

In Search of Quantifier Scope Ambiguity

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Quantifiers

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- ▶ scopally interact with each other: via syntactic computation - movement of universal quantifiers obey the constraints on movement.
- ▶ two possible relative scopes: (i) $\forall > \exists$; (ii) $\exists > \forall$

Quantifiers & Ambiguity

- (1) **Some child** read **every book**.

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Notice the color scheme in (1) and in the paraphrases (a) and (b).

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- ▶ More computational complexity corresponds to more Processing Cost
- ▶ The Human Sentence Processing mechanism prefers to compute a scope configuration with the least computational complexity. (Anderson 2004)

Preference for a Scope reading

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- ▶ Ioup (1975) \leadsto

The preference for a particular scope reading varies with the particular quantifier determiner used.

- ▶ *each* and *every* prefers to take wide scope over other quantifiers in the sentence
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- ▶ **Hierarchy of Scope Preference:**

each > *every* > *all* ...

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- ▶ **Hierarchy of Scope Preference:**

each > *every* > *all* ...

the tendency of *each* to take wide scope over another quantifier is greater than that of *every*, and the tendency of *every* to take wide scope over another quantifier is greater than that of *all*, and so on...

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‘many-trees’ reading

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 - b. There is a certain tree which was climbed by every kid.

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- Preferred readings predicted by Hierarchy of Scope Preference:
each > every > all ...
- (i) Every kid climbed a tree \leadsto ‘many-trees’ reading
 - (ii) Each kid climbed a tree \leadsto ‘many-trees’ reading
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- Acceptability for the ‘many-trees’ reading:
- (i) Each kid climbed a tree \leadsto 90%
 - (ii) Every kid climbed a tree \leadsto 85%
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The results confirm the predictions of the Hierarchy of Scope Preference.

Scrambling Languages

Bangla, German, Greek, Hindi, Japanese, Malayalam, Mandarin, Russian, . . .

Scrambling is a Movement operation that changes the word order of a sentence.

Mahajan 1990

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 Raam-ERG banana ate
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 d. khaayaa raam-ne kelaa (VSO)
 e. khaayaa kelaa raam-ne (VOS)
 f. kelaa khaayaa raam-ne (OVS)

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- Scrambling affects the scope readings of quantifiers.

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Hindi

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 some child every book read.FUT.MSG
 ‘Some child will read every book.’

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(b) *Each book* will be read by *a possibly different child*. IS

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- | | | | | | |
|------|---------------------------|--------------|-----------|--------------------|--|
| (11) | dareka-ga | daremo-o | aisiteiru | SOV | |
| | someone-NOM | everyone-ACC | loves | | |
| | 'Someone loves everyone.' | | | ✓Surface, ✗Inverse | |
| (12) | daremo-o | dareka-ga | aisiteiru | OSV | |
| | everyone-ACC | someone-NOM | loves | | |
| | 'Someone loves everyone.' | | | ✓Surface, ✓Inverse | |

Scrambling Languages

In the canonical order, SS is the only reading available.

- | | | |
|------|------------------------------------|--------------------|
| (9) | koi bacca har kitab parhega | SOV |
| | some child every book read.FUT.MSG | |
| | ‘Some child will read every book.’ | ✓Surface, ✗Inverse |
| (10) | har kitab koi bacca parhega | OSV |
| | every book some child read.FUT.MSG | |
| | ‘Some child will read every book.’ | ✓Surface, ✓Inverse |

- | | | | | | |
|------|---------------------------|--------------|-----------|--------------------|--|
| (11) | dareka-ga | daremo-o | aisiteiru | SOV | |
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Mahajan 2017, Miyagawa 2011,

Bangla, German, Greek, Hindi, Japanese, Malayalam, Mandarin, Russian, ...

Hindi

- Japanese*

- What is the source of this **variation** in perception of ambiguity? **Word Order**

Mahajan 2017, Miyagawa 2011, Bobaljik & Wurmbrand 2012

Scope Transparency & Previous Experimental Work

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 - ▶ Preference for Surface Scope

Fanselow et al 2022, Oikonomou et al. 2020, Ionin et al. 2014, among others

Research Questions

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 - ▶ Surface scope preference is supposedly almost absolute in a scrambling language. Can the quantifiers work against that?

