(A)symmetries in Tagalog RC-processing

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Main take-aways

Tagalog exhibits a robust SRC-ORC asymmetry in processing

This asymmetry is attenuated by the order of the head noun and the RC

Today

Background: RC-processing

Grammatical features of Tagalog

Picture-matching experiments

Discussion

Background:
Relative clause processing

The SRC-ORC asymmetry

Comprehenders prefer RELATIVE CLAUSES WITH SUBJECT-GAPS (SRCs) over RELATIVE CLAUSES WITH OBJECT-GAPS (ORCs)

Comprehenders find ORCs are harder to process than SRCs

(1) **English**

    (a)   The **reporter** [that ___ attacked the senator] admitted the error.   *SRC*

    (b)   The **reporter** [that the senator attacked ___] admitted the error.   *ORC*

Staub (2010)

The SRC-ORC asymmetry

Comprehenders offer fewer ORC-interpretations

(2) **Santiago Laxopa Zapotec**

bez=e'nh [tsyi'in beku'=nh xhan yage'=nh]
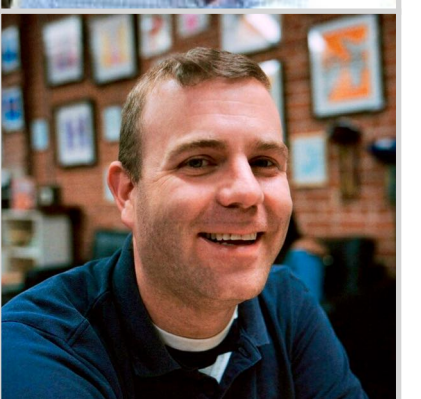
fox=DEF bite.CONT dog=DEF under tree=DEF

The fox [that ___ is biting the dog under the tree] *SRC* (62%)

The fox [that the dog is biting ___ under the tree] *ORC* (38%)

(Foley, Pizarro-Guevara, Sasaki, Silva-Robles, Toosarvandani, & Wagers, 2019)

The SRC-ORC asymmetry

This asymmetry is robust cross-linguistically and cross-methodologically, in both child- and adult-languages

Chamorro: Wagers, Borja, & Chung (2018); **Chinese:** Vasishth, Chen, Li, & Guo (2013), F. Wu, Kaiser, & Andersen (2012); **Dutch:** Frazier (1987), Mak, Vonk, & Schriefers (2002, 2006); **Ch'ol and Q'anjob'al:** Clemens et al. (2015); **English:** Gibson et al. (2005), King & Just (1991), Traxler, Morris, & Seely (2002); **French:** Cohen & Mehler (1996); **German:** Bader & Meng (1999); **Georgian:** S. Foley & Wagers (2017); **Hebrew:** Arnon (2010); **Japanese:** Ueno & Garnsey (2008); **Korean:** Kwon et al. (2010); **Russian:** Levy, Fedorenko, & Gibson (2013); **Spanish:** Betancort, Carreiras, & Sturt (2009); **Tagalog:** Pizarro-Guevara (2014), Tanaka (2016), Bondoc et al. (2018); Tanaka et al. (2019)

Accounting for the asymmetry

Different proposals emphasize different aspects of the dependency:

- ◉ Syntactic structure
- ◉ Memory

Intervention-based accounts

- ◉ Frequency
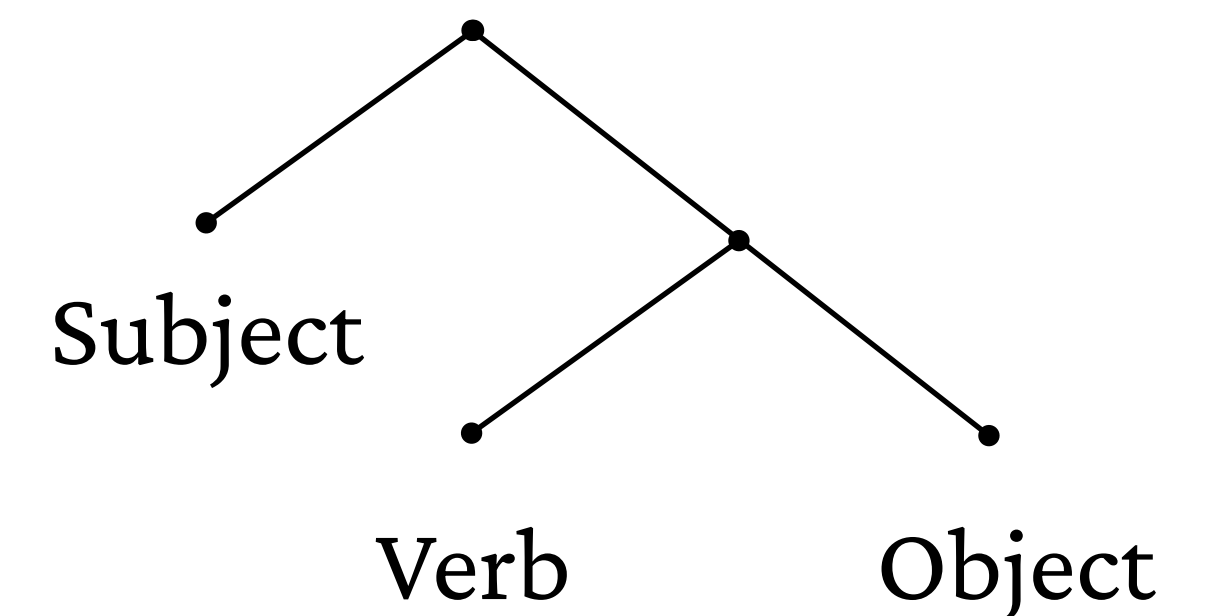- ◉ Word order similarity

Experience-based accounts

The role of syntactic structure

Processing difficulty is correlated with the number of intervening syntactic projections between the head noun and the gap
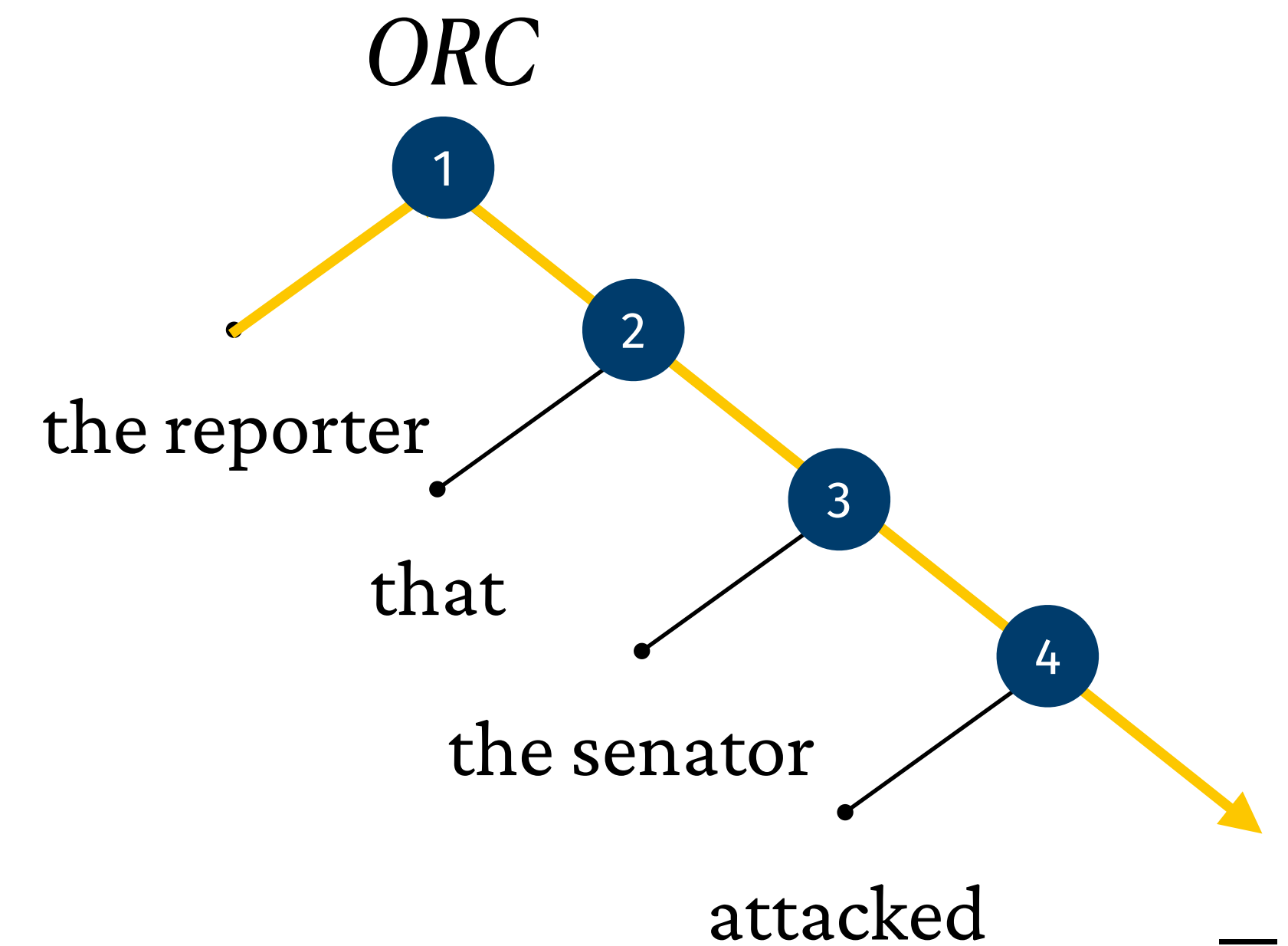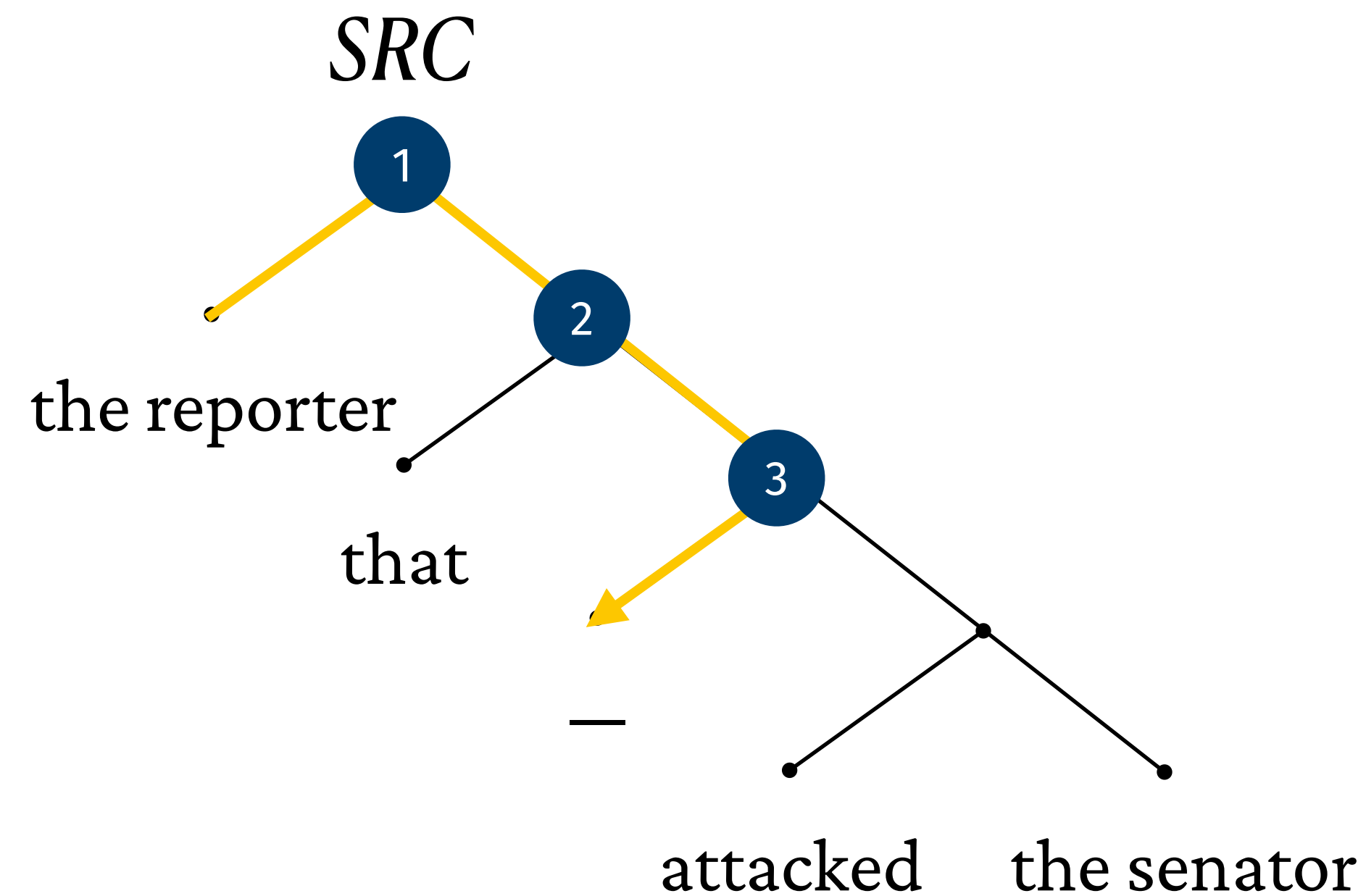
Hawkins (1999); O'Grady, Lee, & Choo, (2003)

