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# Simplified grammar in both languages? On scope assignment in Q-Neg sentences in English-dominant heritage Chinese speakers

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**Abstract**. Quantifier-negation (Q-Neg) sentences are sentences like 'All teachers did not use Donald's car,' where a negation word and universal quantifier occur in the subject position. There are both surface scope (all>not) and inverse scope (not>all) readings in English, but only the surface scope (all>not) reading is allowed in Chinese. This study conducted a picture-matching truth value judgment experiment to examine whether English-dominant heritage Chinese speakers know the difference between English and Chinese regarding the interpretation of Q-Neg sentences. The data reveals three different groups of participants: a. participants who accepted the inverse scope reading in both languages; b. participants who rejected the inverse scope reading in both languages; c. participants who accepted the inverse scope reading in English but rejected it in Chinese. Implications regarding heritage language research will be discussed.

**Keywords**. heritage language; inverse scope; Q-Neg sentences; English/Chinese

**1. Introduction**. Quantifier-negation (Q-Neg) sentences are those involving a negation word *not* as well as a universal quantifier in the subject position such as (1):

(1) Every teacher did not use Donald's car.
a. Surface-scope (every>not): For every teacher, he/she did not use Donald's car.
b. Inverse-scope (not>every): It is not the case that every teacher used Donald's car.

In English, (1) has two possible readings: (i) none of the teachers used Donald's car; (ii) not every teacher used Donald's car. Interpretation (i) is achieved when *every* scopes over *not,* while interpretation (ii) is generated when *not* has scope over *every*. Since interpretation (i) is in accordance with the structural relation between *every* and *not* at S(urface)-structure, interpretation (i) is generally called the surface scope (SS) reading. In contrast, because interpretation (ii) is the opposite of the structural relation between *every* and *not* on the surface, interpretation (ii) is often termed the inverse scope (IS) reading. The existence of the two readings in English Q-Neg sentences were experimentally confirmed by previous studies (e.g., Musolino & Lidz, 2006; Wu & Ionin, 2009). In this paper, we follow Moscati's (2010) analysis that interpretation (ii) is generated by negation raising: the negation word *not* is raised to a position structurally higher than *every* at Logical Form (LF), as in (2):

(2) [CP not$_i$ [IP every teacher [I' did [NegP $t_i$ [VP use Donald's car]]]]] (not>all)

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According to Moscati, negation raising is optional and is needed only when the IS reading is required in a specific context. If negation raising does not occur at LF, the SS reading is generated. Note that since the IS reading involves an additional step of negation raising at LF compared to the SS reading, the IS reading is predicted to be more cognitively costly, as pointed out by several previous studies (e.g., Reinhart, 2006).

**2. Literature review**. Previous research on Q-Neg sentences and scope assignment has mainly focused on L1 and L2 acquisition. To the best of our knowledge, the same phenomenon has never been studied in the context of heritage language research. Zhou and Crain (2009) claimed that the interpretation of scope assignment in Q-Neg sentences involves three layers of representations: syntax, semantics, and pragmatics. This interface phenomenon is considered to be susceptible to attrition among heritage speakers (e.g. Polinsky, 2011).

Scontras et al. (2017) investigated another similar phenomenon that also involves the modules of syntax, semantics, and pragmatics, as in (3):

(3) A shark attacked every pirate.
a. Surface-scope (∃>∀): There is a single shark that attacked each pirate.
b. Inverse-scope (∀>∃): For each pirate, there was a shark that attacked him.

In (3), an existential quantifier and universal quantifier occur in the subject and object positions, respectively; such sentences are known as Doubly Quantified sentences. Similar to Q-Neg sentences, there are two possible readings in English: the SS reading and the IS reading. However, the equivalent sentence in Chinese only allows the SS reading:

(4) You yi-tiao shayu gongji-le mei-yi-ge haidao. (Chinese)
exist one-CL shark attack-PST every-one-CL pirate
'A/one shark attacked every pirate.'
a. Surface-scope (∃>∀): There is a single shark that attacked each pirate.
b.*Inverse-scope (∀>∃): For each pirate, there was a shark that attacked him.

This difference in scope assignment between English and Chinese Doubly Quantified sentences has been discussed in many studies (e.g., Huang, 1982; Aoun & Li, 1993). One well-accepted analysis from May (1977, 1985) suggests that the QP *every pirate* can be raised to a structural position that c-commands the QP *a shark* at LF in English, whereas in Chinese, the QP *every pirate* cannot be raised at LF (e.g. Huang, 1982).