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- (C) How does Scrambling affect Scope Preference?
 - ▶ Sentence Picture Matching Task
 - ▶ Recruited 225 speakers of UK English and 154 speakers of Indian Bangla.

Experiment Design

Target Sentences

Experiment Design

Target Sentences

Two Factors:

Experiment Design

Target Sentences

Two Factors:

- ▶ **Word Order**

English : SVO

Bangla: SOV, OSV

Experiment Design

Target Sentences

Two Factors:

- ▶ **Word Order**

English : SVO

Bangla: SOV, OSV

- ▶ **Determiner Type**

English: *each, every, all of the*

Bangla: *SOB-KOTA, PROTI-TA*

Experiment Design

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English : SVO

Bangla: SOV, OSV

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Target Sentences:

SVO \leadsto

(13) Exactly three monkeys are holding each/every/all of the branch(es).

Experiment Design

Target Sentences

Two Factors:

► Word Order

English : SVO

Bangla: SOV, OSV

► Determiner Type

English: *each, every, all of the*

Bangla: *SOB-KOTA, PROTI-TA*

Target Sentences:

SVO ~

(13) Exactly three monkeys are holding each/every/all of the branch(es).

SOV ~

(14) THIK TIN-TE-BADOR SOB-KOTA/PROTI-TA-DAL-KE DHORE ACHE.
exactly three-CLF-monkey all-MANY.CLF/each-CLF-branch-DAT hold are
'Exactly three monkeys are holding all of the/ each branch(es).'

OSV ~

(15) SOB-KOTA/PROTI-TA-DAL-KE THIK TIN-TE-BADOR DHORE ACHE.
all-MANY.CLF/each-CLF-branch-DAT exactly three-CLF-monkey hold are
'Exactly three monkeys are holding all of the/ each branch(es).'

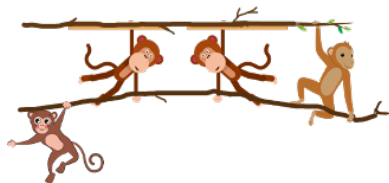
Experiment Design

Two Scope Readings

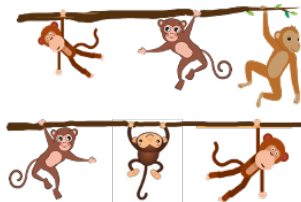
Experiment Design

Two Scope Readings

(10) Exactly three monkeys are holding each/every/all of the branch(es).



(a) exactly 3 monkeys are holding all of the branches

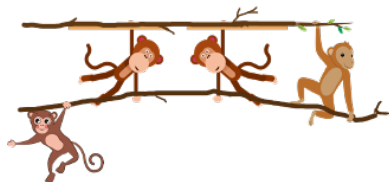


(b) each branch is held by exactly 3 monkeys

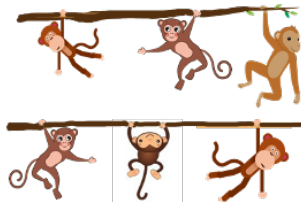
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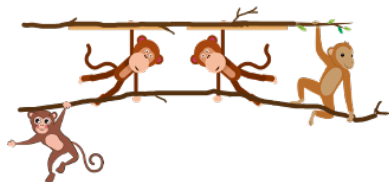
(a) Exactly 3 monkeys are holding all of the branches.

SS

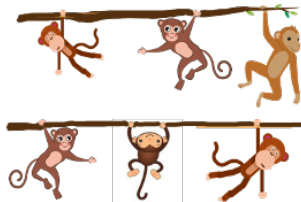
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SS

(b) Each branch is held by exactly 3 monkeys.