By hypothesis, subjects are generated in a structurally higher position than objects

The role of syntactic structure

There are more intervening syntactic projections between the head noun and the gap in ORCs than in SRCs

SRC

ORC

the reporter

that

—

attacked   the senator

the reporter

that

the senator

attacked   —

The role of memory

Processing difficulty is correlated with the number of linear interveners between the head noun and the gap

Gordon, Hendrick, & Johnson (2001); Hsiao & Gibson (2003); Grodner & Gibson (2005); Lewis & Vasishth (2005); Van Dyke & McElree (2006); Carreiras, Duñabeitia, Vergara, de la Cruz-Pavía, & Laka (2010)

Increasing linear distance between head noun and gap impose a greater burden on memory

The role of memory

There are more linearly intervening elements between the head noun and the gap in ORCs than in SRCs

(3)   **English**

(a)   The **reporter** [that __ attacked the senator] admitted the error.   *SRC*

(b)   The **reporter** [that the senator attacked __] admitted the error.   *ORC*

The role of frequency

Processing difficulty is correlated with relative abundance of the type of RC in the language

Mitchell, Cuetos, Corley, & Brysbaert (1995); Brysbaert & Mitchell (1996); Reali & Christiansen (2007)

The more frequent the RC, the easier it is to process

The role of frequency

ORCs are less frequent than SRCs in English

Roland, Dick, & Elman (2007)

	BNC	BNC-Spoken	Brown	Switchboard	WSJ
SRC	14,182	9,851	15,024	9,548	18,229
ORC	2,943	3,863	1,976	5,616	1,802

The role of frequency

More frequent the structure mean that they are more likely continuations

Levy (2006)

(4) **English**

The **reporter** [that ...

(a) __ attacked the senator] admitted the error.   *SRC*

(b) the senator attacked __] admitted the error.   *ORC*

The role of word order similarity

Processing difficulty is correlated with how similar the RC word order is to the word order of the main clause

<div align="right">Bever (1970); Diessel & Tomasello (2005)</div>

The more similar the word order, the easier it is to process

The role of word order similarity

The order of elements in ORCs do not resemble the order of elements in main clauses. In SRCs, it does.

(5) **English**

    (a)   The reporter attacked the senator   S-V-O

    (b)   The **reporter** [that __ attacked the senator] ...   S-V-O

    (c)   The **reporter** [that the senator attacked __] ...   O-S-V

Recap: Accounting for the asymmetry

Different proposals emphasize different aspects of the dependency:

- ⊙ Syntactic structure
- ⊙ Memory

Intervention-based account

- ⊙ Frequency
- ⊙ Word order similarity

Experience-based account

Attenuating the asymmetry

Animacy of the head: inanimate head nouns reduce/ neutralize the asymmetry

(6) **English**

    (a)   The **senator** [that __ criticized the journalist] …   *SRC*

    (b)   The **senator** [that the journalist criticized __] …   *ORC* [animate]

    (c)   The **article** [that the journalist criticized __] …   *ORC* [inanimate]

Lowder & Gordon (2014); **Dutch:** Mak, Vonk, & Schriefers (2002, 2006); **Chinese:** Wu, Kaiser, & Andersen (2012)

Attenuating the asymmetry

Referential type of intervening elements: intervening proper names, pronouns, and quantified expressions reduce the asymmetry

(7) **English**

    (a)   The **senator** [that __ bothered the reporter/Bob/you/everyone] ...   *SRC*

    (b)   The **senator** [that the reporter/Bob/you/everyone criticized __] ...   *ORC*

Gordon & Lowder (2012); **Russian:** Price & Wetzel (2017)

Attenuating the asymmetry

(8) (a) **Head** [RC]   *Head-initial* (e.g., English, Spanish)

(b) [RC] **Head**   *Head-final* (e.g., Chinese, Basque)

Head-RC order: when we compare languages with head-initial RCs and languages with head-final RCs, the asymmetry is reduced—sometimes, even reversed—in languages with head-final RCs

Avar: Polinsky, Gallo, Graff, & Kravtchenko (2012); **Chinese:** Hsiao & Gibson (2003); Chen, Ning, Bi, & Dunlap (2008); Lin & Garnsey (2010); Packard, Ye, & Zhou (2010); Qiao, Shen, & Forster (2011); Gibson & Wu (2013); Sung, Tu, Cha, & Wu (2016)—*c.f.* Vasishth, Chen, Li, & Guo (2013); Jäger, Chen, Li & Vasishth (2015); **Basque:** Carreiras, Duñabeitia, Vergara, de la Cruz-Pavía, & Laka (2010)

Attenuating the asymmetry

Head-RC order: when we compare languages with head-initial RCs and languages with head-final RCs, the asymmetry is reduced—sometimes, even reversed—in languages with head-final RCs

Avar: Polinsky, Gallo, Graff, & Kravtchenko (2012);
Chinese: Hsiao & Gibson (2003), *inter alia*;
Basque: Carreiras, Duñabeitia, Vergara, de la Cruz-Pavía, & Laka (2010)

Skeptic Steve says
"Umm... they're different languages?"

Attenuating the asymmetry

Chamorro has both head-initial and head-final RCs

Wagers, Borja, & Chung (2018)

(9) **Chamorro**

   (a)   tåotao   [i   matåta'chung]

           person   COMP   AGR.sit.PROG

           Man [who __ is sitting down]   *Head-initial*

   (b)   [matåta'chung]   na   tåotao

           AGR.sit.PROG   LNK   person

           Man [who __ is sitting down]   *Head-final*
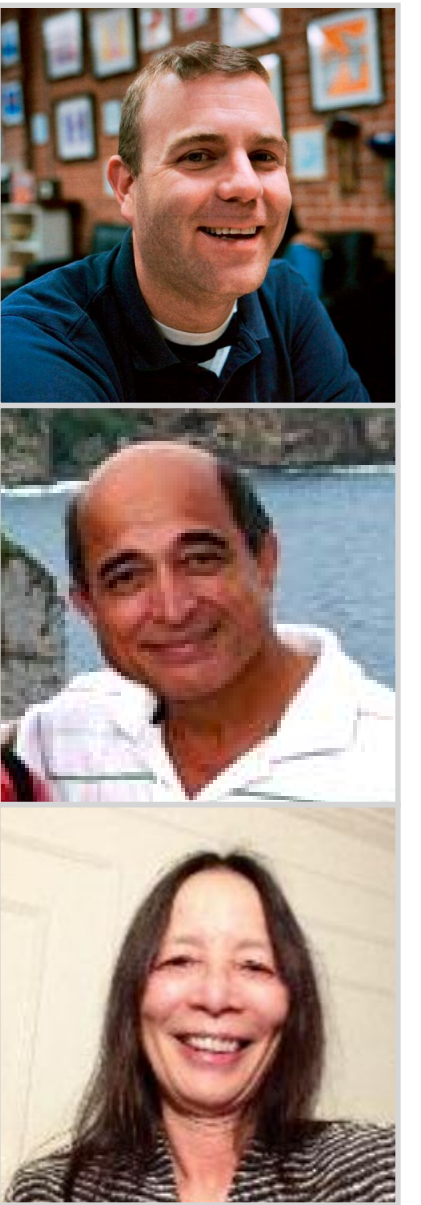
Attenuating the asymmetry

Head-RC order: when we compare languages with head-initial RCs and languages with head-final RCs, the asymmetry is reduced—sometimes, even reversed—in languages with head-final RCs

Avar: Polinsky, Gallo, Graff, & Kravtchenko (2012);
Chinese: Hsiao & Gibson (2003), *inter alia*;
Basque: Carreiras, Duñabeitia, Vergara, de la Cruz-Pavía, & Laka (2010)
Chamorro (language-internal comparison): Wagers, Borja, & Chung (2018)

Recap: Attenuating the asymmetry

Various factors can attenuate the asymmetry:

- ⊙ Animacy of the head noun
- ⊙ Referential type of the intervening element
- ⊙ Head-RC order

Today

Background on RC processing

Grammatical features of Tagalog

Picture-matching experiments

Discussion

Background:
Grammatical features of Tagalog

Voice morphology

Verbs carry voice morphology that cross-references the *ang*-marked argument

Schachter & Otanes (1983)

(10) **Tagalog**

(a) **Sumisipa** ng=aso ang=pusa

 kick.AV GEN=dog NOM=cat

 'The cat is kicking a dog'

 *The dog is kicking the cat

(b) **Sinisipa** ng=pusa ang=aso

 kick.PV GEN=cat NOM=dog

 'The cat is kicking the dog'

 *The dog is kicking the cat

Voice interacts with word order

When the verb AV, both VSO and VOS are considered natural sounding

Kroeger (1993)

(11) **Tagalog**

(a) **Sumisipa**   ng=aso   ang=pusa

kick.AV   GEN=dog   NOM=cat

'The cat is kicking a dog'

*The dog is kicking the cat

(b) **Sumisipa**   ang=pusa   ng=aso

kick.AV   NOM=dog   GEN=cat

'The cat is kicking a dog'

*The dog is kicking the cat

Voice interacts with word order

When the verb has PV, VSO is the most natural sounding

Kroeger (1993)

(12) **Tagalog**

(a) **Sinisipa** ng=pusa ang=aso

kick.PV GEN=cat NOM=dog

'The cat is kicking the dog'

*The dog is kicking the cat

(b) ?**Sinisipa** ang=aso ng=pusa

kick.PV NOM=dog GEN=cat

'The cat is kicking the dog'

*The dog is kicking the cat

Voice interacts with word order

Bondoc & Schaefer (2019) conducted a sentence completion task and found the following:

- ⦿ With AV, the first NP-slot was either the subject or the object (~50%)

