(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. \(\text{SRC}\)

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

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 ]
The fox [ that the dog is biting __ under the tree ]

SRC (62%)
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

Accounting for the asymmetry

Different proposals emphasize different aspects of the dependency:

- Syntactic structure
- Memory
- Frequency
- Word order similarity

Intervention-based accounts

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

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
1
the reporter
2 that
3 __
attacked the senator

ORC
1
the reporter
2 that
3 the senator
4 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.  

(b) The reporter [ that the senator attacked ___ ] admitted the error.
The role of frequency

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


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)

<table>
<thead>
<tr>
<th></th>
<th>BNC</th>
<th>BNC-Spoken</th>
<th>Brown</th>
<th>Switchboard</th>
<th>WSJ</th>
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<tbody>
<tr>
<td>SRC</td>
<td>14,182</td>
<td>9,851</td>
<td>15,024</td>
<td>9,548</td>
<td>18,229</td>
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<tr>
<td>ORC</td>
<td>2,943</td>
<td>3,863</td>
<td>1,976</td>
<td>5,616</td>
<td>1,802</td>
</tr>
</tbody>
</table>
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.  

(b) the senator attacked ___ ] admitted the error.
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

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

Bever (1970); Diessel & Tomasello (2005)
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
- Frequency
- Word order similarity

Intervention-based account

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 ] ...

(b) The **senator** [ that the journalist criticized ___ ] ...

(c) The **article** [ that the journalist criticized ___ ] ...

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 ]
(b) [ RC ] Head

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-Pavia, & Laka (2010)
Attenuating the asymmetry

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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 ]

\[
\begin{array}{ll}
\text{person} & \text{COMP} \\
\text{AGR.sit.PROG}
\end{array}
\]

Man [ who ___ is sitting down ]

Head-initial

(b) [ matåta’chung ] na tåotao

\[
\begin{array}{ll}
\text{AGR.sit.PROG} & \text{LNK} \\
\text{person}
\end{array}
\]

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

(10) Tagalog

(a) **Sumisipa**  ng=aso  ang=pusa  
    kick.Av  GEN=dog  NOM=cat
    ‘The cat is kicking a dog’

(b) **Sinisipa**  ng=pusa  ang=aso  
    kick.Pv  GEN=cat  NOM=dog
    ‘The cat is kicking the dog’

*The dog is kicking the cat*

Schachter & Otanes (1983)
Voice interacts with word order

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

(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 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

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

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

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

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

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

- No data for head-final RCs

Does head-RC order attenuate the asymmetry?

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

1. Hindi sure
2. Medyo sure
3. Sure na sure

Gaano ka sigurado?
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 ]
- ORC: baboy [ na sinisipa ng kambing ]

Final
- SRC: [ sumisipa ng kambing na ] baboy
- ORC: [ sinisipa ng kambing na ] baboy

16 items via Latin square design
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

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

![Graph of choice data for SRC and ORC categories](image-url)
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

<table>
<thead>
<tr>
<th></th>
<th>Head-initial</th>
<th>Head-final</th>
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</thead>
<tbody>
<tr>
<td>Choice</td>
<td>Asymmetry</td>
<td>No asymmetry</td>
</tr>
<tr>
<td>RT</td>
<td>Asymmetry</td>
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Frequency-based
Word order similarity
Memory-based
Structure-based
<table>
<thead>
<tr>
<th></th>
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<th></th>
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<td>Choice</td>
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<tr>
<td>Asymmetry</td>
<td>Asymmetry</td>
<td>No asymmetry</td>
<td>Asymmetry</td>
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</table>

Frequency-based

👎 👎 👎 👎

**ORCs are more frequent than SRCs**

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

Nagaya (2019)
<table>
<thead>
<tr>
<th>Head-initial</th>
<th>Choice</th>
<th>RT</th>
<th>Head-final</th>
<th>Choice</th>
<th>RT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asymmetry</td>
<td>Asymmetry</td>
<td>No asymmetry</td>
<td>Asymmetry</td>
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</table>

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
<table>
<thead>
<tr>
<th></th>
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<tr>
<td><strong>Choice</strong></td>
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<td>No asymmetry</td>
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<tr>
<td><strong>RT</strong></td>
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</tbody>
</table>

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
**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?

<table>
<thead>
<tr>
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/thumb = Consistent with account  
/thumb = Inconsistent with account
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
Experiment 2: RCs with pronominal co-arguments
A typical trial

**Task:** Picture-matching plus confidence ratings

(A) Context

(B) Picture selection

(C) Confidence rating

---

1. Hindi sure
2. Medyo sure
3. Sure na sure

Pindutin ang numero
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

There is a lion.
Sometimes, s/he likes to bite.
Sometimes, she likes to be bitten.

May isang leon.
Minsan gusto niyang mangagat
Minsan naman, gusto niyang magpakagat.
A sample item

Piliin ang larawan ng... buwaya na kinakagat niya

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)

<table>
<thead>
<tr>
<th>Initial</th>
<th>Yes</th>
<th>palaka [ na kakahuli lang ng kuneho ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial</td>
<td>No</td>
<td>palaka [ na kakahuli lang sa kuneho ]</td>
</tr>
<tr>
<td>Final</td>
<td>Yes</td>
<td>[ kakahuli lang ng kuneho na ] palaka</td>
</tr>
<tr>
<td>Final</td>
<td>No</td>
<td>[ kakahuli lang sa kuneho na ] palaka</td>
</tr>
</tbody>
</table>

16 items via Latin square design
Comparing Ambig SRCs and Unambig SRCs
Unambig < Ambig

Comparing Ambig SRCs and Ambig ORCs
Head-initial: SRC < ORC
Head-final: SRC = ORC