Inverse Scope in Scrambling Languages: The Case of Bangla

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1. Introduction

1.1. Quantifier Scope in Scrambling Languages

In English, sentences with two scopally interacting quantifiers such as (1) can receive two readings, a Surface Scope (SS) and an Inverse Scope (IS) reading, corresponding to the two possible scope configurations of the quantifiers at LF, i.e., *someone » everyone* for SS and *everyone » someone* for IS.[1]

(1) Someone loves everyone.
   a. There is a (single) person who loves everybody. SS
   b. For every person, there is someone who loves them. IS

By contrast, it is generally reported that, in scrambling languages (e.g., German, Japanese, Mandarin), doubly quantified sentences similar to (1) lack an IS reading in canonical word order, and may only express this reading by reversing the linear order of the quantifiers through scrambling (e.g., by scrambling the object above the subject), as exemplified for Japanese by the reported contrast between (2) and (3) (examples and judgments from Miyagawa 2011).

(2) [dareka-ga]$_S$ [daremo-o]$_O$ aisiteiru — Canonical SOV
someone-NOM everyone-DAT loves — Reported: ✓SS ✗IS
'Someone loves everyone.'

(3) [daremo-o]$_O$ [dareka-ga]$_S$ aisiteiru — Scrambled OSV
everyone-DAT someone-NOM loves — Reported: ✓SS ✓IS
'Someone loves everyone.'

To account for these cross-linguistic differences, Bobaljik & Wurmbrand (2012) proposed that languages prefer to maintain a strict correspondence between word order and scope, and that this correspondence may only be upset if word order manipulation is disallowed. This preference is formlulated in terms of a soft constraint, Scope Transparency (ScoT), operating at the LF-PF interface. ScoT can explain, among other things, the interpretive contrast between the English sentence in (1) and its Japanese

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[1] While English speakers often accept IS interpretations of sentences like (1), experimental results show that they also have a robust preference for their SS interpretations. It has been proposed that this preference stems from the fact that SS involves a less complex syntactic derivation than IS and, as a result, processing SS requires less effort than processing IS (a.o., Kurtzman & MacDonald 1993, Tunstall 1998, Anderson 2004, Hackl et al. 2012). In other words, the human sentence processor prefers to settle for SS interpretations because SS calculation is less costly relative to IS calculation. It is worth emphasizing here that this line of explanation, accounting for speakers' preference for SS over IS, is orthogonal to the categorical claim made about scrambling languages, according to which, in canonical word order, SS is the only scope configuration available (as opposed to, say, the most preferred one).

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counterpart in (2). In a nutshell, the IS reading of (1), just like the one of (2), violates ScoT. In English, this violation remains inconsequential as English is devoid of a strategy for expressing this reading by means of a more transparent word order. In the absence of a competitor, the IS reading of (1) can thus be expressed by the word order in (1). In Japanese, however, it is possible in this case to maintain a strict correspondence between LF and PF, by scrambling the object over the subject, as shown in (3). Crucially, unlike the canonical SOV order, the scrambled OSV order in (3) permits to satisfy ScoT. As a result, the IS reading of (2), licensed in (3), may not be expressed by the word order in (2). In sum, according to Bobaljik & Wurmbrand, the English sentence in (1) is expected to be ambiguous between an IS and SS readings, while the Japanese sentence in (2) is expected to only allow a SS reading.

As of today, however, the datasets permitting to evaluate by experimental means the empirical adequacy of this proposal remain limited and deliver conflicting results. Thus, for instance, Scontras et al. (2017) has provided experimental evidence that, in Mandarin, doubly quantified sentences cannot receive an IS reading, consistent with Bobaljik & Wurmbrand's proposal. However, some researchers have questioned the depth of the observation for German, suggesting that IS can in fact be induced by controlling several factors (a.o., Philipp & Zimmermann 2020). Similarly, results from recent experimental work focusing on free word order languages like Russian (Ionin et al. 2014) and Greek (Oikonomou et al. 2020) suggest that doubly quantified sentences in these languages are in fact ambiguous between SS and IS readings. The present article aims to extend and clarify the empirical landscape by investigating the correlation between word order and scope in Bangla, a verb-final Indo-Aryan language with scrambling.