Scontras et al. (2017) conducted a truth value judgment experiment with English-dominant heritage Chinese speakers, L1 Chinese speakers, and L1 English speakers. Their L1 data first confirmed that the IS reading is available in English but not in Chinese. Data from the English-dominant heritage Chinese speakers suggested that they lack the IS reading not only in their heritage language Chinese, but also in their dominant language English. Thus, we can infer that the raising of universal QPs in English Doubly Quantified sentences, such as *every pirate* in (3), is prohibited in the heritage speakers' English grammar. Based on this finding, Scontras et al. (2017) and Polinsky and Scontras (2020) argued that heritage speakers tend to simplify their grammars to save processing efforts because maintaining two grammars in their heads is cognitively challenging. Let us call this phenomenon the *grammar simplification hypothesis* for convenience.

This hypothesis was further supported by Ronai's (2018) study, which examined how English-dominant heritage Hungarian speakers and Hungarian-dominant heritage English speakers interpret Doubly Quantified sentences in both English and Hungarian. It is suggested that Hungarian is similar to Chinese in that it does not allow the IS reading in its Doubly Quantified sentences (É. Kiss, 2002). By conducting a truth value judgment experiment similar to that in Scontras et al. (2017), Ronai found that both heritage groups lack the IS reading in their English and Hungarian, supporting the grammar simplification hypothesis.

**3. Present study**. This study tests the grammar simplification hypothesis by examining another well-known phenomenon that involves scope ambiguity in English: Q-Neg sentences. As introduced earlier, English Q-Neg sentences have both SS and IS readings. However, Chinese Q-Neg sentences only allow the SS reading, which was confirmed by several experimental studies (Fan, 2017; Wu & Ionin, 2019, 2021; Zhou & Crain, 2009):

(5)

| suoyou | laoshi | dou | meiyou | yong | Tanglaoya | de | che |
|---|---|---|---|---|---|---|---|
| all | teacher | all | not | use | Donald | GEN | car |

'All teachers did not use Donald's car.'
a. Surface-scope (all>not): None of the teachers used Donald's car.
b. *Inverse-scope (not>all): Not all teachers used Donald's car.

Note that (5) involves the universal quantifier *suoyou* 'all' rather than *mei* 'every.' We chose to use *suoyou* 'all' because, unlike *mei* 'every,' it does not require a classifier. In (5), the only possible reading is the SS reading, while the equivalent sentence in English *all teachers did not use Donald's car* has both SS and IS readings. As discussed, the IS reading in English Q-Neg sentences is derived via the negation raising strategy. However, due to the absence of the IS reading in Chinese, we assume that such strategy is not allowed in Chinese Q-Neg sentences: the negation *not* cannot be raised at LF in Chinese. If the grammar simplification hypothesis holds, we would predict that English-dominant heritage Chinese speakers lack the IS reading in both English and Chinese Q-Neg sentences because Chinese Q-Neg sentences, which do not involve negation raising, are syntactically simpler. Our research questions are: (i) do English-dominant heritage Chinese speakers disallow the IS reading in Chinese Q-Neg sentences? (ii) If yes, do they also prohibit the IS reading in the English Q-Neg sentences?

**4. Experiment.** A picture-matching truth value judgment task (TVJT) (Crain & Thornton, 1998) was created in both English and Chinese. We used LexTALE (Lemhöfer & Broersma, 2012), an online lexical decision task in English, and Wen's (2015) Chinese proficiency test to assess heritage participants' English and Chinese proficiency. Each participant was also asked to fill out a background information sheet. All participants were paid for their participation.

4.1. PARTICIPANTS. A total of 24 English-dominant heritage Chinese speakers were recruited. All participants were university students (age range: 18-26; mean: 21.17) born and raised in the US. They identify Mandarin Chinese as their home language and English as their strongest language. A total of 21 L1 Chinese speakers participated in the Chinese TVTJ as controls. All L1 Chinese participants were also university students and none of them had lived outside China for more than one month at the time of the experiment.

