriction** (~ “a resumptive pronoun cannot occupy a subject-position immediately subjacent to its binder”; McCloskey, 1990, 2006)
- Yet, what is the status of **Highest Object Resumption** in the language?



Is a response bias obscuring grammatical performance in Object Pro conditions?



Probably not.

- We split speakers in the NP-only condition according to their interpretation preference.
- Even **speakers least apt to give SRC responses** in ambiguous RCs **made many errors with object pronoun RCs**.

Are Object RPs actually grammatical in SLZ?

- **Foreman & Munro (2007):**

Object RPs – and only object RPs – are unacceptable in Macuilianguis Zapotec (**MacZ**)
 - A parsing constraint is proposed to account for this:
immediately post-verbal NPs are parsed as subjects, if they satisfy the verb's selectional requirements.
- Thus, in MacZ:**
- ... NP-only RCs receive a default ORC interpretation
 - ... and subject RPs are frequently used to achieve SRCs

Are Object RPs actually grammatical in SLZ?

- **SLZ** impressionistically seem a lot like MacZ:
 - subject RPs are optional but freely used, and
 - object RPs are, in some sense, fragile
- However, Foreman & Munro's account for MacZ cannot immediately be ported to SLZ, because **SLZ NP-only RCs** show an **SRC preference**.

Animacy and Object RP

- ...And fieldwork reveals that any difficulty with object RPs **disappears when RC arguments are of unequal animacy**
- E.g., an **object RP** in (15) is as good or **better** than a **gap**.

(15) Ble'eyd=a' xhile' tsjanaw bi byu (leb)
see.comp=1sg sheep chase.cont boy 3sg.an
'I saw the sheep that the boy is chasing.'

- Animacy effects on resumption have been observed in Irish (McCloskey 2017).
- Could object RP difficulty in equal-animacy cases be related to retrieval or encoding interference (Oberauer & Kliegl 2006)?

Conclusions

- SLZ exhibits the subject-gap advantage, even in the absence of case and agreement cues
- Subject pronouns are preferentially interpreted as RPs
 - an unusual instance of an optional RP actually being preferred (cf. Hebrew, Meltzer-Asscher et al. 2015)
- Comprehenders struggle with object RPs in SLZ
 - similar to observations in MacZ, but the existing account of MacZ cannot be ported
 - need a finer-grained picture of parsing AND the influence of animacy

Duxklhenu' ~ Thank you!

- Raul Díaz Robles, and two other speakers
- Residents of Santiago Laxopa
- Director Evaristo López Velazquez
- Santiago Laxopa President Celestino Robles Ramirez
- Roque Reyes Mendoza, Illustrator



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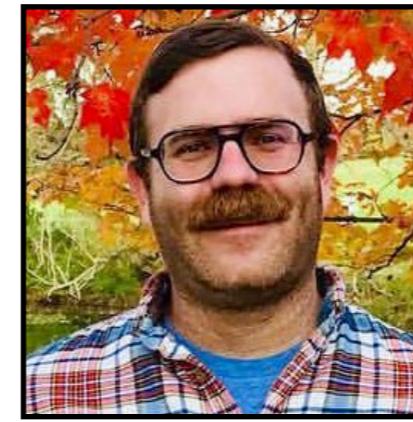
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Appendices

Appendix A

Audio of all conditions

Materials

A typical trial can be schematized as follows:



(13.5) bez=e'nh

bi'a=nh tsyi'in **beku'=nh** xhan yage'=nh
fox=DEF CL=DEF bite.CONT dog=DEF under tree=DEF

'the fox that __ is biting the dog under the tree.'

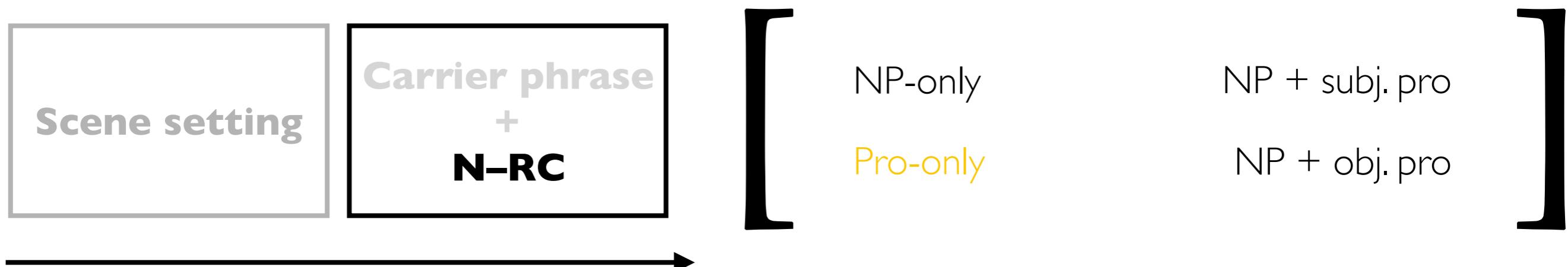
'the fox that the dog is biting __ under the tree.'

Schematized



Materials

A typical trial can be schematized as follows:



- (14) bez=e'nh tsyi'in=**eb** xhan yage'=nh
fox=DEF bite.CONT=3.AN under tree=DEF

'the fox that it_{RP} is biting (s.t) under the tree.'