1.2. Scope and Scrambling in Bangla

Previous work discussing the relationship between linear order and quantifier scope in Bangla have claimed that, in the canonical SOV order, Bangla sentences are unambiguous, allowing only SS. Thus, for instance, discussing examples like (4), Bhattacharya & Simpson (2011) reported that, when the subject precedes the object, the relative scope between the two quantifiers must correspond to their surface order.

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

Like other scrambling languages, Bangla allows the constituents of a sentence to be placed in a wide range of linear orders, and scrambled word orders may induce subtle differences in meaning as well as license certain scope configurations. Discussing the minimal pair in (5), Guha (2018) observed for instance that, in the SOV order, a distributive universal quantifier like *prottek-* 'each one of' only marginally license the co-varying interpretation of the distributive numeral in subject position; by contrast, this interpretation becomes readily available in the corresponding OSV order, which is therefore the most preferred way to express the relevant IS reading. Guha also notes that, unlike *prottek-*, non-distributive quantifiers (e.g., *ɔnek-* 'many', *khub-kɔm-* 'very few') in object position do not license a distributive numeral in subject position; in these cases, scrambling the quantifier to a position c-commanding the distributive numeral is the only way to make a co-varying interpretation available (see Guha 2018: p.51).

(5) a. ?[du-jon-kore-mee]$_S$ [prottek-ṭa-boi]$_O$ poṛeche — Canonical SOV
two-CLF-do.PFV-girl each.one-CLF-book read
Intended: 'Each book was read by two girls'

b. [prottek-ṭa-boi]$_O$ [du-jon-kore-mee]$_S$ poṛeche — Scrambled OSV
each.one-CLF-book two-CLF-do.PFV-girl read
Intended: 'Each book was read by two girls'

Thus, the picture emerging from the theoretical literature on Bangla is that IS is unavailable for SOV sentences in the most simple cases, as reported for other scrambling languages, and that it is, at best, marginally available for SOV sentences with a distributive universal quantifier in object position. The goal of the present study is to test the empirical adequacy of these claims experimentally and, in so doing,

to achieve a first step towards establishing by quantitative means which scope readings are available for canonical SOV and scrambled OSV sentences in Bangla, and to what extent.

2. Experiment

The experiment used a Truth Value Judgment Task (Crain & Thornton 1998), capitalizing on previous work showing how this type of task can be used to detect and quantify over scope ambiguity (a.o. Musolino 2009, Ionin et al. 2014, Scontras et al. 2017). The experiment tested the comprehension of canonical SOV and scrambled OSV Bangla sentences involving a non-monotonic quantifier in the subject position (e.g., exactly three NPs) and a distributive quantifier in the object position (e.g., each NP). The aim of the experiment was to determine whether Bangla-speaking adults perceive these sentences as ambiguous and, in particular, whether they accept IS interpretations of canonical SOV sentences.

2.1. Participants

74 adult native speakers of Bangla were recruited via email (26 female; average age 34 yrs). Of these, 2 were excluded prior to analyses because their responses in the demographic questionnaire did not meet all the language-related requirements we had pre-established for our study. Participants were paid 100 rupees ($1.3) for their participation and average completion time was about 12 minutes. All participants gave written informed consent to the processing of their information for the purposes of this study. All data were collected and stored in accordance with the provisions of Data Protection Act 2018, the UK's implementation of the General Data Protection Regulation.

2.2. Materials

Target sentences were canonical SOV sentences like (6) and scrambled OSV sentences like (7). The attested SS reading and the hypothetical IS reading of these sentences are indicated below them.