IS

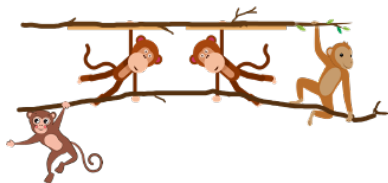
Experiment Design

Two Scope Readings - for SOV

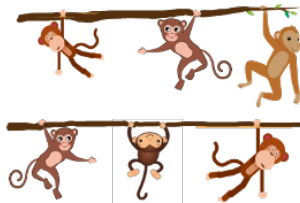
Experiment Design

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SS
IS

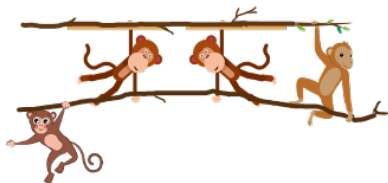
Experiment Design

Two Scope Readings - for OSV

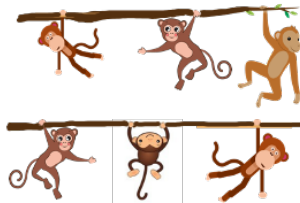
Experiment Design

Two Scope Readings - for OSV

- (17) SOB-KOTA/PROTI-TA-DAL-KE THIK TIN-TE-BADOR DHORE ACHE.
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IS
SS

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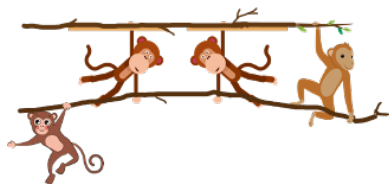
Picture Type

Experiment Design

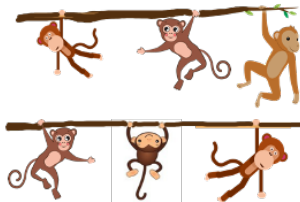
Picture Type

Third Factor: Picture Type

1. (a) SS for SVO & SOV, IS for OSV
2. (b) IS for SVO & SOV, SS for OSV
3. (c) Ctrl-True
4. (d) Ctrl-False



(a) exactly 3 monkeys are holding all of the branches



(b) each branch is held by exactly 3 monkeys

Experiment Design

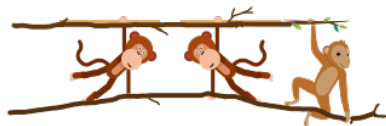
Picture Type

Experiment Design

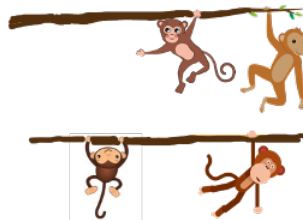
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3. (c) Ctrl-True
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Ctrl-True



Ctrl-False

- ▶ Ctrl-True depicts a situation where both scope readings are true.
- ▶ Ctrl-False depicts a situation where both scope readings are false.

Experiment Design

Target Conditions

- ▶ Target Conditions: Word Order x Picture Type x Determiner Type
 - ▶ Word Order and Picture Type were manipulated **within-subject**
 - ▶ Determine Type was manipulated **between-subject**

Experiment Design

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Exactly three monkeys are holding every branch.

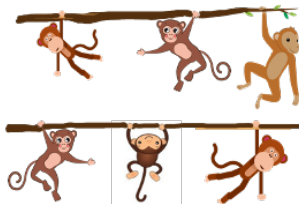


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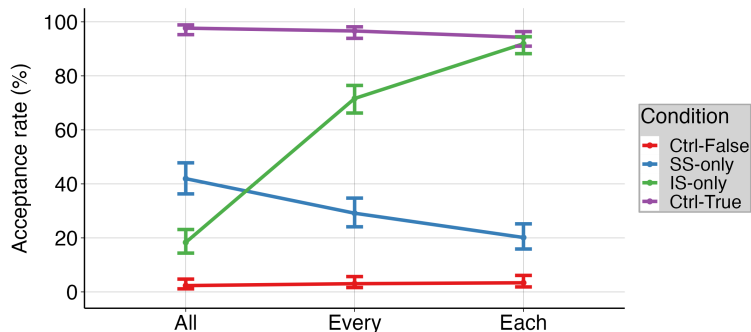


- ▶ The list of Targets were created from 16 sets of sentences and 16 sets of pictures.
- ▶ They were presented in a randomized order along with Controls and Fillers.