4.2. EXPERIMENTAL DESIGN. An English version of a picture-matching TVJT was first created, followed by an equivalent Chinese version. Each sentence in the English TVJT was closely

translated to Chinese for the Chinese TVJT. All sentences in the English TVTJ were written sentences only, while the Chinese TVTJ contained written sentences as well as their audio recordings. For the Chinese version only, we let heritage participants read and hear sentences at the same time. There was no time limit for the TVJTs, and heritage participants were allowed to listen to the audio stimuli more than one time. The English TVTJ was presented before the Chinese TVJT, which was then followed by the Chinese and English proficiency tests.

Six well-known Disney characters were used in the TVJT. Three were students: *Mickey* (6a), *Minnie* (6b), and *Donald* (6c). The other three were teachers: *Pooh* (6d), *Tigger* (6e) and *Stitch* (6f). There was also a dog (5g) who could speak languages.

(6) a.  b.  c.  d.  e.  f.  g. 

The participants were informed that the three students, Mickey, Minnie and Donald, love to put pictures of their faces on their belongings. Each experimental item starts with a short story such as the following example: one day, the three students each bought their own cars, and an accompanying diagram as in (7):

(7) 

Each item had both a SS and IS condition. For the SS condition, the story above continues as follows: the three teachers, Pooh, Tigger and Stitch, used Minnie's car. Pooh also used Mickey's car, but no one used Donald's car, as shown in (8a). For the IS condition, the story in (7) continues as follows: the three teachers used Mickey's and Minnie's cars. Pooh also used Donald's car, as shown in (8b). In both conditions, there was a dog who saw what happened.

(8) a.  b. 

The dog then says an English sentence as in (9) or its equivalent Chinese sentence as in (10):

(9) all teachers did not use Donald's car.

(10)

| suoyou | laoshi | dou | meiyou | yong | Tanglaoya | de | che |
|---|---|---|---|---|---|---|---|
| all | teacher | all | not | use | Donald | GEN | car |

'All teachers did not use Donald's car.'

Participants were then asked to judge whether the sentence and the picture matched each other by saying 'yes' or 'no.' In order for (9) and (10) to match (8a), *all* has to take a wider scope over *not*. If participants accept the given sentence in the situation of (8a), the SS reading should be possible. Thus, (9)/(10) and (8a) constitute an SS item. On the other hand, in order for (9) and (10) to match (8b), the negation word *not* has to take a wider scope over *all*. If participants accept the given sentence in (8b), the IS reading should be acceptable. Therefore, (9)/(10) and (8b) constitute an IS item.

A total of 20 sentences of different lexicalizations were created. Each of the 20 sentences were combined with 2 pictures: one picture for the SS reading and another picture for the IS reading. In total, there were 40 sentence-picture pairs. These 40 pairs were further distributed into 2 lists so that there were 20 critical items (10 for SS and 10 for IS) in one list. Each list contained only one condition from the same lexicalization. Each participant saw either List 1 in English and List 2 in Chinese or List 2 in English and List 1 in Chinese.

For each experimental item, apart from the critical sentence, two other sentences were added as fillers, which were categorized as either Type 1 filler or Type 2 filler. The Type 1 filler in English for the sample involving (7) and (8a) is shown in (11):

(11) All teachers used Mickey's/Minnie's car.

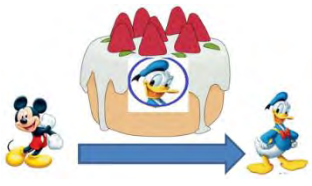
Equivalent Chinese items were also created. Type 1 fillers were used as baseline items to ensure that our heritage participants understand positive statements involving the quantifier *all* in Chinese. There were 10 'match' items and 10 'mismatch' items in each list. The Type 2 filler in English for the sample involving (7) and (8a) is shown in (12):

(12) Tigger/Pooh did not use Mickey's car.

Like Type 1 fillers, there were 10 'match' and 10 'mismatch' Type 2 fillers in each list. These fillers were used to make sure that our heritage participants could understand statements involving the negation *not* in Chinese. All experimental items were pseudo-randomized.

To ensure that our participants fully understood how to complete a TVJT, we provided several sample items in the instruction session of the experiment for the participants to practice with. Two items were used show that the same sentence could have two possible interpretations. If so, so long as one interpretation matched the picture, the answer should be 'yes.' One practice item had the sentence (13) with the picture (14a); another item had the sentence (13) with the picture (14b):

(13) Mickey sent Donald his cake.

(14) a. 

b. 