(6) [ṭhik tin-ṭe-mee]$_S$ [proti-ṭa-gach-ke]$_O$ chũe ache — Canonical SOV
exactly three-CLF-girl each-CLF-tree-ACC touch be.PRS.3
'Exactly three girls are touching each tree.'
a. Exactly three girls are such that they are touching every tree. — SS: ✓
b. For each tree, there are exactly three girls that are touching it. — IS: ?

(7) [proti-ṭa-gach-ke]$_O$ [ṭhik tin-ṭe-mee]$_S$ chũe ache — Scrambled OSV
each-CLF-tree-ACC exactly three-CLF-girl touch be.PRS.3
'Exactly three girls are touching each tree.'
a. For each tree, there are exactly three girls that are touching it. — SS: ✓
b. Exactly three girls are such that they are touching every tree. — IS: ?

Both sentence types differ in terms of their word order, but otherwise involved the same building blocks: a modified numeral in subject position, a transitive verb and a universal quantifier in object position. The verb was either *chõwa* 'touch' or *dhɔra* 'hold'. The modified numeral was either *ṭhik du-ṭo* 'exactly two' or *ṭhik tin-ṭe* 'exactly three'. We used these non-monotonic quantifiers to prevent the numerals in our sentences from receiving an 'at least'-reading, as this reading would make SS and IS interpretations semantically indistinguishable in our test cases (see Radó & Bott (2012) and Bott & Schlotterbeck (2015) for related experimental work in German using 'exactly one').[2] Finally, the universal quantifier was *proti-*

[2] To illustrate, suppose that we replace the modified numeral *ṭhik tin-ṭe* 'exactly three' with the bare numeral *tin-ṭe* 'three' in the sentence in (6). On a lower-bound reading of the numeral, the SS interpretation of this sentence would now be that *at least three girls are such that they are touching every tree* and it would now logically entail its IS interpretation, *for each tree, there are at least three girls that are touching it*. As a result, in a situation like the one depicted in Fig.3, these two interpretations would be indistinguishable.

ṭa-N. We used this quantifier as we surmised that *proti*-based quantifiers have more IS potential compared to *šɔb*-based forms (see also Guha 2018).[3] All objects were marked with the postposition *-ke*.

Test sentences were paired with four picture types, as illustrated in Fig.1-4. Ctrl-True and Ctrl-False pictures (Fig.1 and Fig.2) depicted situations that made the test sentences respectively true and false on both scope readings. SS-only and IS-only pictures depicted situations that made the test sentences true on one scope reading (i.e., SS for SS-only and IS for IS-only), but false on the other (i.e., IS for SS-only and SS for IS-only). The SS-only pictures for SOV sentences corresponded to the IS-only pictures for OSV sentences (Fig.3) and, conversely, the SS-only pictures for OSV sentences corresponded to the IS-only pictures for SOV sentences (Fig.4). To illustrate, consider again the SOV sentence in (6) and its OSV variant in (7). In the situation represented in Fig.3, (6) is true only on its SS reading whereas (7) is true only on its IS reading. In the situation represented in Fig.4, this reading-picture correspondence is reversed: (6) is true only on its IS reading whereas (7) is true only on its SS reading.

Target conditions were obtained by crossing word order (SOV and OSV) and picture type (Ctrl-True, Ctrl-False, SS-only and IS-only). Ctrl-True and Ctrl-False conditions were used as controls to evaluate participants' understanding of the test sentences in clearly true and clearly false situations. SS-only and IS-only conditions were used to quantify over the availability of SS and IS readings with both word orders.