Results

English

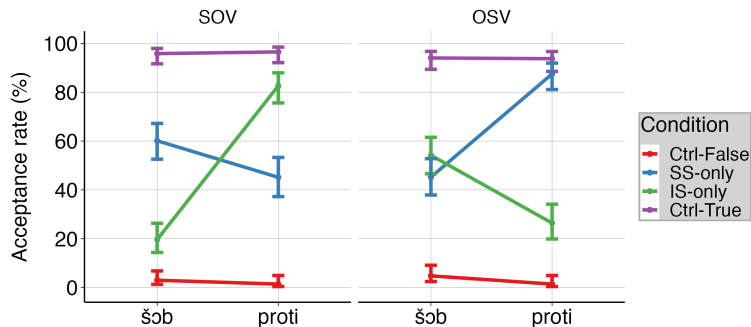
Accuracy scores for Ctrl-True and Ctrl-False conditions were > 95%



Mean of 'Yes' responses to experimental conditions by Determiner type. Error bars represent 95% confidence intervals.

- ▶ Scope Preference shifts from SS, for *all* to IS for *every* and *each*.
- ▶ Gradient in acceptance rates is in line with the Scope Preference Hierarchy.

Accuracy scores for Ctrl-True and Ctrl-False conditions were > 95%



Mean of 'Yes' responses to SOV and OSV sentences by experimental condition and Determiner type. Error bars represent 95% confidence intervals.

- ▶ SOV: Scope Preference reverses from SS, for SOB to IS for PROTI.
- ▶ OSV: A strong preference for wide scope shown by PROTI.

- ▶ Results confirm that the Hierarchy of Scope Preference is attested for IS in English and Bangla. (A, B)
- ▶ Results from the Bangla experiments show that Scrambling maintains the inherent Scope Preference of the determiners. (C)
 - ▶ SOB resists scope reversal (IS) in canonical order, but takes wide scope when aided by OSV word order, consistent with Scope Transparency.
 - ▶ PROTI prefers wide scope irrespective of word order, showing that Scope Preference can overturn the requirements for Scope Transparency or for simpler computation.

Conclusion

- ▶ Among the Bangla universal quantifier determiners, PROTI has a strong preference for taking wide scope over other quantifiers, but SOB does not seem to have any scope preference at all.
- ▶ Thus the vocabulary of Bangla universal determiners has a strongly specific item and an underspecified item. (in tune with Gill (1995)'s typology of universal quantifiers)
- ▶ Word Order or Scope Transparency can be reliable cues for interpretation, only when a determiner is underspecified for its Scope Preference.

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Why is *all* basic and *every* exceptional?

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The relationship between these two is that of hyponymy. ‘The semantic field of *all* contains that of *every*.’

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All: (Bangla *SOB*)

- ▶ allows for both collective and distributive readings
- ▶ is compatible with *together*
- ▶ can combine with mass nouns
- ▶ has the ability to induce generic readings

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- ▶ cannot combine with mass nouns
- ▶ cannot induce generic readings

One could predict that for Bangla *SOB* will show a dispreference for IS-based distributive reading.

When to Use Experimental Methods

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Davidson, Katherine (2020)

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- ▶ when we need to control for several linguistic/grammatical and contextual factors
- ▶ when we feel conscious introspective judgement is associated with confounding factors, and the research question needs to be hidden from the participants
- ▶ when statistical power is needed as there is a lot of variation in judgement

Thank You!

Email: ishani.guho@gmail.com

Appendix A: Singular/Plural Continuation Task

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Kurtzman & MacDonald (1993)

- ▶ Target/Test sentence: ambiguous sentence with two quantifiers
- ▶ **Continuation sentence:** a reasonable discourse continuation of the quantifier sentence under only one interpretation.

Q. Is (a) a reasonable continuation of (16)?

- (18) Every kid climbed a tree.
a. The tree was full of apples.

Q. Is (a) a reasonable continuation of (17)?

- (19) Every kid climbed a tree.
a. The trees were full of apples.

Appendix B: Reported Judgements on Bangla

Bhattacharya & Simpson (2011):

- (20) [kono ak-jon nars]_S [prottek-ta rugi-ke]_O šahajjo korlo
some one-CLF nurse each.one-CLF patient-DAT help did
'Some nurse helped every patient.'
Reported: ✓SS, ✗IS

Guha (2018):

- (21) a. [du-jon-kore-mee]_S [prottek-ta-boi]_O poreche SOV
two-CLF-do.PFV-girl each.one-CLF-book read
Intended: 'Each book was read by two girls' ?
b. [prottek-ta-boi]_O [du-jon-kore-mee]_S poreche OSV
each.one-CLF-book two-CLF-do.PFV-girl read
Intended: 'Each book was read by two girls' Ok