- ⦿ With PV, the first NP-slot with overwhelmingly the subject
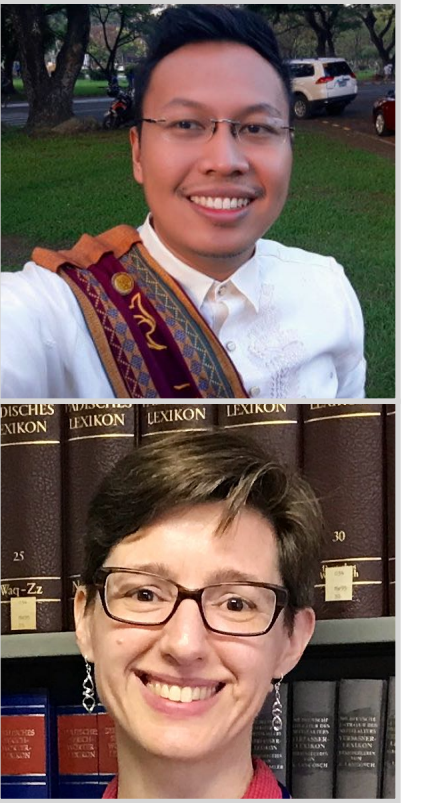
Voice interacts with RC-formation

Voice morphology restricts what can be relativized

- AV (*Sumisipa*) → SRC

- PV (*Sinisipa*) → ORC

Schachter (1977); Ceña (1979); Aldridge, (2002); Rackowski & Richards (2005); Kaufman (2009); Law (2016), *inter alia*

This feature is called **Parse** (SRC, ORC) in our experiment

Variability in head-RC configuration

Both head-initial and head-final RCs are available in the language

- **Head** [RC Verb Co-Argument]
- [RC Verb Co-Argument] **Head**

Law (2016); Aldridge, (2017), *inter alia*

This feature is called **HEAD** (INITIAL, FINAL) in our experiment

Miscellany

Nagaya (2019) conducted a corpus analysis of Tagalog conversations:

- **ORCs are more frequent than SRCs**, echoing the general prevalence of PV in matrix clauses(Garcia et al 2019)

- Most RCs are headless(~80%). Head-initial RCs (~15%), while head-final RCs (~5%)

Recap

- Tagalog verbs typically carry voice morphology
- Voice interacts with word order
- Voice interacts with what can be relativized
- Both head-initial and head-final RCs are available
- ORCs are more frequent than SRCs

Today

~~Background on RC processing~~

~~Grammatical features of Tagalog~~

Picture-matching experiments

Discussion

Picture-matching experiments

Questions

Are ORCs more difficult to process than SRCs in Tagalog?

- Previous studies suggest that there is an asymmetry in head-initial RCs

Pizarro-Guevara (2014); Bondoc et al., (2018); Tanaka et al. (2019)

- No data for head-final RCs

Does head-RC order attenuate the asymmetry?

Questions

What can the RC-landscape of Tagalog tell us about the classes of proposals?

A typical trial

Task: Picture-matching plus confidence ratings
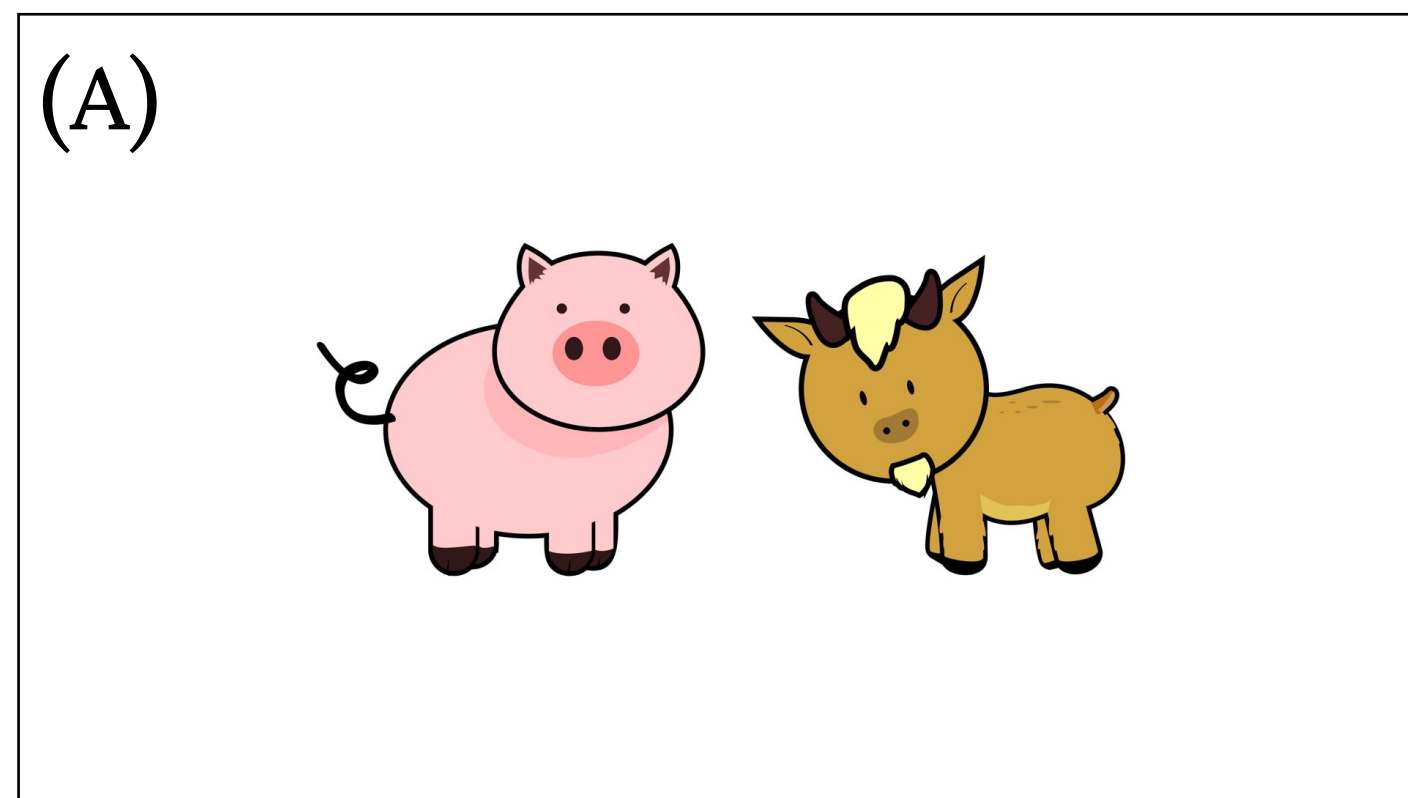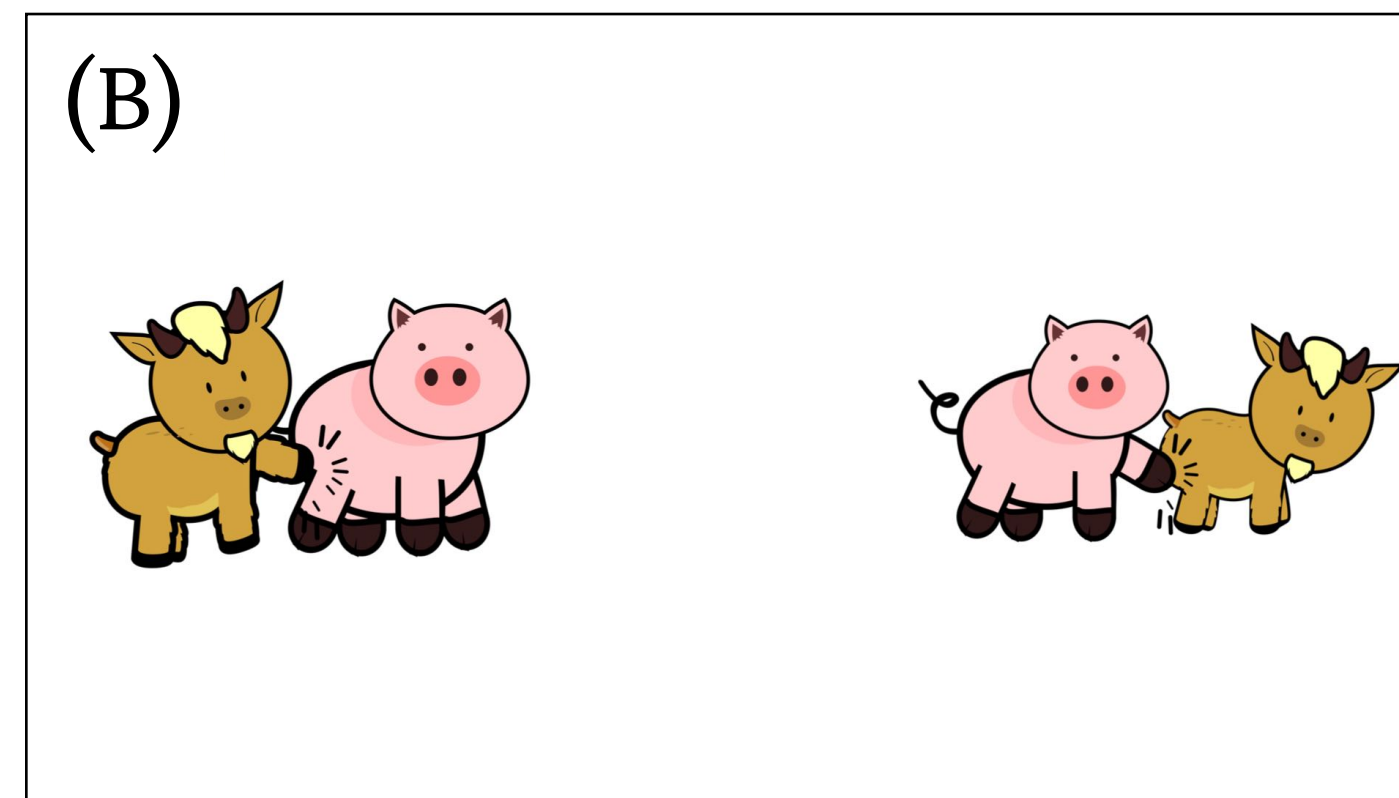
(A) Context   (B) Picture selection   (C) Confidence rating

Overview

3 sub-experiments were run simultaneously

- ◉ Unambiguous RCs with nouns as co-arguments
- ◉ Unambiguous RCs with pronouns as co-arguments
- ◉ Ambiguous RCs with noun as co-arguments

Design

2 (**HEAD**: INITIAL, FINAL) x 2 (**PARSE**: SRC, ORC)

Initial	SRC	**baboy** [na **sumisipa** ng kambing]
Initial	ORC	**baboy** [na **sinisipa** ng kambing]
Final	SRC	[**sumisipa** ng kambing na] **baboy**
Final	ORC	[**sinisipa** ng kambing na] **baboy**