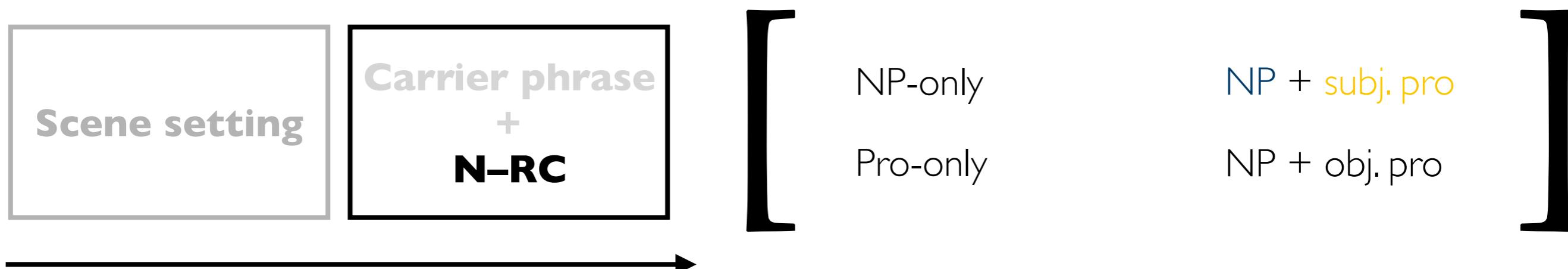
'the fox that it (the dog) is biting __ under the tree.'

Schematized

N V =pro PP ✓SRC ✓ORC

Materials

A typical trial can be schematized as follows:



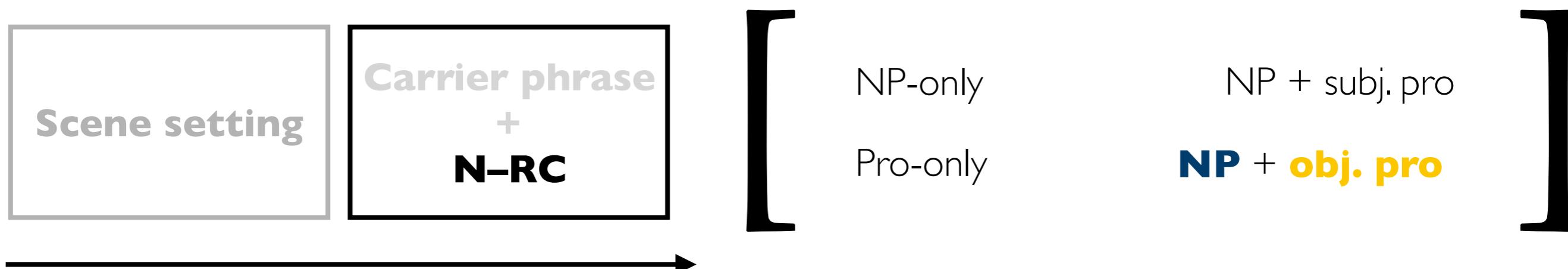
- (15) bez=e'nh tsyi'in=**eb** **beku'=nh** xhan yage'=nh
fox=DEF bite.CONT=3.AN dog=DEF under tree=DEF
- ‘the fox that it_{RP} is biting the dog under the tree.’

Schematized



Materials

A typical trial can be schematized as follows:



- (16) bez=e'nh tsyi'in **beku'=nh** **leb** xhan yage'=nh
fox=DEF *bite.CONT* *dog=DEF* *3.an* *under* *tree=DEF*
- ‘the fox that the dog is biting it_{RP} under the tree.’