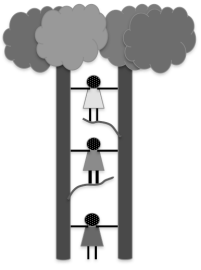

Figure 1: Ctrl-True

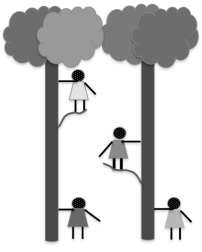

Figure 2: Ctrl-False

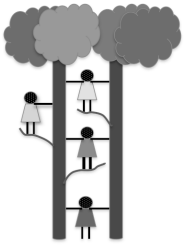

Figure 3: SS-only for SOV & IS-only for OSV

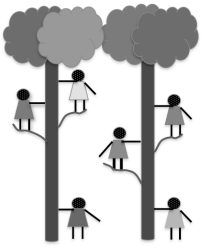

Figure 4: IS-only for SOV & SS-only for OSV

In addition to the test items we just described, the experiment included control items involving sentences like those in (8). The sentences in (8-a)-(8-c) were paired with suitable pictures that made them either true or false. These items were included to verify on independent grounds that participants had no difficulty interpreting the non-monotonic numeral quantifiers and the *proti*-based universal quantifier used in the test sentences. Sentence like (8-d) were paired with pictures that made them true on their SS reading. These items were included to verify that participants had no difficulty accessing a distributive reading when non-monotonic numerals appear in object position and *proti-* appears in subject position and, more generally, to ensure that the IS reading of the critical SOV sentences (or, similarly, the SS reading of their OSV counterparts) was perceived as a plausible reading when the same quantifiers were placed in a different grammatical configuration.

[3] The inventory of universal quantifiers in Bangla primarily contains forms made with determiners *proti-* and *šɔb-*. Quantifiers made with *proti-* (e.g, *proti-ṭa-N*, *prottek-ṭa-N*) tend towards the meaning of *each*, while those based on *šɔb-*, (e.g., *šɔb-kɔṭa-N*, *šɔb-gulo-N*) tend towards the meaning of *all*. We also refer to Mahajan (2017) for a detailed discussion of quantifiers in the related Indo-Aryan language Hindi.

(8) a. chele-ṭa ṭhik du-ṭo-beṛal-ke khete dieche — Exactly-2 control
boy-CLF exactly two-CLF-cat-DAT eat.INF gave
'The boy has given food to exactly two cats.'

b. bagane ṭhik tin-ṭe-projapoti uṛche — Exactly-3 control
garden.LOC exactly three-butterfly flying
'Exactly three butterflies are flying in the garden.'

c. proti-ṭa-chele lal jama pore ache — *Proti*-control
each-CLF-boy red dress wear be.PRS.3
'Each boy is wearing a red shirt.'

d. proti-ṭa-mee ṭhik æk-ṭa-gach-ke chũe ache — Distributivity control
each-CLF-girl exactly one-CLF-tree-DAT touch be.PRS.3
'Each girl is touching exactly one tree.'

In total, 16 pairs of SOV-OSV test sentences were created by varying content words. For each of these pairs, a set of 4 related pictures was created, that is, one picture for each of the 4 picture types illustrating the target conditions. All the pictures were created using free clip arts available online. 8 lists of items were created using a Latin Square design so that none of the pictures or sentences used in the test items was ever repeated in a list. Each list of items included two instances of each target condition, hence 16 test items, 19 control items as well as 16 filler items unrelated to our experimental purposes.

2.3. Procedure

The experiment was run as an online survey. The survey was created using the JavaScript library jsPsych (De Leeuw 2015) and was hosted on Cognition.run. All written materials in the survey were written in the Bengali script. After filling out a consent form and a short demographic questionnaire, participants were given general instructions. They were told that they would be presented various sentences, each of them would be accompanied with a picture that relates to it, and that their task would be to decide, for each sentence, whether it appropriately describes the accompanying picture and to report their judgments by clicking on one of two response buttons labelled 'hæ̃' ('yes') and 'na' ('no'), respectively. After the instructions, participants were assigned a list of items. Lists were pseudo-randomly assigned so as to reach a balanced number of participants per list. The survey started with 3 unannounced practise trials and then continued with the items from the assigned list. Items were presented in random order with a 500ms interstimulus interval. Items remained on the screen until participants gave their answer.