16 items via Latin square design
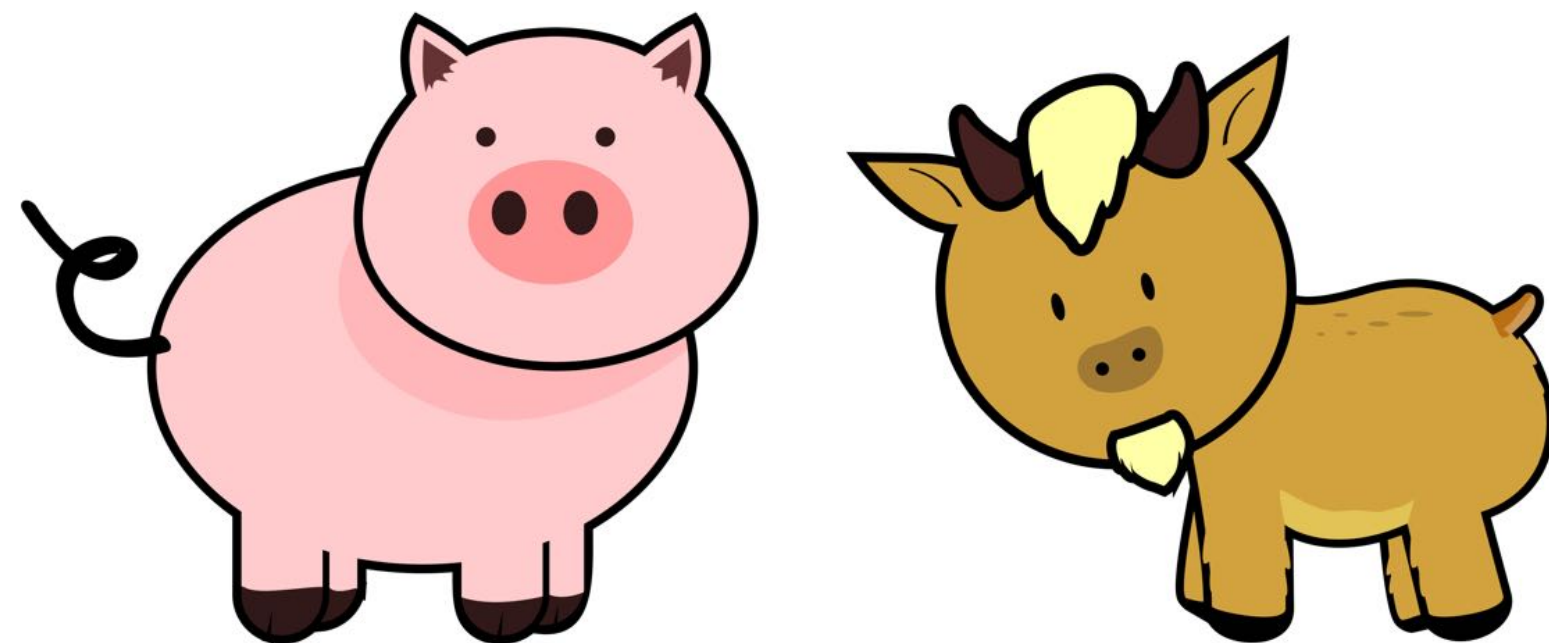
A sample item

May isang baboy at kambing.

Minsan gusto nilang manipa.

Minsan naman, gusto nilang magpasipa.

There is a pig and a goat.

Sometimes, they like to kick.

Sometimes, they like to be kicked.

A sample item

Piliin ang larawan ng...

baboy na sumisipa ng kambing

Choose the picture of ...

the pig that is kicking the goat
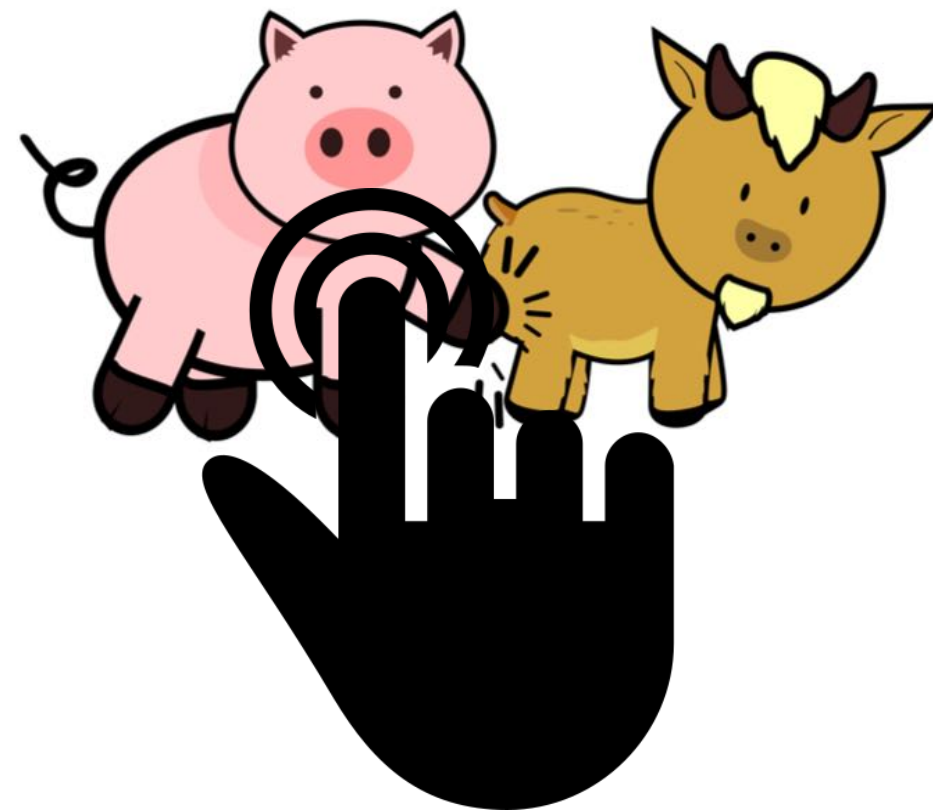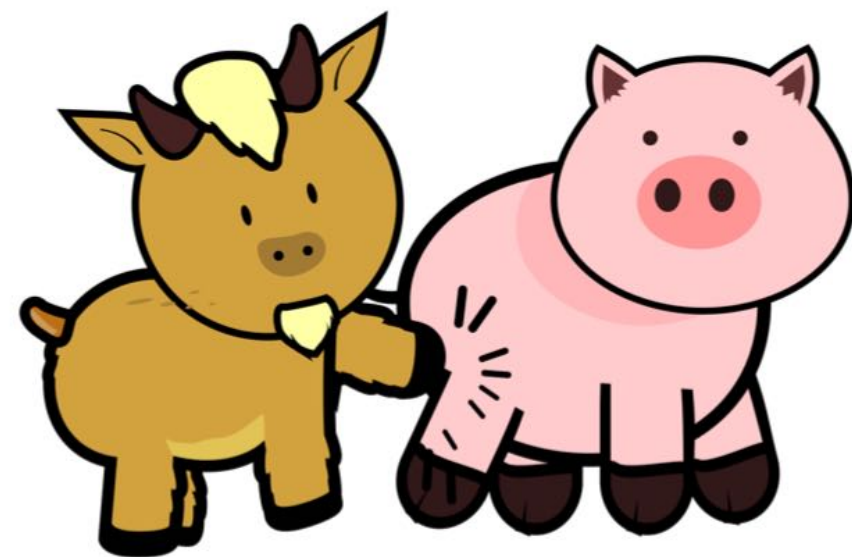
Methodology

Dependent measures:

- Selection + confidence rating
- RT of correct responses
- Gaze (very preliminary)

Deployed in OpenSesame using a Surface Pro tablet

Mathôt, Screij, & Theeuwes (2012)

Methodology

Participants: 65 speakers ($M = 25$ y.o., $SD = 8$), ranging from 18 to 59 y.o.

Mostly L1 speakers. Some early simultaneous/sequential bilinguals

Results: Choice data
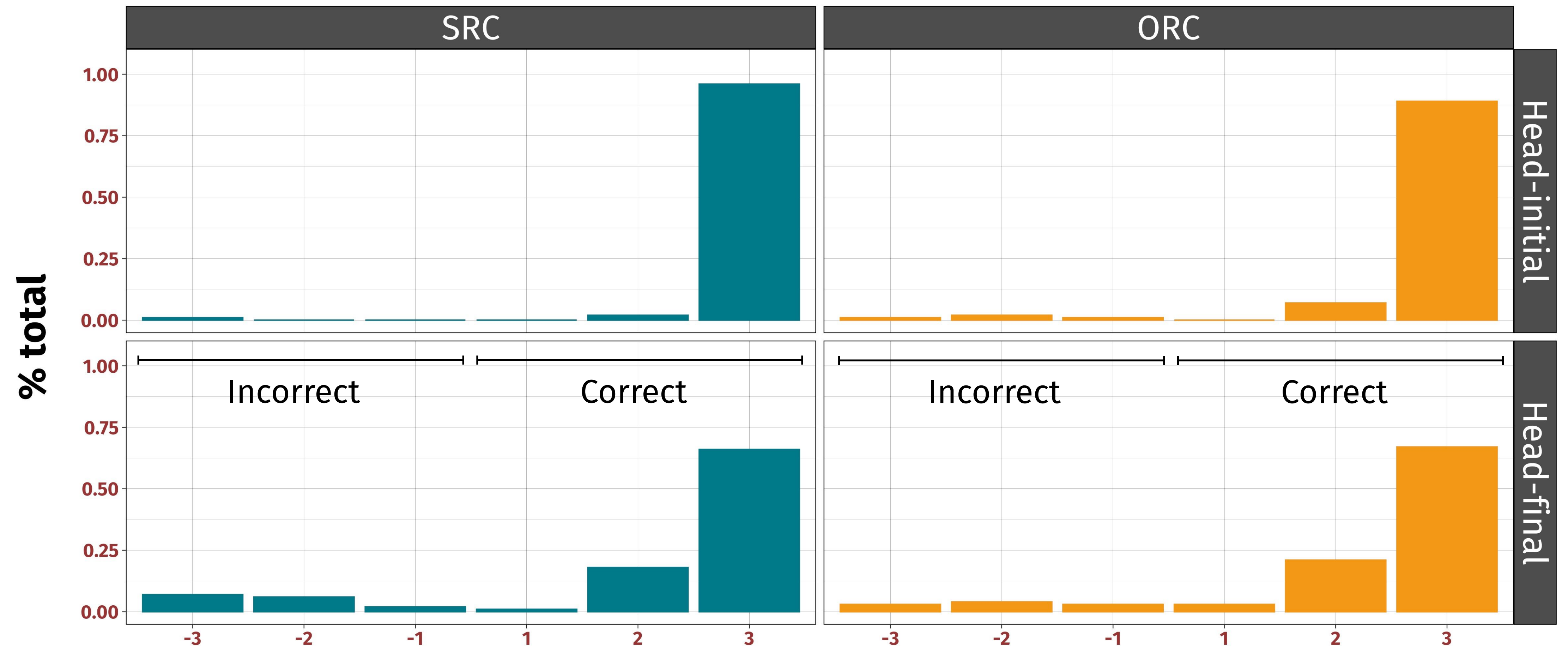
Results: Choice data

Main effect of Head ($p < .001$)

Participants were more accurate and confident in head-initial RCs than in head-final RCs

Main effect of Parse ($p < .05$)