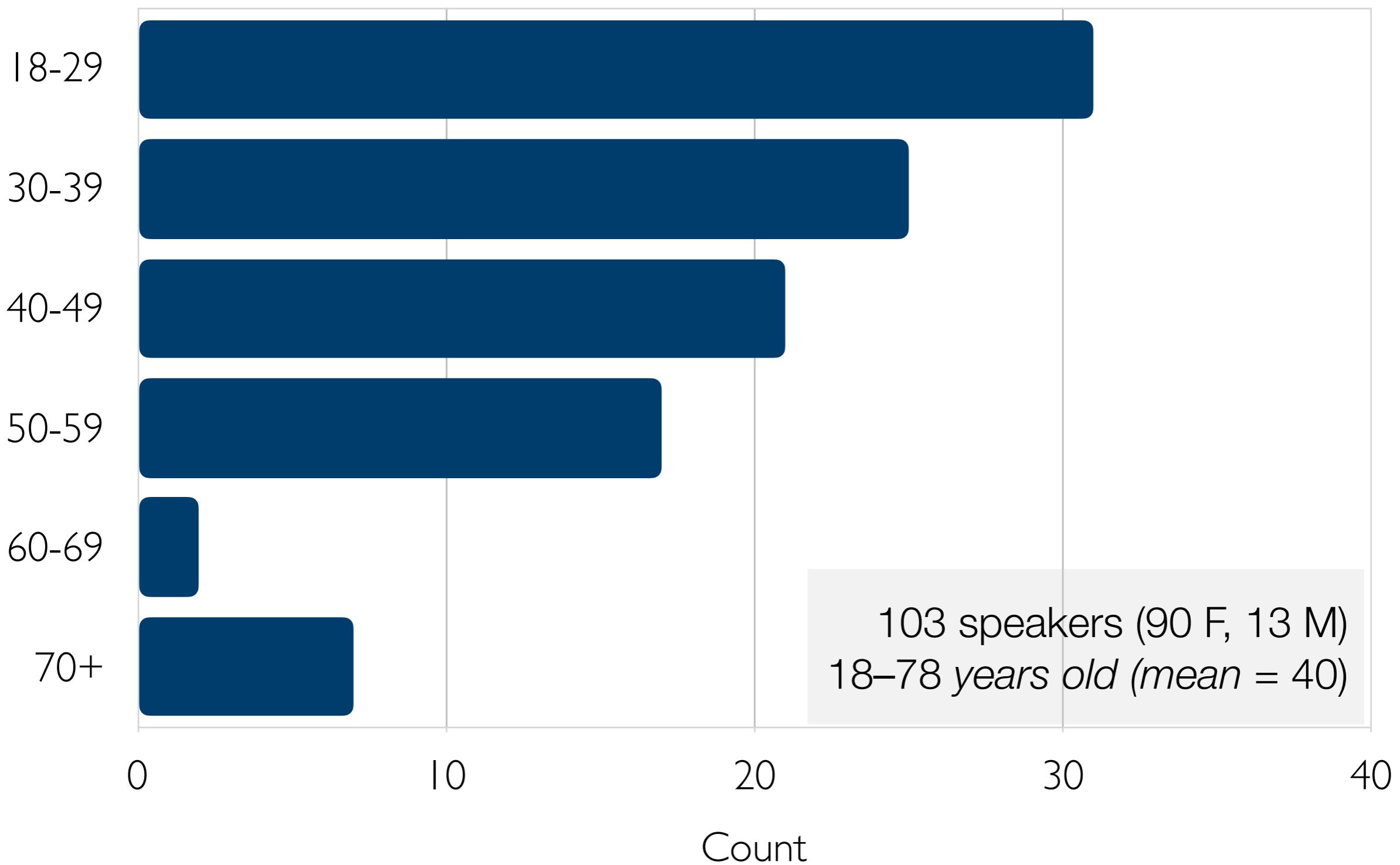
Schematized



Appendix B

Participant details

Participants



Appendix C

Alternative Data Views

Appendix C I: Initiation times

Table 4: Average of participant median RTs, measured by when the screen first touched (ms)

Condition	SRC		ORC	
	<i>Median</i>	<i>SE</i>	<i>Median</i>	<i>SE</i>
NP only	3110	1751	4070	1831
Subj. clit. only	3620	1656	4700	2141
NP + subj. clit.	2250	1443	4274	2345
NP + obj. pron.	2658	1609	3273	1950

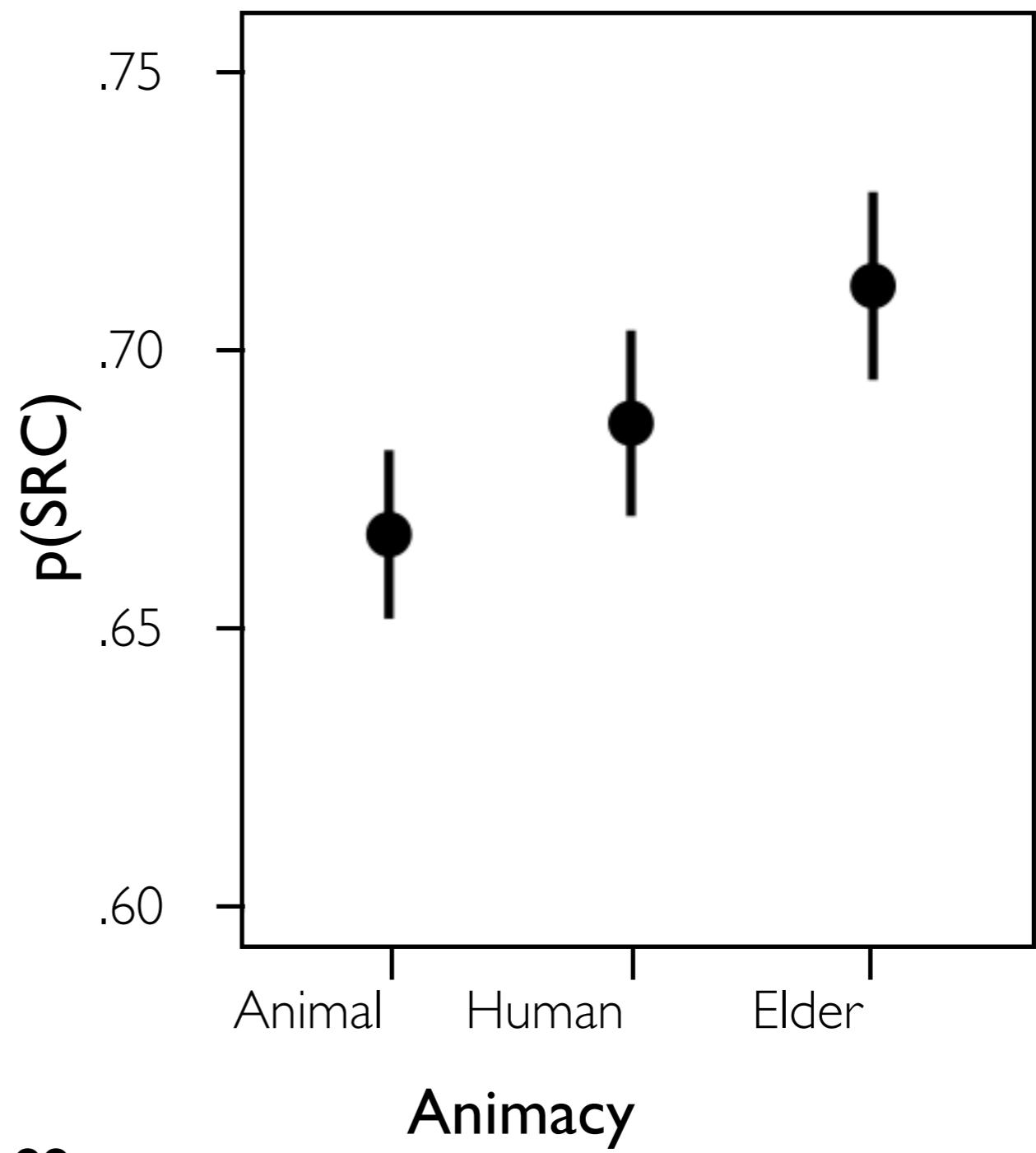
Appendix C2: Animacy effects

Is SGA mediated by Zapotec specific properties?

We think it's possible.

Elder arguments elicited
more SRC interpretations.

Animacy	$p(\text{SRC})$
Animal	67%
Human	69% ($p < .05$)
Elder	71%



Appendix C2: Animacy effects

Is SGA mediated by Zapotec specific properties?

SGA could be mediated by the language's animacy hierarchy

(20) Elder > Human > Animal > Inanimate,

where " $\alpha > \beta$ " means " α is higher in the hierarchy than β "

This hierarchy has been argued for on independent grounds.

Appendix C2: Animacy effects

Is SGA mediated by Zapotec specific properties?

Previous evidence leads us to expect an animacy effect that differentiates humans from animals.