2.4. Predictions

If canonical SOV sentences only allow SS readings, then participants' responses to these sentences should pattern together in the relevant IS-only and Ctrl-False conditions; similarly, if scrambled OSV sentences only allow SS readings, then participants' responses to these sentences should pattern together in the relevant IS-only and Ctrl-False conditions.

2.5. Data treatment and analyses

Prior to analyses, we examined participants' responses to the control items (see examples in (8)). Participants' performance to these items was uniformly high (mean accuracy score > 95%; all individual mean accuracy scores ≥ 80%). These results show that participants performed the task appropriately and, in particular, that they had no difficulty interpreting the quantifiers of interest or accessing distributive interpretations for the numerals. All the participants were thus included in our analyses of the test items. Responses to these items were analyzed by modeling response-type likelihood using logit mixed effects regression models (Jaeger 2008). Analyses were conducted using the lme4 (Bates et al. 2011, 2014) and emmeans (Lenth et al. 2018) libraries for the R statistics program (R Core Team 2013).

2.6. Results

Fig.5 shows the mean proportion of 'Yes' responses to SOV and OSV sentences by experimental condition. Responses to the control conditions were as expected: participants uniformly accepted the SOV sentences and their OSV counterparts in the Ctrl-True conditions (all mean acceptance rates > 94%), and robustly rejected them in the Ctrl-False conditions (all mean acceptance rates < 2%). Participants' responses to the target conditions were analyzed by fitting a mixed-effect model testing the fixed effect of Sentence (SOV vs. OSV), Condition (SS-only vs. IS-only) and of their interaction, with Subject as a random effect and a by-subject random slope for Condition. The model yielded a significant interaction between Sentence and Condition: $\chi^2(1) = 115.25$, $p < .0001$. The effect of Condition was not significant ($\chi^2(1) = 0.977$, $p = .32$), and the effect of Sentence was only marginally significant ($\chi^2(1) = 3.81$, $p = .05$). To better identify the source of the established interaction, we next compared responses to each sentence type in their SS-only and IS-only conditions. For each sentence type, the model included Condition as a fixed effect and Subject as a random effect. For SOV sentences, the mean acceptance rate was significantly higher in IS-only conditions ($M = 82\%$, 95% CI[89, 76]) than in SS-only conditions ($M = 44\%$, 95% CI[52, 35], $\chi^2(1) = 36.58$, $p < .0001$), showing that IS was strongly preferred while SS was moderately available. By contrast, for OSV sentences, the mean acceptance rate was significantly higher in SS-only conditions ($M = 87\%$, 95% CI[93, 82]) than in IS-only conditions ($M = 24\%$, 95% CI[31, 17], $\chi^2(1) = 25.31$, $p < .0001$), showing this time that SS was strongly preferred; crucially, however, the acceptance rate for OSV sentences was still substantially higher in the IS-only than in the Ctrl-False conditions, suggesting that participants also accessed the IS-reading of these sentences, albeit to a lesser extent than the IS-reading of the SOV sentences.[4]