Participants were more accurate and confident in SRCs than in ORCs
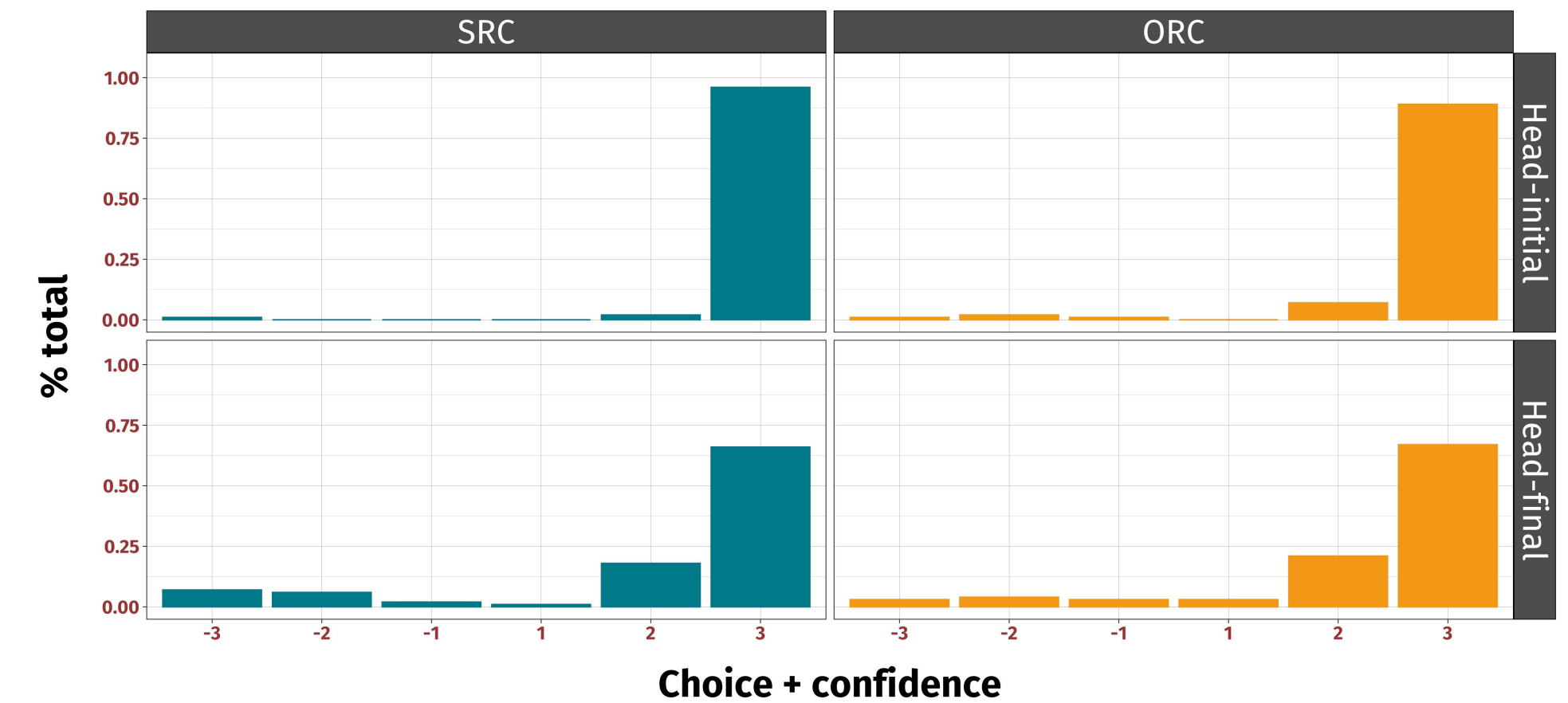
Results: Choice data

Head-Parse interaction ($p < .05$)

Participants were more accurate and confident in SRCs than in ORCs when the RC was head-initial, but not when it was head-final
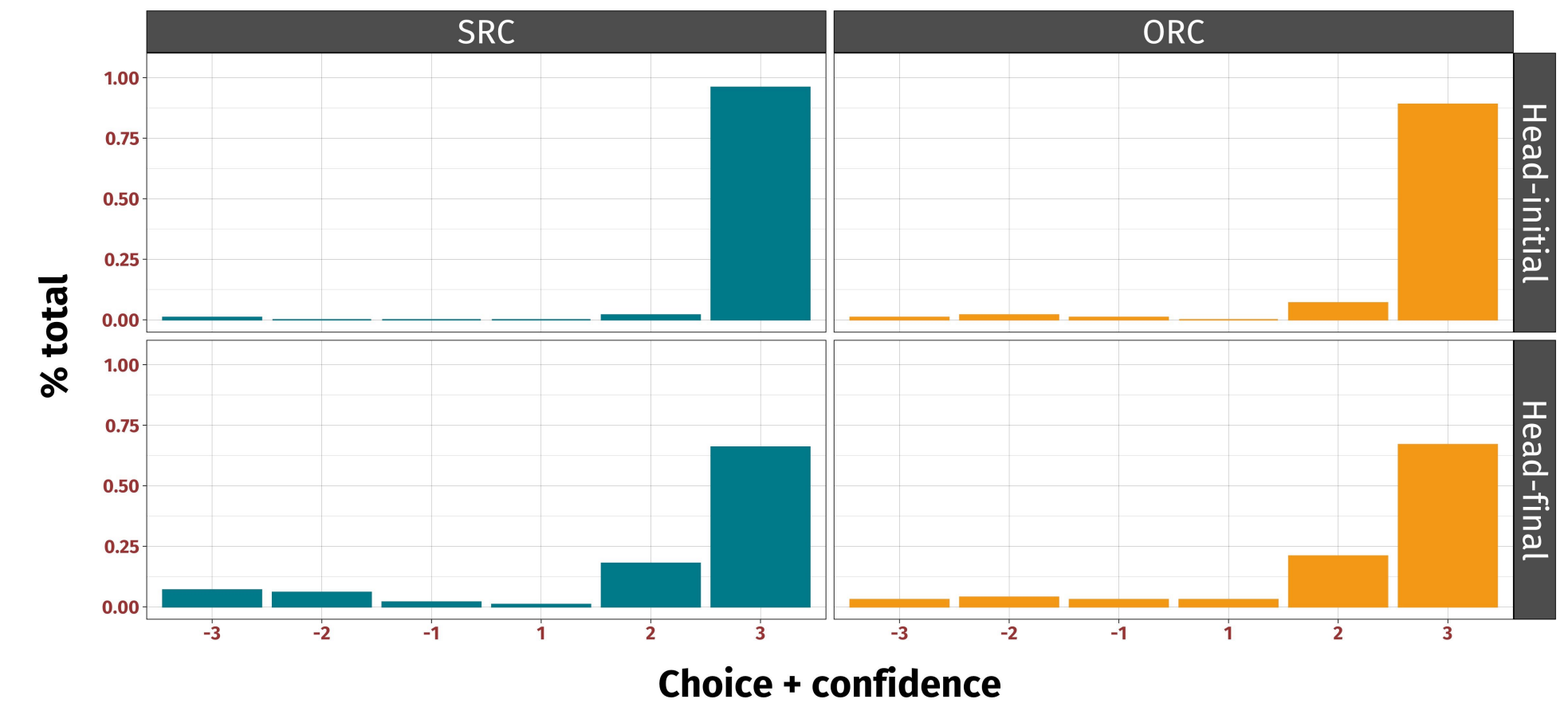
Choice data suggests an asymmetry in head-initial RCs, but no evidence for asymmetry in head-final RCs

Results: RT data
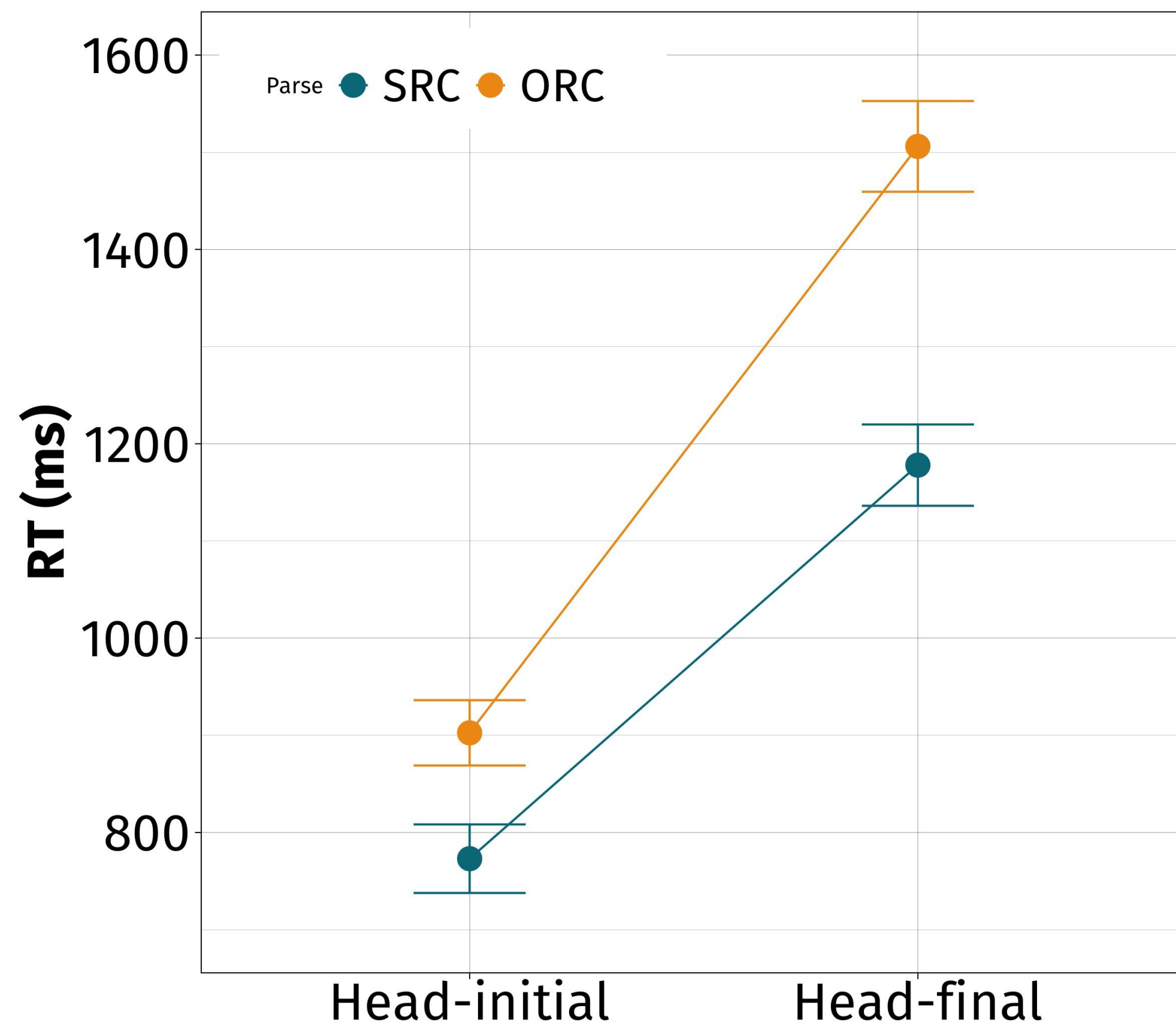
Main effect of Head $(p < .001)$

Correct head-initials were faster than correct head-finals

Main effect of Parse $(p < .05)$

Correct SRCs were faster than correct ORCs

Recap: Results

Choice data

Asymmetry in head-initial RCs

No evidence for asymmetry in head-final RCs

RT data

Asymmetry in both head-initial and head-final RCs

Today

~~Background on RC processing~~

~~Grammatical features of Tagalog~~

~~Picture-matching experiments~~

Discussion

Discussion

Chamorro vs. Tagalog

Wagers, Borja, and Chung (2018) found the following:

- In head-initial RCs, comprehenders preferred SRCs over ORCs (i.e., the asymmetry)

- In head-final RCs, comprehenders modestly preferred ORCs over SRCs (i.e., a reversal)…

- but were nonetheless faster at giving correct SRC-interpretations

Head-initial RCs are easier

Collapsing across PARSE, participants found head-initial RCs easier to process compared to head-final RCs

This finding is unsurprising:

- Head-initial RCs are the "unmarked" option
- Head-final RCs become more natural if they're "smaller"

How does each account fare?