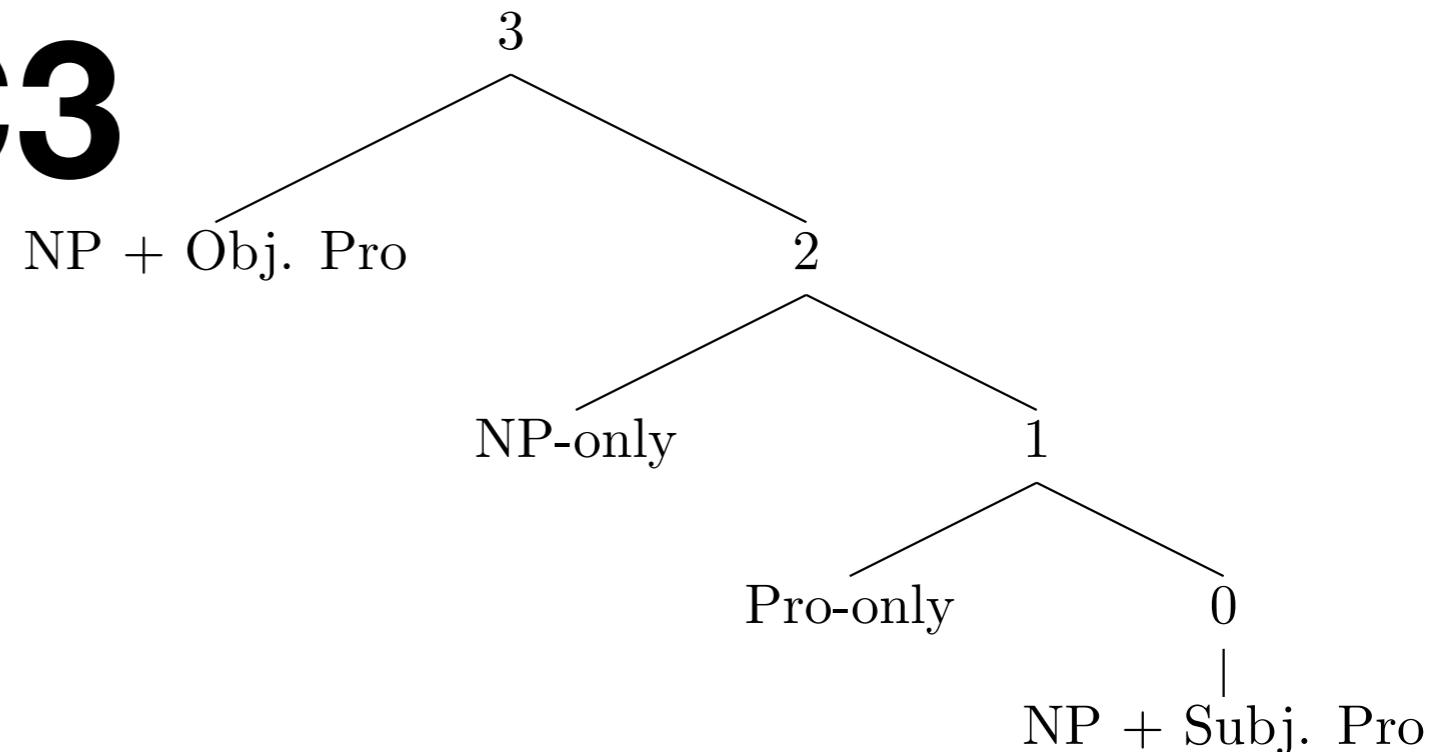
But elders over non-elders?

- Statistical tendency: elders in subject position
- **What we're pursuing:** formal feature geometries have an impact on online sentence processing

Rosenbach (2005); Wagers & Pendleton (2016)