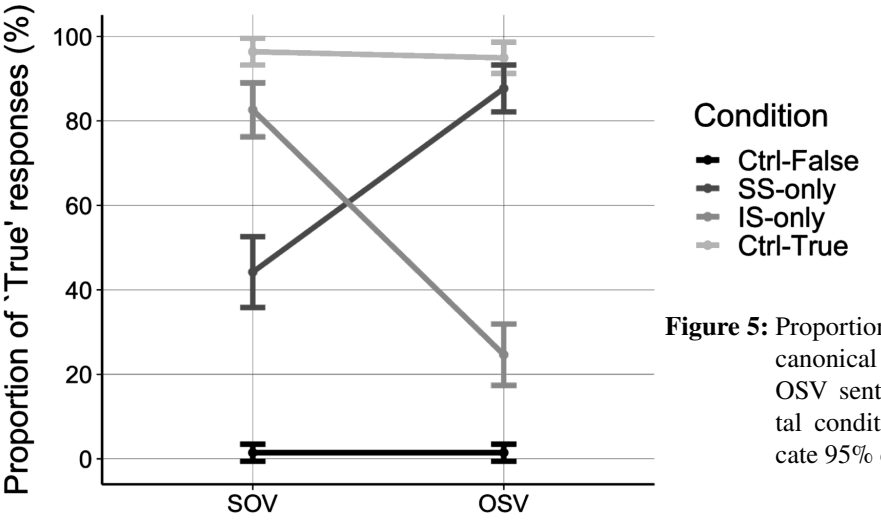

Figure 5: Proportion of 'Yes' responses to canonical SOV and scrambled OSV sentences by experimental condition. Error bars indicate 95% confidence intervals.

3. Discussion

Our main findings are twofold. First, our results show that doubly quantified sentences in Bangla may be perceived by speakers as ambiguous between a SS and an IS interpretation. In particular, our results establish that, in Bangla, canonical SOV sentences can give rise to scope ambiguities, even in the most simple cases. These findings contradict the common idea that, in scrambling languages, IS is unavailable in canonical word order and, therefore, they raise a challenge for existing theories that posit a strict correspondence between linear order and scope at LF (a.o., Bobaljik & Wurmbrand 2012). Second, our results show that participants in our study displayed in fact a strong preference for IS over SS with

[4] Recall that all objects in our sentences were marked with the postposition *-ke*. While this postposition is obligatory on animate objects, it is optional on inanimate ones. Each list of items contained 4 sentences with animate objects and 12 sentences with inanimate objects. We did not observe any effect of animacy in our data.

canonical SOV sentences. Not only are these findings at odds with previous claims from the theoretical literature, but they also contrast with recent experimental work on German (Philipp & Zimmermann 2020) and Russian (Ionin et al. 2014), which found that IS is available, yet much less so than SS in canonical word order. These findings thus raise an immediate question: where does this overwhelming preference for IS over SS that we observe in our data come from?

We propose that this preference comes from the fact that the universal quantifier *proti-*, used in our test sentences, is a strongly distributive quantifier which is lexcially predisposed to take wide scope over other quantifiers in the sentence. The idea that determiners carry lexical information that may affect quantifier scope was suggested as early as in Ioup (1975), and was later elaborated on by Beghelli & Stowell (1997), who called *each* and *every* strongly distributive quantifiers, distinguishing them from other quantifiers in terms of scope (see also Tunstall 1998 and Brasoveanu & Dotlačil 2015 for experimental investigations on these two determiners). In that respect, we note that the rates of acceptance we observed in our study for SOV sentences in SS-only and IS-only conditions are very similar to those Musolino (2009: p.33) found in English for the strong distributive quantifier *each* when it appears in object position (100% acceptability for IS and 31% for SS). If this line of explanation is on the right track, then our results could be taken as evidence that the lexical information associated with *proti-* is prioritized over Scope Transparency (ScoT) in sentence comprehension or, similarly, as evidence that *proti-*'s scopal preferences outweigh the preference for ScoT in the disambiguation process.

Yet our results raise another, and perhaps more pressing question: is a principle like ScoT relevant at all to explain our data? Even though ScoT appears to play a lesser role than *proti-*'s scopal preferences, one could argue that its effects are still detectable in our data, albeit in a gradual form. Consider for instance the two test cases where acceptance indicate that participants did not interpret *proti-* as taking wide scope, i.e., the SS-only conditions for SOV and the IS-only conditions for OSV. In the first case, ScoT is satisfied whereas, in the second, it is violated. Our results show that participants found SOV sentences in SS-only conditions twice more acceptable than OSV sentences in IS-only conditions (43% vs. 23%). The contrast observed between these two cases could, therefore, be interpreted as reflecting a preference to maintain LF-PF correspondence where possible. We notice, however, that no such contrast was found between the two test cases where acceptance indicate that participants interpreted *proti-* as taking wide scope, i.e., the IS-only conditions for SOV and the SS-only conditions for OSV. Yet these cases are entirely parallel to the previous ones in regard to ScoT: LF-PF correspondence is maintained in one case, but not in the other. While these observations do not rule out the possibility that ScoT is the driving force behind some of the contrasts we found, they also suggest that there is limited evidence in favor of this interpretation.