👍🏽 = Consistent with account   👎🏽 = Inconsistent with account

	Head-initial		Head-final	
	Choice	RT	Choice	RT
	Asymmetry	Asymmetry	No asymmetry	Asymmetry
Frequency-based				
Word order similarity				
Memory-based				
Structure-based				

	Head-initial		Head-final	
	Choice	RT	Choice	RT
	Asymmetry	Asymmetry	No asymmetry	Asymmetry
Frequency-based	👎	👎	👎	👎

ORCs are more frequent than SRCs

Nagaya (2019)

Prediction: Reversals across-the-board (i.e., ORCs are easier to process than SRCs)

	Head-initial		Head-final	
	Choice	RT	Choice	RT
	Asymmetry	Asymmetry	No asymmetry	Asymmetry
Word order similarity	👍🏽	👍🏽	👍🏽	👎🏽

Basic word order depends on voice

- ◉ With AV: VSO or VOS

- ◉ With PV: VSO

Prediction:

- ◉ Asymmetry in head-initial RCs: S before O in AV; no O before S in PV

- ◉ No asymmetry in head-final RCs: S after O in AV; O after S in PV

	Head-initial		Head-final	
	Choice	RT	Choice	RT
	Asymmetry	Asymmetry	No asymmetry	Asymmetry
Memory-based	👍	👍	👍	👎

Basic word order depends on voice

- ◉ With AV: VSO or VOS
- ◉ With PV: VSO

Prediction:

- ◉ Asymmetry in head-initial RCs: Head [V __ O] vs. Head [V S __]
- ◉ No asymmetry in head-final RCs: [V O __] Head vs. [V S __] Head

	Head-initial		Head-final	
	Choice	RT	Choice	RT
	Asymmetry	Asymmetry	No asymmetry	Asymmetry
Structure-based	👍🏽	👍🏽	👎🏽	👍🏽

Assumption: the mechanism by which we combine verbs and its co-arguments is the same in English and Tagalog
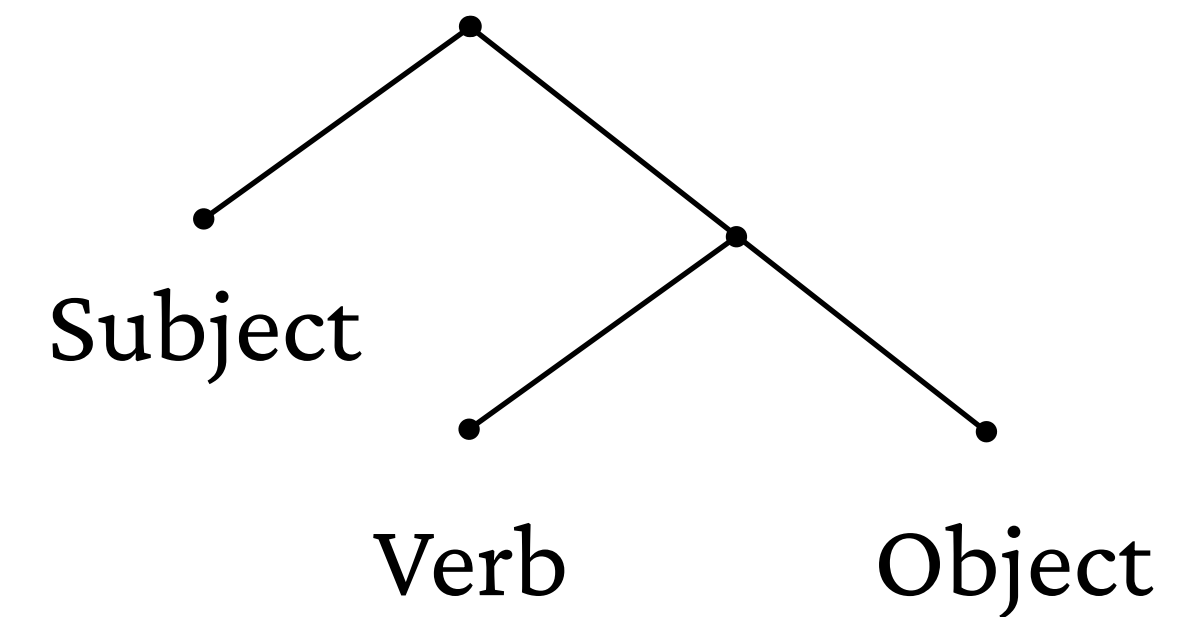
Prediction: Asymmetry across-the-board (by hypothesis)

How does each account fare?

👍🏽 = Consistent with account   👎🏽 = Inconsistent with account

	Head-initial		Head-final	
	Choice	RT	Choice	RT
	Asymmetry	Asymmetry	No asymmetry	Asymmetry
Frequency-based	👎🏽	👎🏽	👎🏽	👎🏽
Word order similarity	👍🏽	👍🏽	👍🏽	👎🏽
Memory-based	👍🏽	👍🏽	👍🏽	👎🏽
Structure-based	👍🏽	👍🏽	👎🏽	👍🏽

Main take-aways

Empirically: even in places where the asymmetry is attenuated, the participants' RT data still show it

Theoretically: There was not a single class of explanation that could fully account for all of the contours of the data

Samantha Sadural
(Voice actor)

Melvin Santiago
(Illustrator)

UP DEPARTMENT OF LINGUISTICS
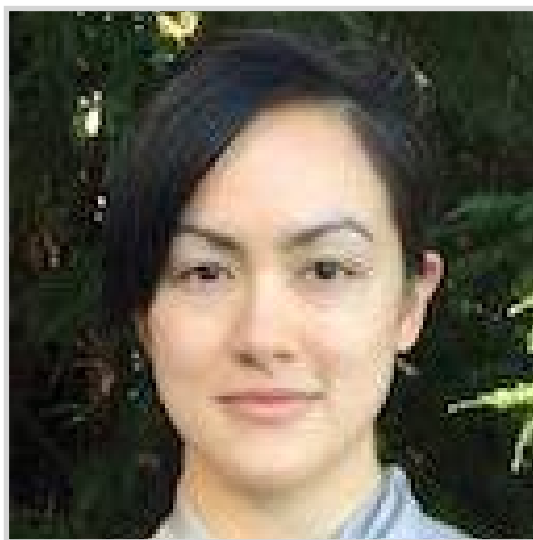
Sandy Chung & Amanda Rysling

Maraming salamat!

Thank you!
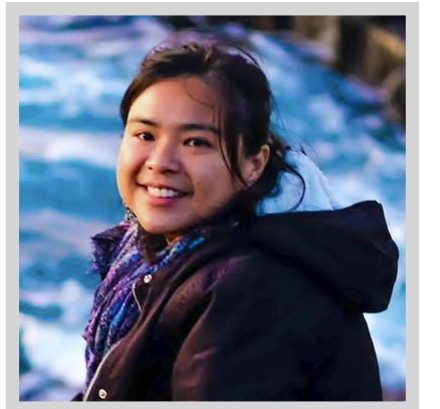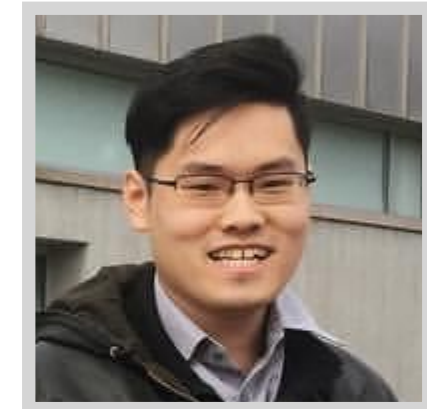
Henrison Hsieh (McGill/NUS), Kristina Gallego (ANU)
Rowena Garcia (MPI), Nozomi Tanaka (Indiana)
Divine Endriga (UP Diliman)

Experiment 2: RCs with pronominal co-arguments

A typical trial
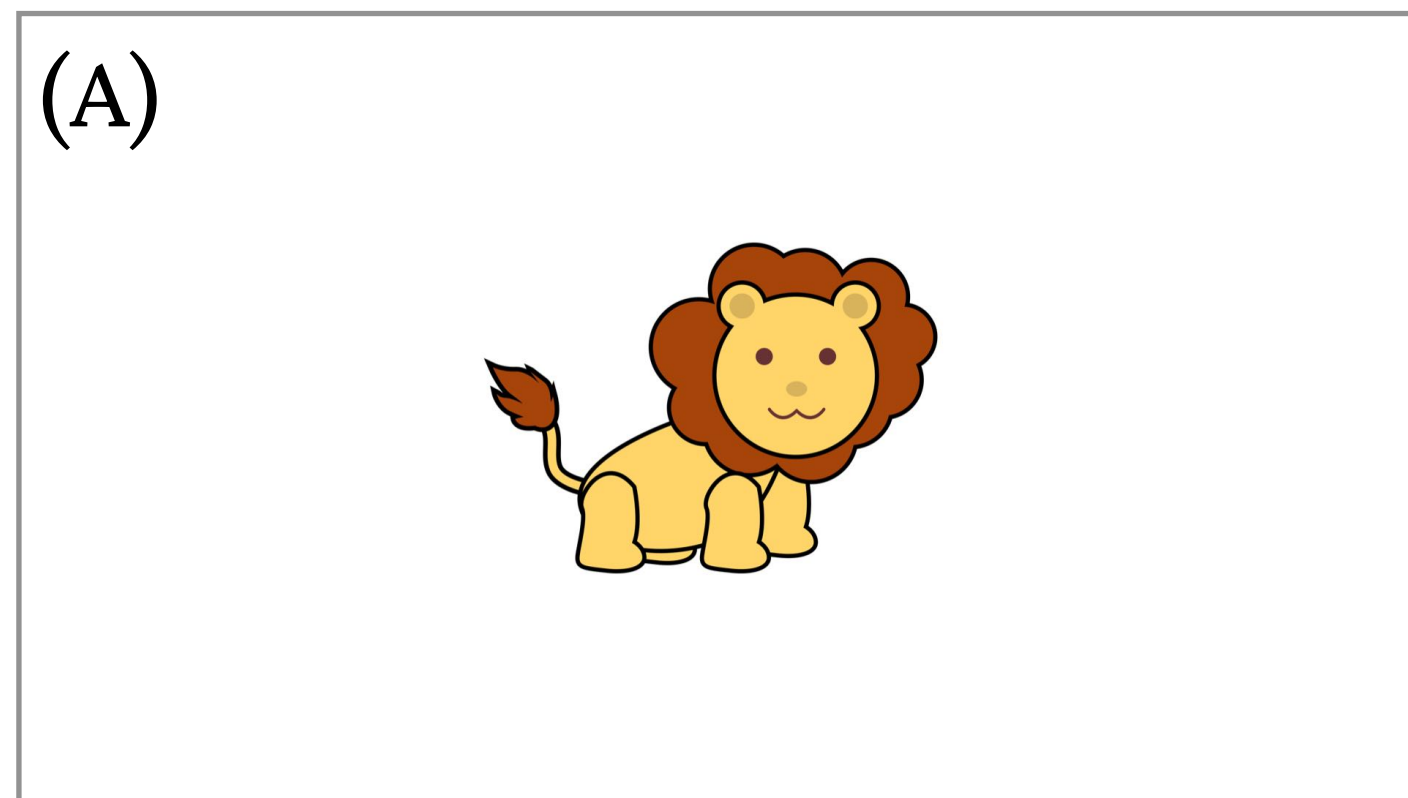
Task: Picture-matching plus confidence ratings