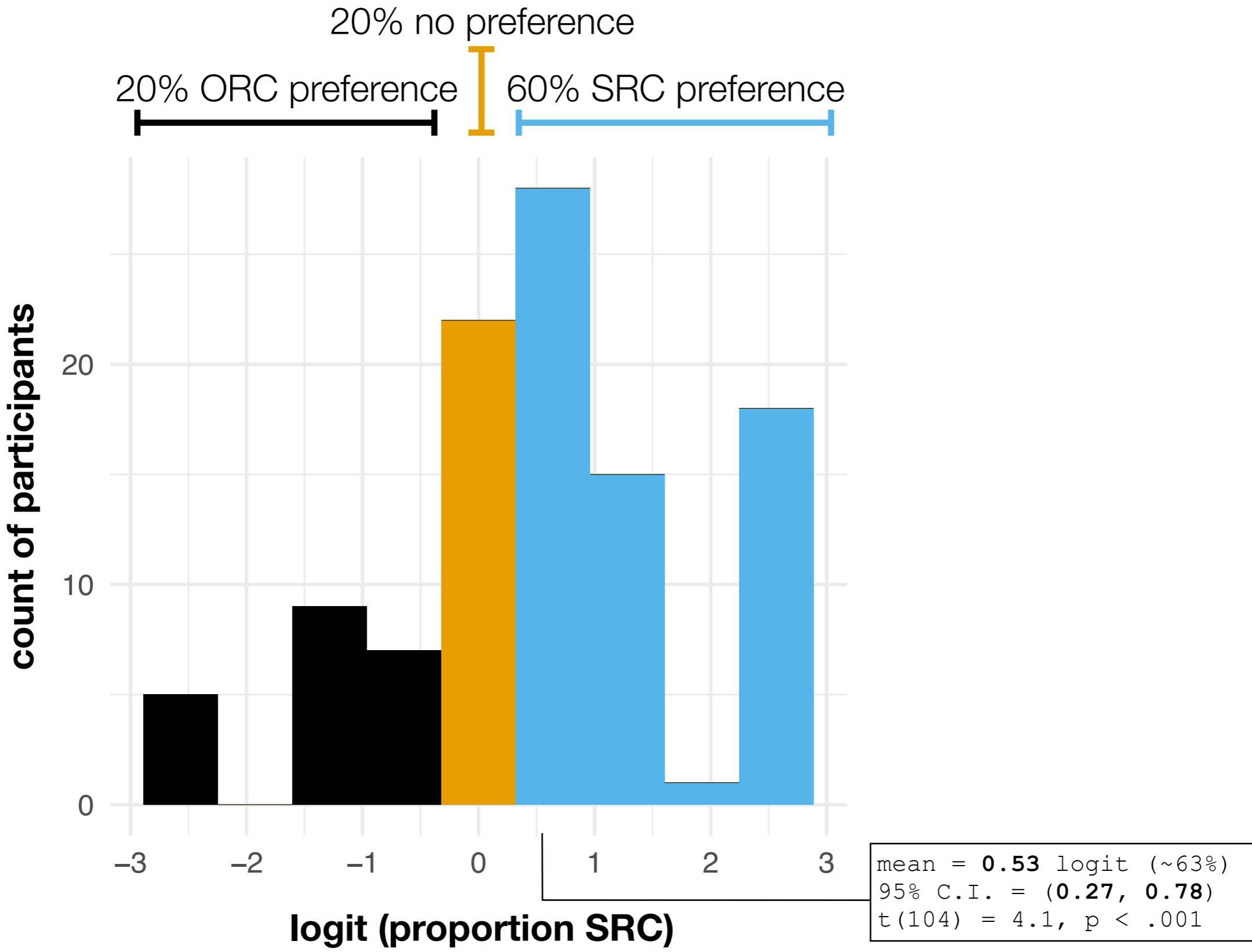
Appendix C3

Regression results



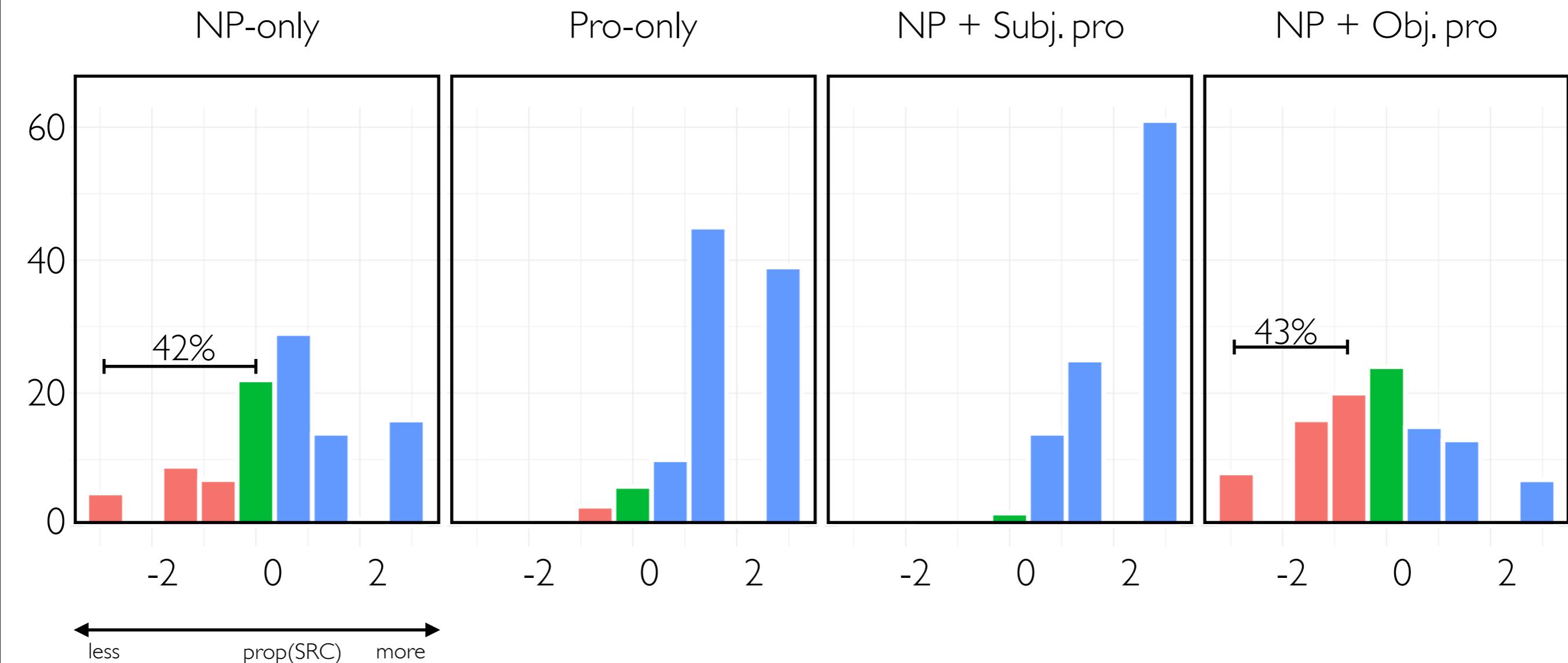
	Estimate	Std Error	z-value	Pr(> z)	
0. NP + Subj. Pro	1.27	0.16	8.0	9.6E-16	***
1. Pro-only - 0.	0.27	0.09	3.1	0.0022	**
2. NP-only - (0,1)	0.55	0.04	12.9	< 2e-16	***
3. NP + Obj. Pro - (0-2)	0.45	0.03	-15.9	< 2e-16	***

Appendix C4: NP-Only Preference by Participant



Appendix C5:

Preference by Participant



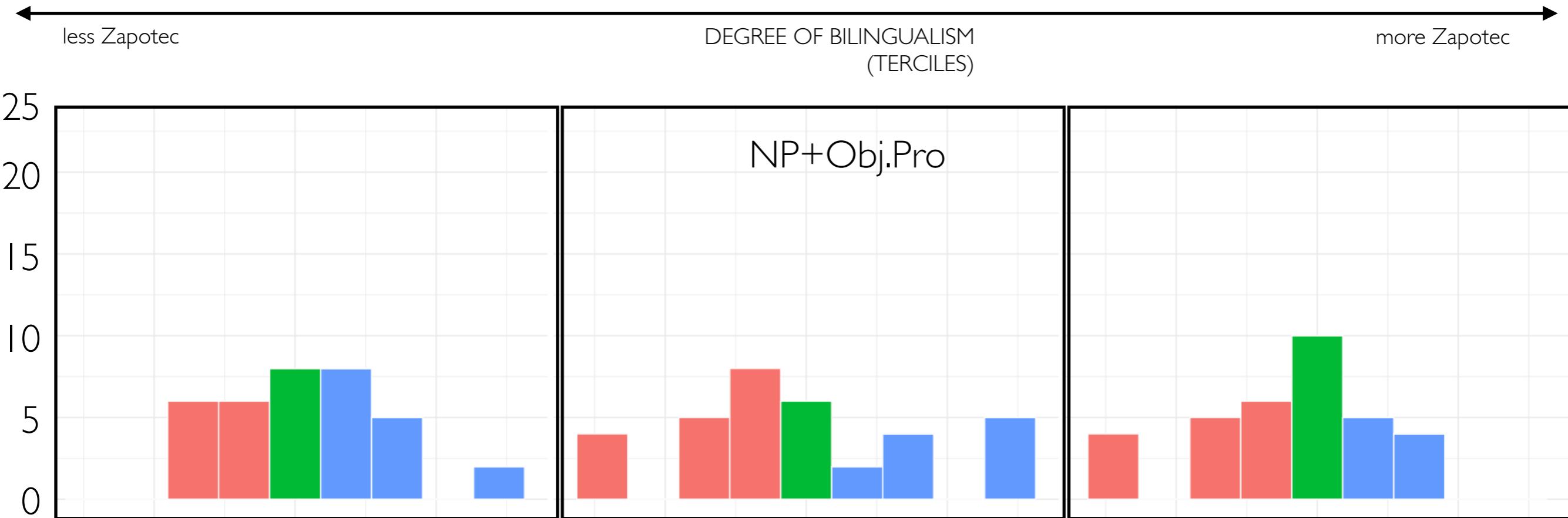
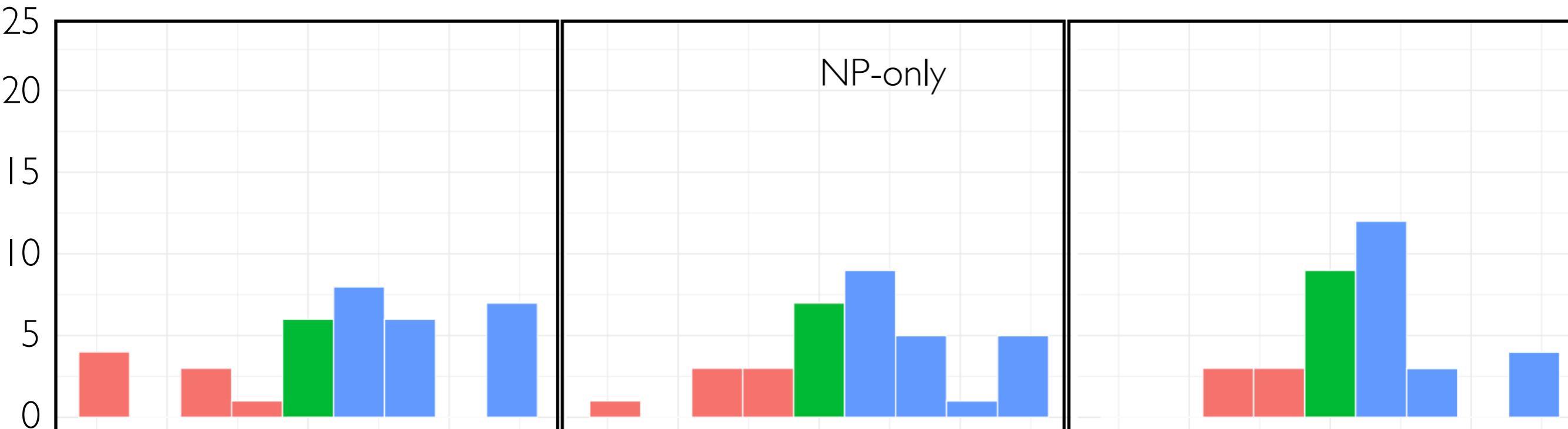
Discussion

Is SGA mediated by the degree of SLZ/Spanish-bilingualism?