To summarize, we take our findings to highlight that the scopal preferences associated with a determiner play a critical role in the resolution of quantifier scope ambiguity. On our view, it is possible that the studies in German and Russian that we mentioned did not observe any preference for IS over SS because they tested universal quantifiers that are closer in meaning to *every*, as opposed to *each*. Interestingly, the same reasoning is applicable to the universal quantifiers in Bangla: we should not witness such a preference if we were to replace *proti-* with the Bangla universal determiner *šɔb-* 'all' in our test sentences.[5]

To test this hypothesis, a follow-up study with *šɔb-* is under way, where the test and control sentences are the same as in the present experiment, except that every occurrence of *proti-ṭa-* has been replaced with *šɔb-kɔṭa-*, as illustrated by the minimal pair in (9). In contrast to *proti-ṭa-*, the quantifier *šɔb-kɔṭa-* is akin in meaning to *every*. Consistent with our proposal, we expect that speakers should favor SS over IS for these novel sentences. To complete our work, we have also planned to test English doubly quantified sentence and compare the effect of the universal quantifiers *each*, *every* and *all*.

[5] Comparably, Hoji (1985) observed important variations in scope-rigidity among quantifier determiners in Japanese, which Erlewine & Kotek (2018) relate to larger generalizations regarding intervention effects.

(9) a. [ṭhik tin-ṭe-mee]$_S$ [šɔb-kɔṭa-gach-ke]$_O$ chũe ache — Canonical SOV
exactly three-CLF-girl all-few.CLF-tree-ACC touch be.PRS.3
'Exactly three girls are touching every tree.'

b. [šɔb-kɔṭa-gach-ke]$_O$ [ṭhik tin-ṭe-mee]$_S$ chũe ache — Scrambled OSV
all-few.CLF-tree-ACC exactly three-CLF-girl touch be.PRS.3
'Exactly three girls are touching every tree.'

Finally, we note that the nature of the subject quantifier may also have contributed to the prevalence of IS in our results. Unlike plain indefinites, modified numerals have been found to resist existential wide scope (see Beghelli & Stowell 1997, Szabolcsi 1997), and so the results of our study could be slightly different with indefinite subjects. We suspect that the discrepancies between our findings for Bangla and those of Scontras et al. (2017) for Mandarin could result from differences in the choice of both the subject and the object quantifier in these studies. We hope that future investigations along the lines we suggested will help establish a clearer picture of these variations across quantifiers and across languages.

References

Anderson, Catherine. 2004. *The structure and real-time comprehension of quantifier scope ambiguity*. Northwestern University, Evanston, IL dissertation.

Bates, Douglas, Martin Mächler, Ben Bolker & Steve Walker. 2014. Fitting linear mixed-effects models using lme4. *arXiv preprint arXiv:1406.5823*.

Bates, Douglas, Martin Maechler & Ben Bolker. 2011. *lme4: Linear mixed-effects models using S4 classes*.

Beghelli, Filippo & Tim Stowell. 1997. Distributivity and negation: the syntax of *each* and *every*. In Anna Szabolcsi (ed.), *Ways of scope taking*, 71–107. Springer.

Bhattacharya, Tanmoy & Andrew Simpson. 2011. Diagnosing double object constructions in Bangla/Bengali. *Lingua* 121. 1067–1082.

Bobaljik, Jonathan David & Susi Wurmbrand. 2012. Word order and scope: Transparent interfaces and the 3/4 signature. *Linguistic Inquiry* 43(3). 371–421.