In (13), *his cake* can mean either Mickey's cake or Donald's cake. Participants first looked at the picture (14a) and the written sentence (13). If they responded 'no,' we asked them to reconsider whether it is possible to say (13) in the context of (14a). We then presented the item involving (13) and (14b) and followed the same procedure as with (14a). After receiving 'yes' answers on both items, we explicitly conveyed to participants that if a given sentence had two possible readings, as long as one reading matched the picture, the item should be accepted. This was used to ensure that our participants would explore all possibilities in doing the task and make judgments based on acceptability rather than preference.

**5. Findings.** The Chinese data from the 21 L1 Chinese speakers were first analyzed. Since there were two critical conditions each with 10 items: the SS condition (all>not) and the IS condition (not>all), based on the binomial distribution, we would be more than 95% confident that a participant made consistent judgments if he/she accepted or rejected 8 items or more out of 10. An initial screening of their judgments on Type 1 and Type 2 fillers revealed that all participants consistently accepted 'match' items and rejected 'mismatch' items. Table 1 summarizes the 21 participants' mean proportion of 'yes' answers in the critical conditions of the Chinese TVJT:

| Condition | Mean proportion | SD | SE |
|---|---|---|---|
| Surface Scope | 1 | 0 | 0 |
| Inverse Scope | 0.02 | 0.05 | 0.01 |

Table 1. Summary of the L1 Chinese participants' mean proportion of 'match' answers in the critical conditions of the Chinese TVJT

Pairwise comparison revealed a significant difference between the two critical conditions: ($t(20)= 83$, $p < .01$). The individual data showed that all participants consistently rejected the IS condition, which confirmed that the IS reading is unavailable in Chinese Q-Neg sentences.

Now, we examine the data from the 24 English-dominant heritage Chinese speakers. An initial screening of their judgments on fillers showed that they all consistently accepted 'match' items and consistently rejected 'mismatch' items. Such results suggests that our heritage speakers were all *qualified* participants with a high enough Chinese level to understand plain statements with *all* as well as those with negation. Table 2 summarizes the 24 participants' mean proportion of 'match' answers in each condition:

| Language | Condition | Mean proportion | SD | SE |
|---|---|---|---|---|
| English | Surface Scope | 1 | 0 | 0 |
| | Inverse Scope | 0.77 | 0.38 | 0.08 |
| Chinese | Surface Scope | 0.98 | 0.06 | 0.01 |
| | Inverse Scope | 0.46 | 0.46 | 0.09 |

Table 2. Summary of the English-dominant heritage Chinese speakers' mean proportion of 'match' answers in the critical conditions of the English and Chinese TVJTs

A two-way repeated measures ANOVA revealed a statistically significant interaction between *Scope Assignment* (SS/IS) and *Language* (English/Chinese) on the participants' acceptance of items: $F(1,23) = 11.87$, $p < .01$. Pairwise comparison shows a significant difference within the IS condition ($F(1,23) = 12.3$, $p < .01$). There was also a significant difference between SS and IS in English ($F(1,23) = 9.13$, $p < .01$) and in Chinese ($F(1, 23) = 31.13$, $p < .01$).

Since heritage speakers normally vary in the competence of their heritage language, we believe the individual data of our heritage participants is more informative. First, all heritage participants consistently accepted the SS items in both English and Chinese, suggesting that the SS reading is fully accessible to all participants. Regarding the IS reading, there were 9 (37.5%) participants who consistently accepted the IS items in both English and Chinese. For this group of individuals, the IS reading seems possible in their grammar for Q-Neg sentences in both languages. In contrast, there were 5 (20.8%) participants who consistently rejected the IS items in both English and Chinese. I.e., these 5 participants could not elicit the IS reading in their English and Chinese Q-Neg sentences. Finally, 7 (29.17%) participants consistently accepted the IS items in English but consistently rejected the IS items in Chinese, which suggests that they made a clear distinction between English and Chinese regarding the availability of the IS reading in Q-Neg sentences. There were 3 participants who did not make consistent judgments in all critical conditions, thus their data are not considered here. The heritage participants' individual data are summarized in Table 3:

| Judgment on Q-Neg sentences | Number of Participants | Percentage |
|---|---|---|
| Accepting IS in English & Chinese | 9 | 37.5% |
| Accepting IS in English but rejecting IS in Chinese | 7 | 29.2% |
| Rejecting IS in English & Chinese | 5 | 20.8% |
| Other | 3 | 12.5% |
| Total | 24 | 100% |