(A) Context   (B) Picture selection   (C) Confidence rating
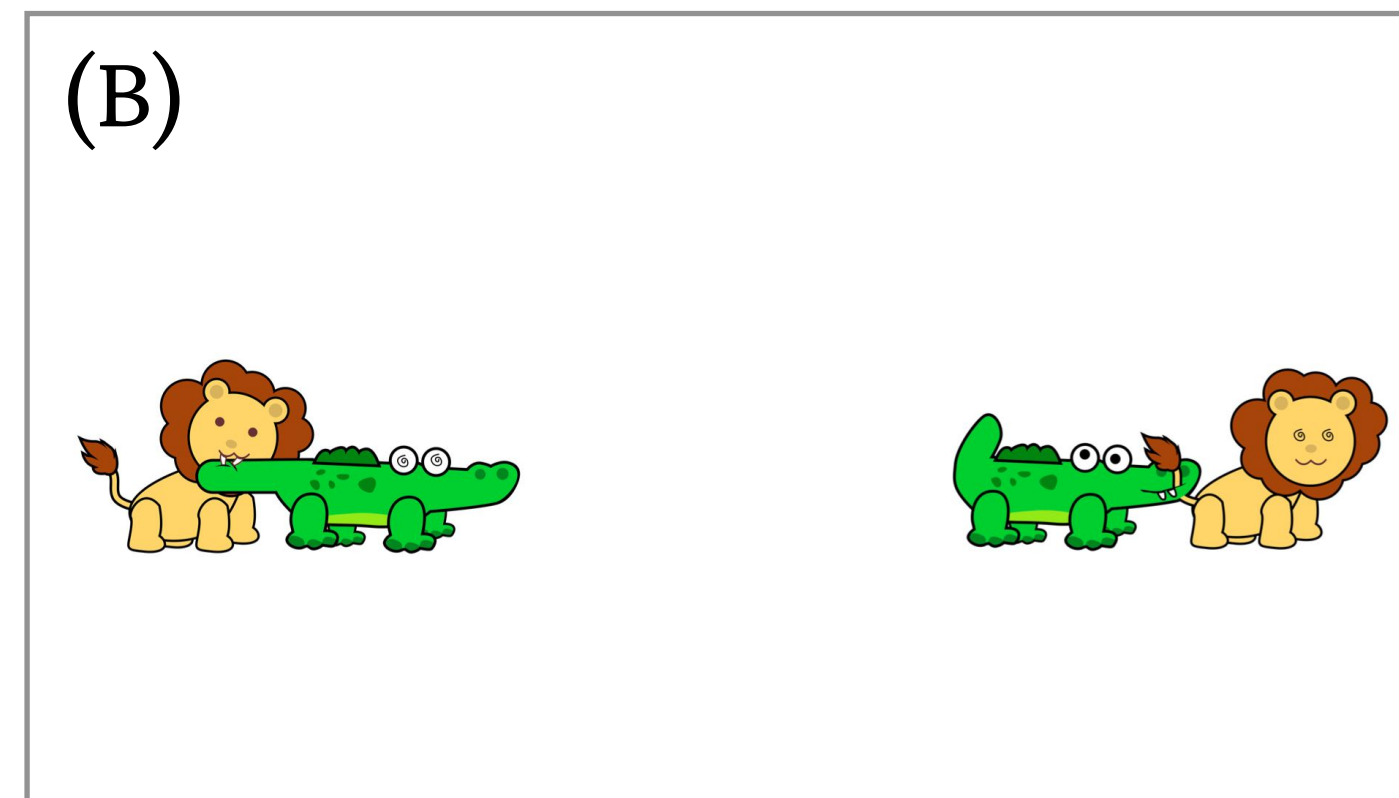
Design

2 (**HEAD**: INITIAL, FINAL) x 2 (**PARSE**: SRC, ORC)

Initial	SRC	**buwaya** [na **kumakagat** sa kaniya]
Initial	ORC	**buwaya** [na **kinakagat** niya]
Final	SRC	[**kumakagat** sa kaniya na] **buwaya**
Final	ORC	[**kinakagat** niya na] **buwaya**

16 items via Latin square design
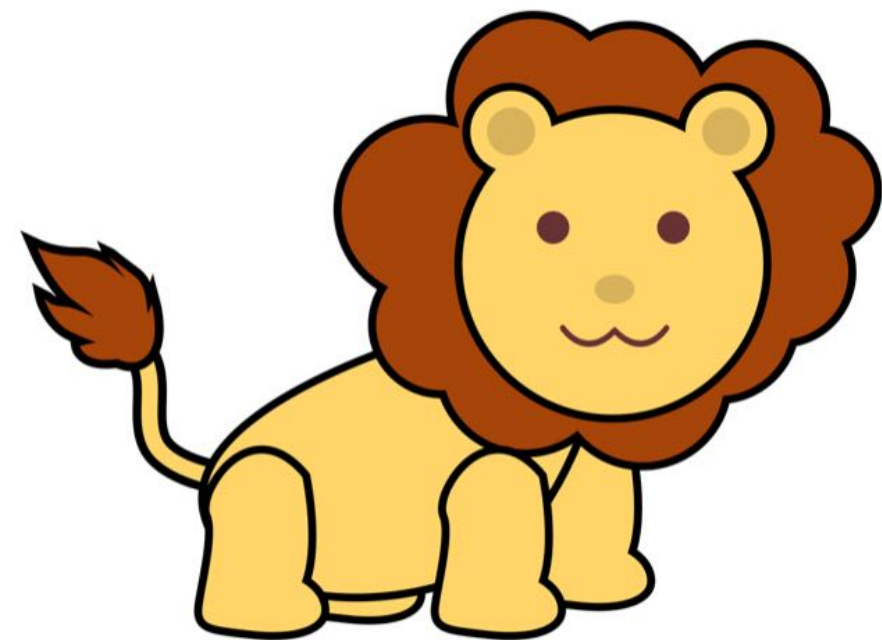
A sample item

May isang leon.

Minsan gusto niyang mangagat

Minsan naman, gusto niyang magpakagat.

There is a lion.

Sometimes, s/he likes to bite.
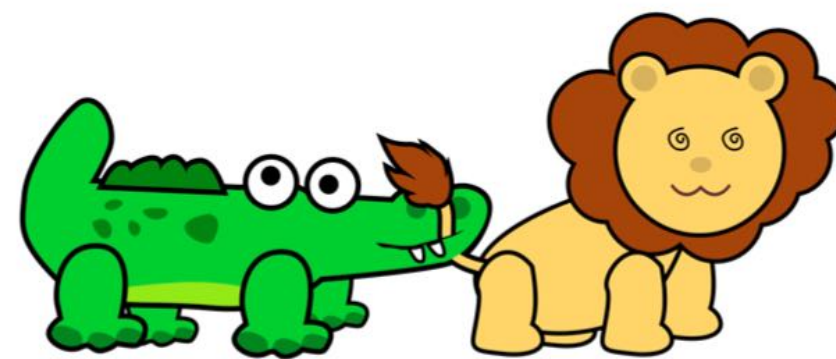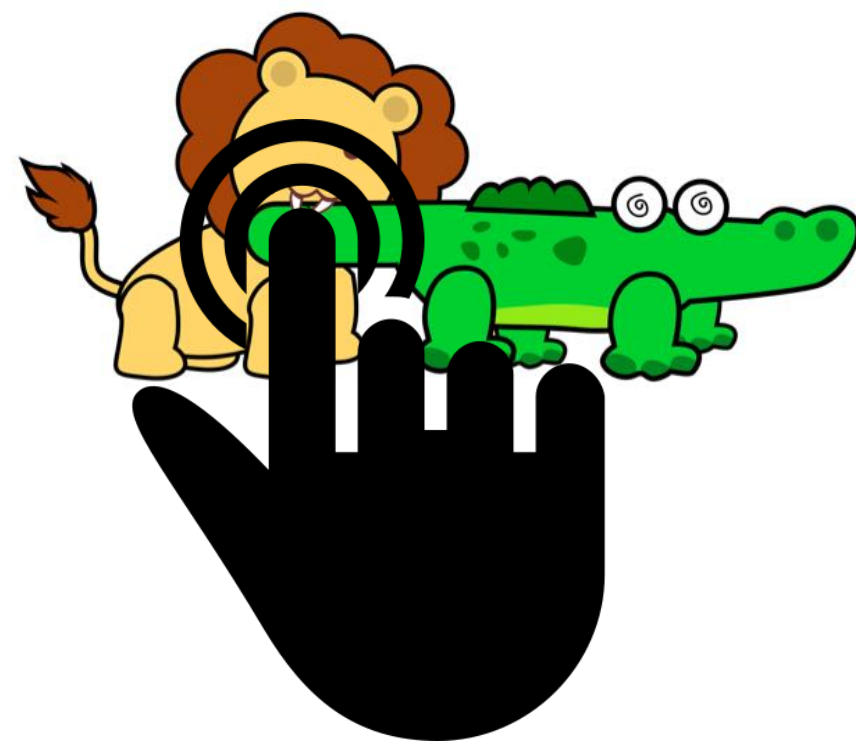
Sometimes, she likes to be bitten.

A sample item

Piliin ang larawan ng...

buwaya na kinakagat niya

Head-initial, ORC

Choose the picture of ...
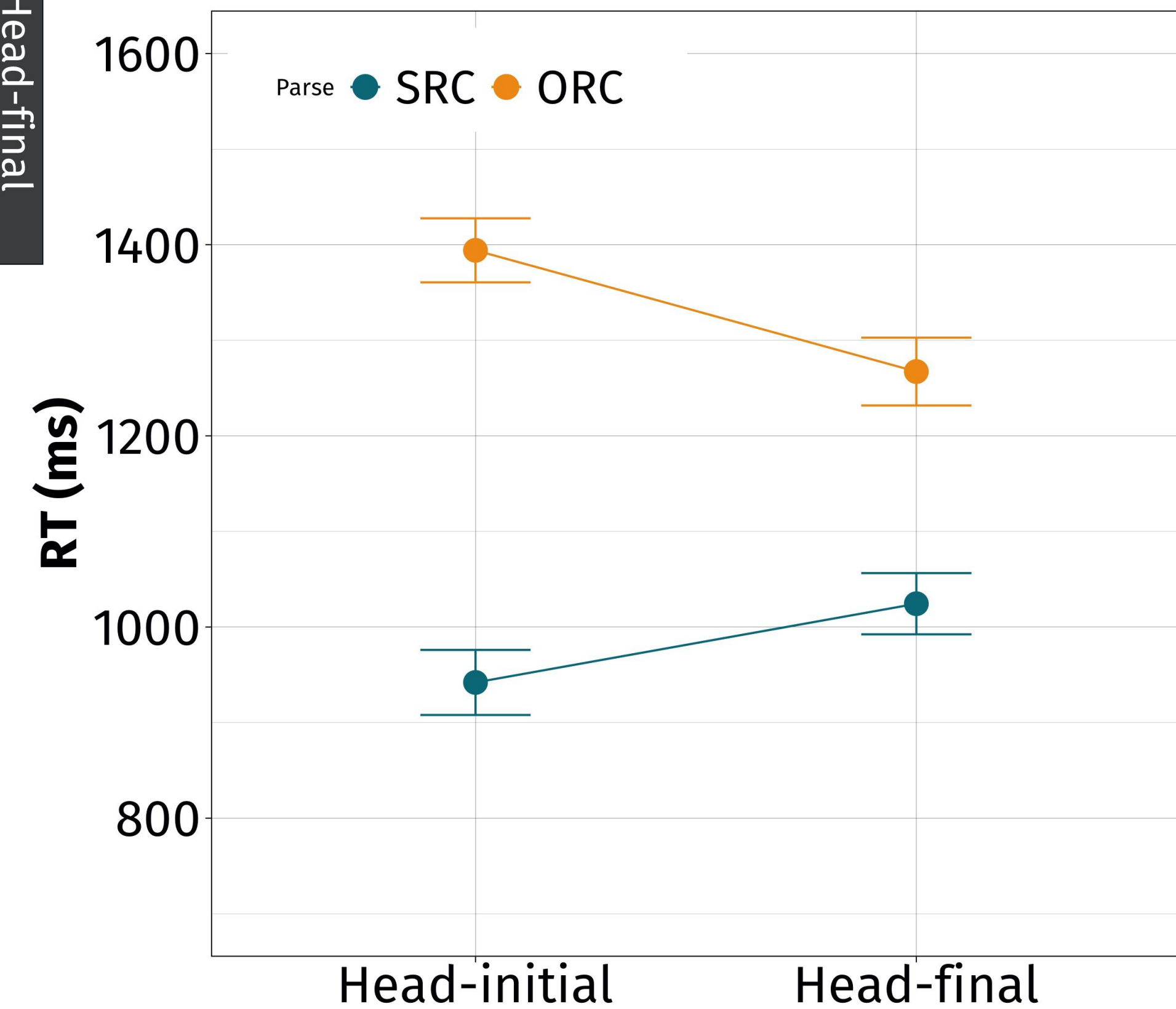
the crocodile that s/he is biting.