Bott, Oliver & Fabian Schlotterbeck. 2015. The processing domain of scope interaction. *Journal of Semantics* 32(1). 39–92.

Brasoveanu, Adrian & Jakub Dotlačil. 2015. Strategies for scope taking. *Natural Language Semantics* 23(1). 1–19.

Crain, Stephen & Rosalind Thornton. 1998. *Investigations in Universal Grammar: A Guide to Experiments on the Acquisition of Syntax and Semantics*. Cambridge, MA: MIT Press.

De Leeuw, Joshua R. 2015. Jspsych: a JavaScript library for creating behavioral experiments in a Web browser. *Behavior research methods* 47(1). 1–12.

Erlewine, Michael Yoshitaka & Hadas Kotek. 2018. Intervention tracks scope rigidity in Japanese. Ms.

Guha, Ishani. 2018. *Distributivity across domains: a study of the distributive numerals in Bangla*. MIT dissertation.

Hackl, Martin, Jorie Koster-Hale & Jason Varvoutis. 2012. Quantification and ACD: Evidence from real-time sentence processing. *Journal of Semantics* 29(2). 145–206.

Hoji, Hajime. 1985. *Logical form constraints and configurational structures in Japanese*. University of Washington dissertation.

Ionin, Tania, Tatiana Luchkina & Anastasia Stoops. 2014. Quantifier scope and scrambling in the second language acquisition of Russian. In *Selected Proceedings of the 5th Conference on Generative Approaches to Language Acquisition North America*, 169–180.

Ioup, Georgette. 1975. Some universals for quantifier scope. In *Syntax and Semantics: volume 4*, 37–58. Brill.

Jaeger, T Florian. 2008. Categorical data analysis: away from ANOVAs (transformation or not) and towards logit mixed models. *Journal of memory and language* 59(4). 434–446.

Kurtzman, Howard S & Maryellen C MacDonald. 1993. Resolution of quantifier scope ambiguities. *Cognition* 48(3). 243–279.

Lenth, Russell, Henrik Singmann, Jonathon Love, Paul Buerkner & Maxime Herve. 2018. *Emmeans: Estimated marginal means, aka least-squares means*.

Mahajan, Anoop. 2017. Quantification in Hindi. In Denis Paperno & Edward L. Keenan (eds.), *Handbook of Quantifiers in Natural Language: volume ii*, 383–430. Springer.

Miyagawa, Shigeru. 2011. Optionality. In Cedric Boeckx (ed.), *The Oxford Handbook of Linguistic Minimalism*.

Musolino, Julien. 2009. The logical syntax of number words: Theory, acquisition and processing. *Cognition* 111(1). 24–45.

Oikonomou, Despina, Felix Golcher & Artemis Alexiadou. 2020. Quantifier scope and information structure in Greek. *Glossa: A journal of general linguistics* 5(1).

Philipp, Mareike & Malte Zimmermann. 2020. Empirical investigations on quantifier scope ambiguities in German. In *Proceedings of Sinn und Bedeutung*, vol. 24, 145–163.

R Core Team. 2013. *R: A language and environment for statistical computing. Vienna, Austria: R Foundation for Statistical Computing*.

Radó, Janina & Oliver Bott. 2012. Underspecified representations of quantifier scope. In *Logic, Language and Meaning: 18th Amsterdam Colloquium. Springer, The Netherlands*.

Scontras, Gregory, Maria Polinsky, C-Y Edwin Tsai & Kenneth Mai. 2017. Cross-linguistic scope ambiguity: When two systems meet. *Glossa: A journal of general linguistics* 2(1). 1–28.

Szabolcsi, Anna. 1997. Strategies for scope taking. In Anna Szabolcsi (ed.), *Ways of scope taking*, 109–154. Springer.

Tunstall, Susanne Lynn. 1998. *The interpretation of quantifiers: Semantics & processing*. University of Massachusetts at Amherst dissertation.

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