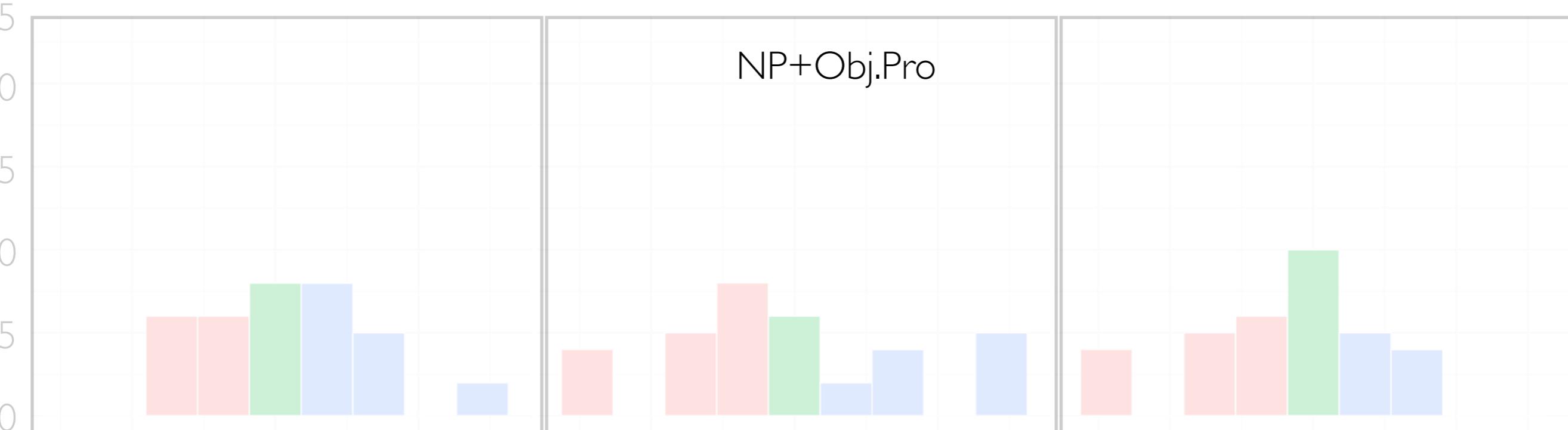
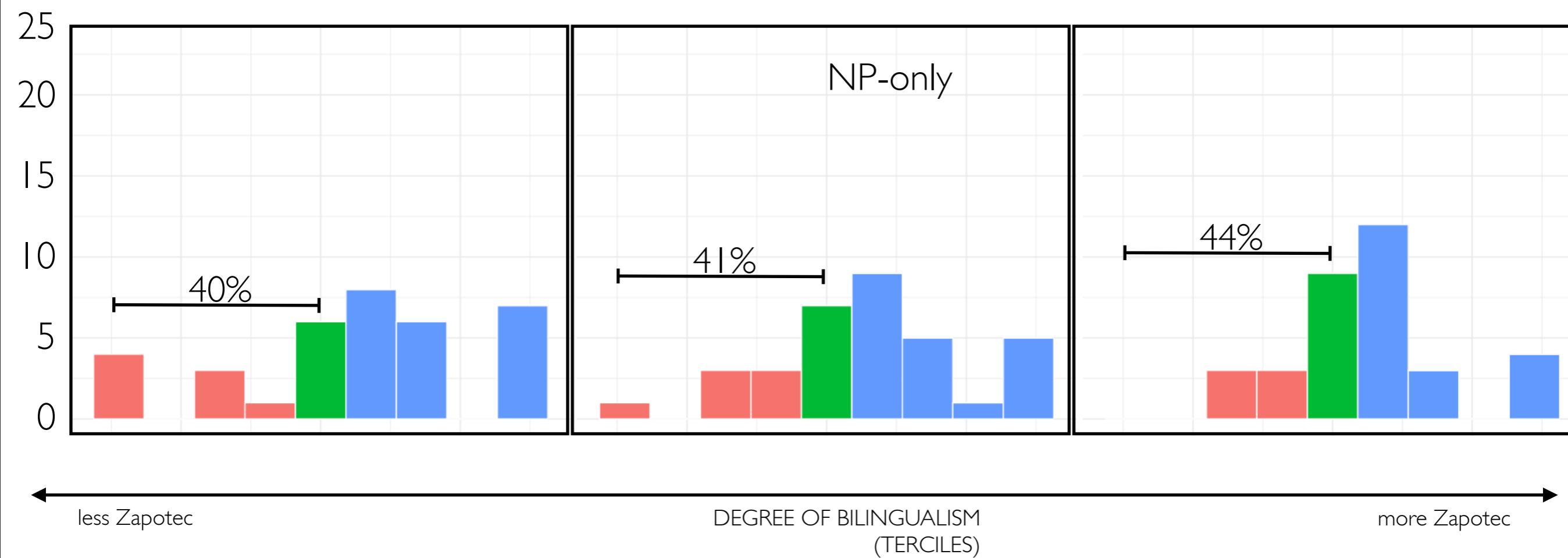
Previous research on Mayan Ch'ol and Q'anjob'al RC-processing suggests that fluency in Spanish affects interpretations: ↑ **bilingual**, ↑ **proportion(SRC)**

Clemens, Coon, Mateo Pedro, Morgan, Polinsky, Tandet, Wagers (2015)