tl;dr
Head-initial:
No asymmetry (choice); Asymmetry (RT)
Head-final:
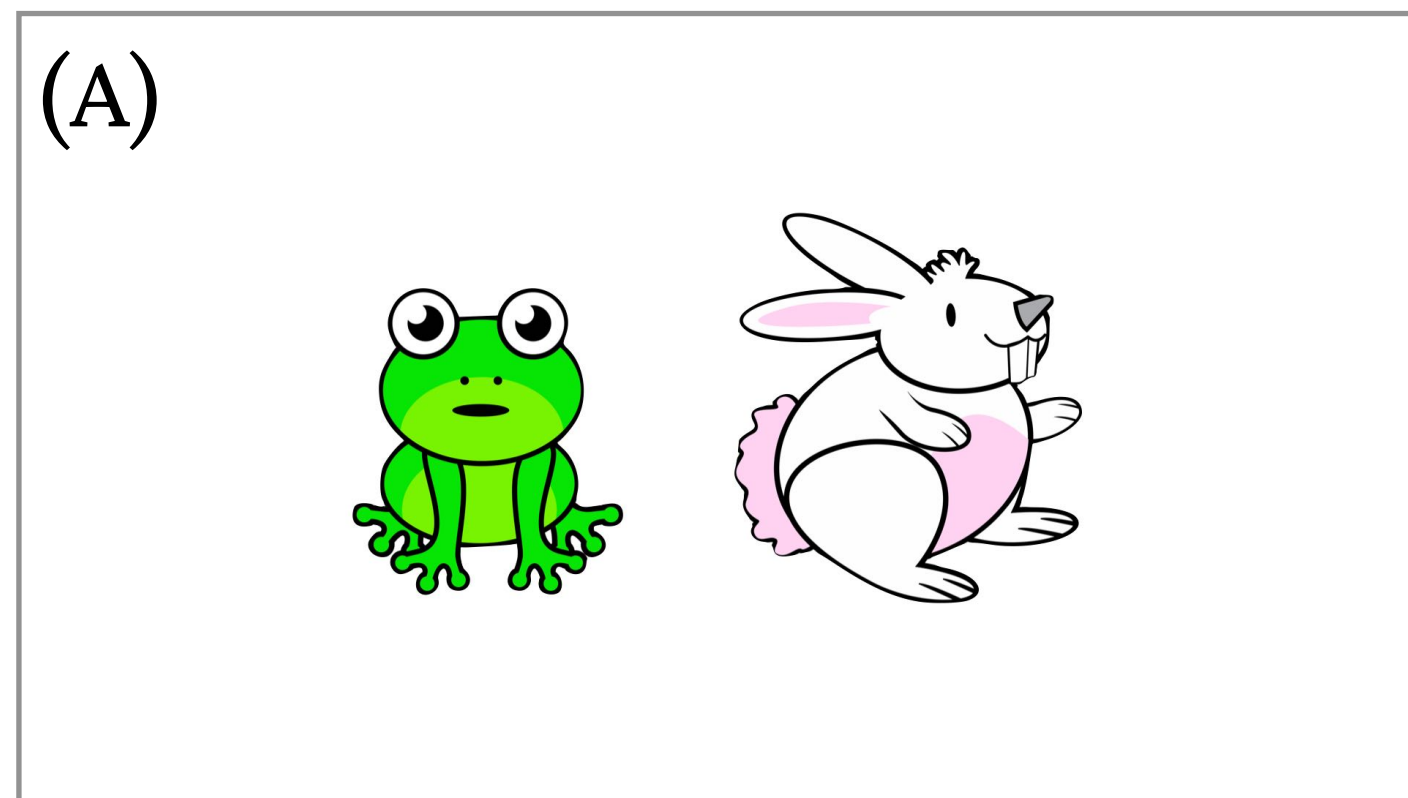No asymmetry (choice); Asymmetry (RT)

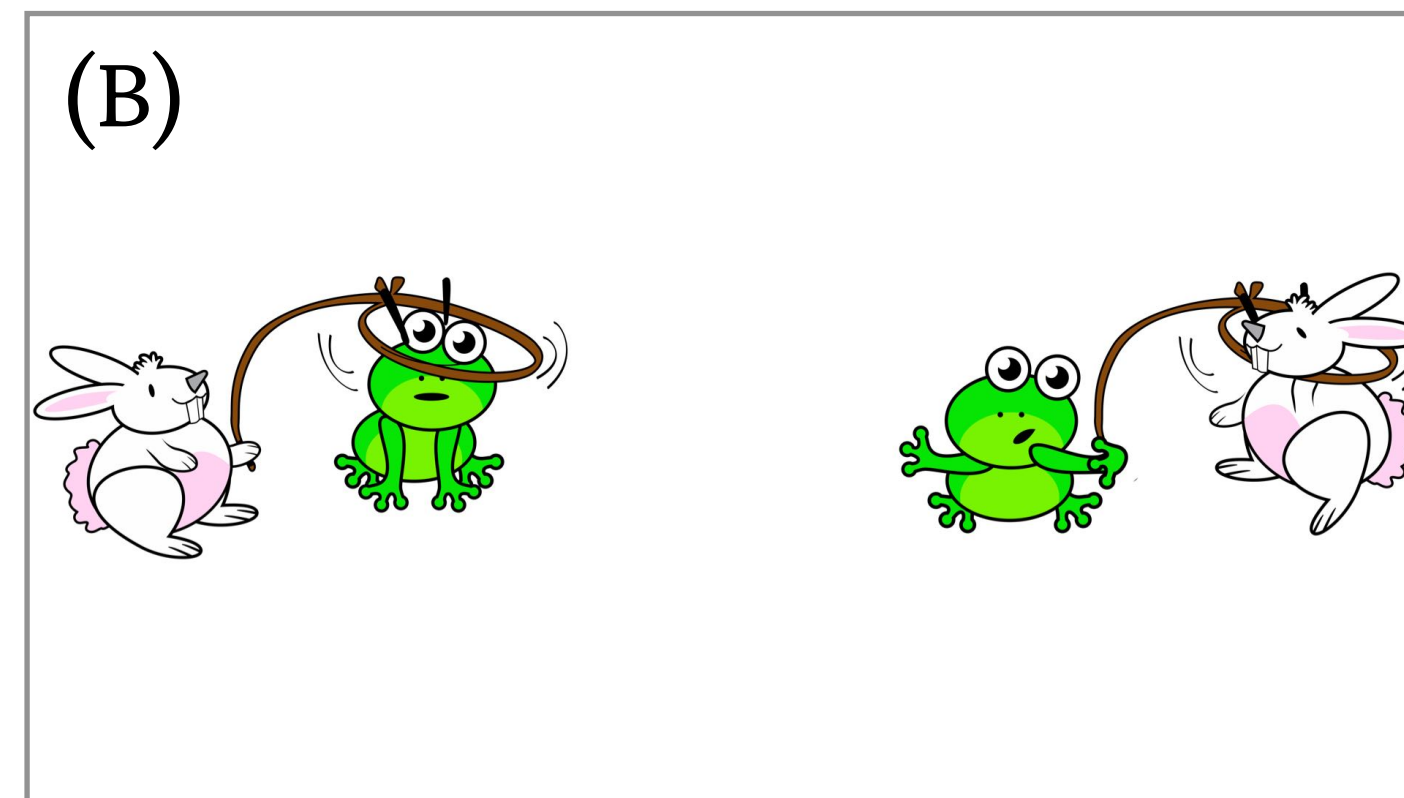# Experiment 3: ambiguous RCs with NP coarguments

A typical trial

Task: Picture-matching plus confidence ratings

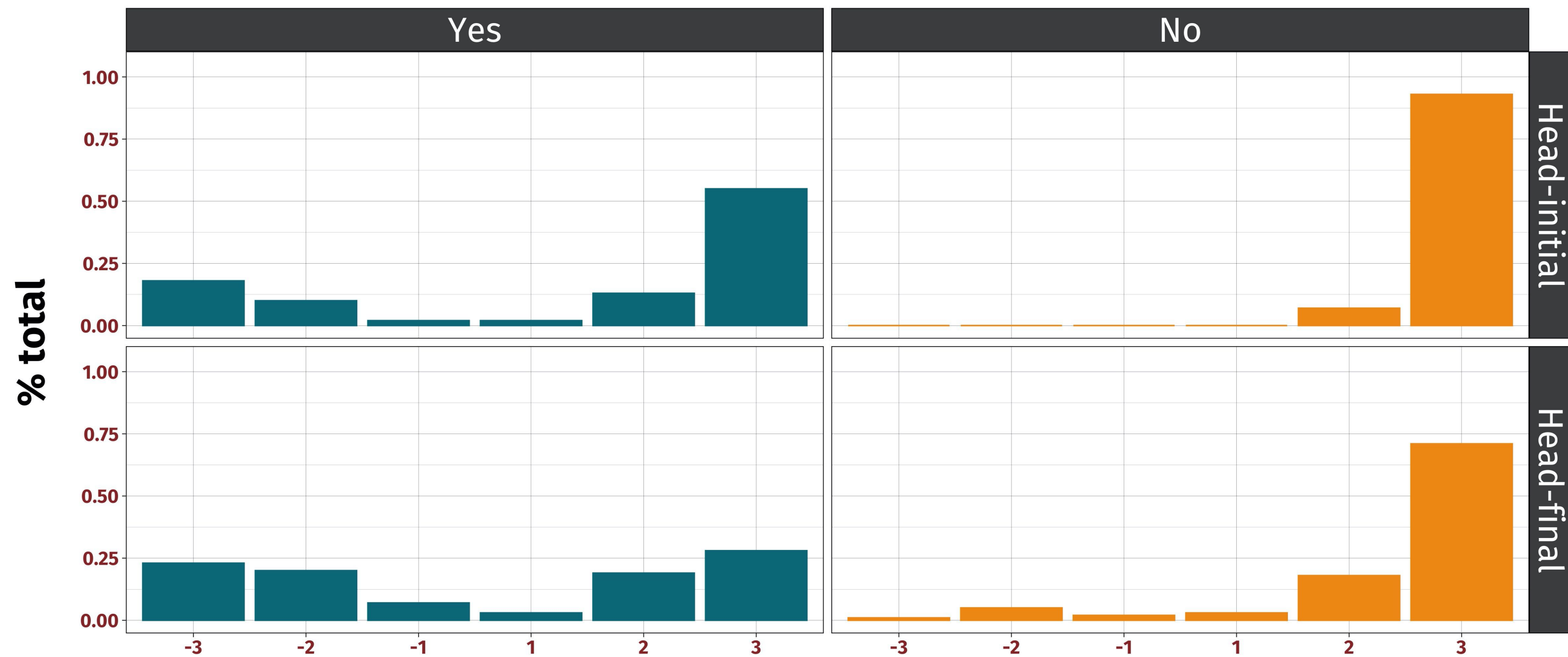(A) Context (B) Picture selection (C) Confidence rating

Design

2 (**HEAD**: INITIAL, FINAL) x 2 (**AMBIG**: YES, NO)

Initial	Yes	**palaka** [na **kakahuli** lang ng kuneho]
Initial	No	**palaka** [na **kakahuli** lang sa kuneho]
Final	Yes	[**kakahuli** lang ng kuneho na] **palaka**
Final	No	[**kakahuli** lang sa kuneho na] **palaka**

16 items via Latin square design

tl;dr
Head-initial:
Head-initial: Asymmetry (choice); Asymmetry (RT)
Head-final:
No asymmetry (choice); No asymmetry (RT)

Comparing Ambig SRCs and Unambig SRCs

Unambig < Ambig

Comparing Ambig SRCs and Ambig ORCs

Head-initial: SRC < ORC

Head-final: SRC = ORC