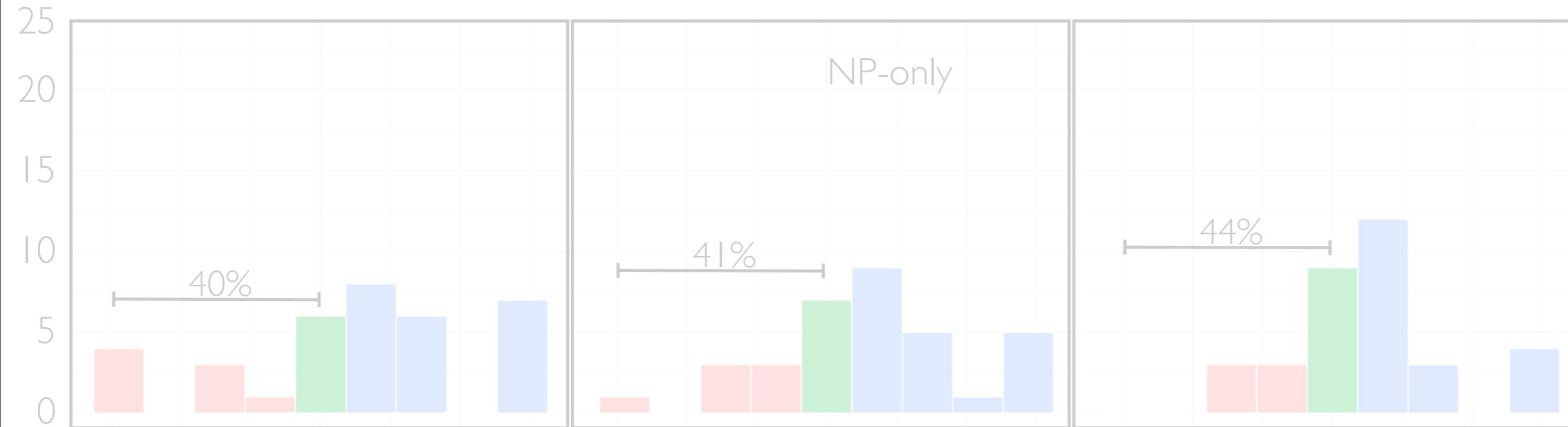
Appendix C6: Degree of Zapotec Use



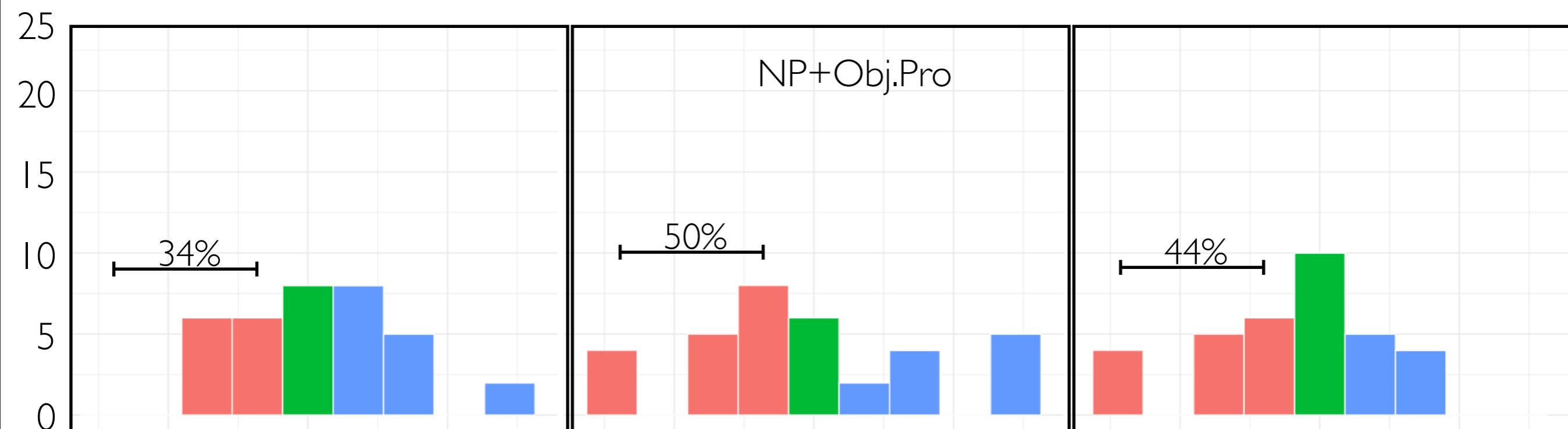
Appendix C6: Degree of Zapotec Use



Appendix C6: Degree of Zapotec Use



← less Zapotec DEGREE OF BILINGUALISM (TERCILES) more Zapotec →



Appendix D

Discussion

Are object RPs even grammatical in SLZ?

If they were not grammatical...

- the distribution of RPs in SLZ would be typologically unusual: the Accessibility Hierarchy rules out languages with subject RPs but no object RPs; and
- since pronouns are otherwise freely distributed, the grammatical principle ruling out object RPs would have to (implausibly) be specific to RPs.

Keenan & Comrie (1977)

Pronouns

As subjects, pronouns obligatorily cliticize onto the verb.

	Verb=Subject	Object
(7)	Tsyill= e' <i>pinch.CONT=3EL</i>	bene' xyage'=nh. CL man=DEF

'S/he (an elder) is pinching the man.'

	Verb	Subject	Object
(8)	*Tsyill <i>pinch.CONT</i>	le' 3EL	bene' xyage'=nh. CL man=DEF

Schematized			
V=pro	NP	✓Clitic	
V	pro	NP	✗No Clitic

Pronouns

Object pronouns can only cliticize onto the verb if there's already a subject clitic.

	Verb=Object	Subject	Verb=Subject=Object
(9)	Tsyill= eb <i>pinch.CONT=3AN</i>	bene' xyage'=nh. CL man=DEF	
			(10) Tsyill= e=b. <i>pinch.CONT=3EL=3AN</i>

*'The man is pinching it.'

'S/he is pinching it'

OK It (an animal) is pinching the man.

Resumptive pronouns

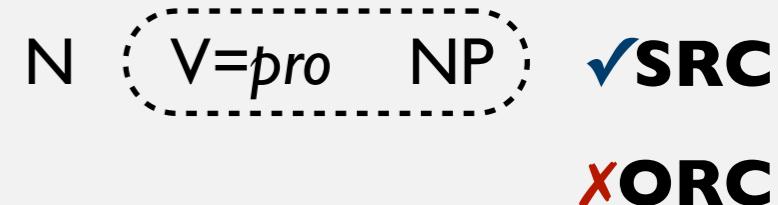
Resumptive pronouns (RPs) can eliminate ambiguity.

	Head noun	Relative clause
(11)	Shlhe'eyd=a' bene' nu'ulhe=nh <i>see.CONT=1SG CL woman=DEF</i>	tsyill=e' bene' xyage'=nh. <i>pinch.CONT=3EL CL man=DEF</i>

'I see the woman that is pinching the man.'

NOT 'I see the woman that the man is pinching.'

Schematized



Resumptive pronouns

Resumptive pronouns (RPs) can eliminate ambiguity.

	Head noun	Relative clause
(12) Shlhe'eyd=a'	bene' nu'u'lhe=nh <i>see.CONT=1SG CL woman=DEF</i>	tsyill <i>pinch.CONT CL man=DEF 3EL</i>

NOT 'I see the woman that is pinching the man.'

'I see the woman that the man is pinching.'

Schematized

✗SRC

N V NP pro ✓ORC

RP or not RP?

But when the NPs have the **same animacy**, RPs do not eliminate the ambiguity

	Head noun	Relative clause
(13) Shlhe'eyd=a'	bene' nu'ułhe=nh <i>see.CONT=1SG CL woman=DEF</i>	tsyill=e'. <i>pinch.CONT=3EL</i>

'I see the woman that **she_{RP}** is pinching (s.o./s.t.).'

OR 'I see the woman that s/he is pinching.'

Choices

If RP, then SRC

If **not RP**, then ORC