Table 3. Summary of English-dominant heritage Chinese participants' judgment on the inverse scope (IS) reading in English and Chinese

Now we examine our heritage participants' English and Chinese proficiency test scores, which are summarized in Table 4:

| Language | Range | Mean | SD | SE |
|---|---|---|---|---|
| English | 62.5-100 | 90.52 | 9.62 | 1.92 |
| Chinese | 0-48 | 14.66 | 14.1 | 2.81 |

Table 4. Summary of English-dominant Chinese heritage participants' scores of English and Chinese proficiency tests

The English proficiency test (LexTALE) is scored out 100 points, with Lemhöfer and Broersma (2012) setting 60 as a cutoff for selecting advanced L2 learners of English. It is not surprising to see our heritage participants achieve a high mean score, as their dominant language is English. For the 5 participants who consistently rejected the IS reading in English, one might

argue that proficiency played a central role in their judgments. However, all 5 participants in this group scored at least 80 points and were in the 90th percentile of Lemhöfer and Broersma (2012) 289 L2 English learners. Specifically, their scores were as follows: 87.5, 98.75, 97.5, 98.75, and 81.25. Their consistent rejection of the IS items should therefore be irrelevant to their English proficiency.

Next, we examine our heritage participants' Chinese proficiency scores. For the 9 participants who consistently accepted the IS reading in Chinese, is it possible that their Chinese level was not advanced enough? In the Chinese proficiency test, Wen (2015) sets 22 out of 50as the cutoff score for selecting advanced L2 Chinese learners. Although the 9 participants' mean score was 12.86, much lower than 22, there were 2 participants who scored above 22 (one participant even got 48, the highest score among the 24 participants). For the 7 'successful' participants who made a clear distinction between Chinese and English, only one participant scored higher than 22. Furthermore, 2 participants were unable to get any points at all for the Chinese proficiency test. Therefore, it does not seem likely that the acquisition of the target constraint in Chinese Q-Neg sentences is related to our participants' Chinese proficiency level.

**6. Discussion.** Our data showed that the English-dominant heritage Chinese speakers diverge in their interpretations of Q-Neg sentences in English and Chinese. They can be roughly categorized into three groups: (i) Group One consistently accepts the IS reading in both English and Chinese; (ii) Group Two consistently accepts the IS reading in English but consistently rejects it in Chinese; (iii) Group Three consistently rejects the IS readings in both English and Chinese.

The acceptance of IS in Chinese indicates that Group One participants did not have the native-like constraint that prohibits negation raising in Chinese Q-Neg sentences. As mentioned previously, proficiency did not seem to influence the judgments made by these individuals. Chinese proficiency test scores were generally low, but 2 Group One participants received high scores. If this is the case, what specifically prevents Group One participants from acquiring the native-like constraint in Chinese? Zhou and Crain (2009) found that L1 Chinese children initially allow the IS reading in their Q-Neg sentences but lose it as they grow older. Although we do not know the exact factors that trigger this unlearning, cues in the surrounding input may be partially responsible. Unlike the L1 Chinese children studied by Zhou and Crain (2009), our Group One heritage participants might never encounter cues in their input to suggest that the IS reading is prohibited in Chinese. This is to be expected, as heritage speakers do not have the same input as monolinguals in terms of quantity or quality. Another possible explanation is influence from their dominant language English. Cues from Chinese input may not work under these circumstances. In future studies, the two explanations can be tested among Chinese-dominant heritage speakers of a language that allows the IS reading in Q-Neg sentences.

Unlike Group One participants, Group Two participants successfully distinguished between English and Chinese. If L1 Chinese children initially allow the IS reading in Chinese Q-Neg sentences, we expect heritage speakers to do the same. Thus, Group Two participants managed to acquire the native-like constraint in Chinese in the same way L1 Chinese children do.

Group Three participants lacked the IS reading in both English and Chinese, following the grammar simplification hypothesis: to reduce ambiguity and maintain more processing resources, English-dominant heritage Chinese speakers simplify their grammar for English Q-Neg sentences by prohibiting negation raising. This is because negation raising is an extra step at LF that requires more cognitive effort. Despite the abundant English Q-Neg sentences in input that only allow the IS reading, such as *all that glitters is not gold*, our Group Three heritage speakers

still unlearned the negation raising in their English Q-Neg sentences. As discussed, English proficiency does not play a role, as all participants scored very high in the English proficiency test. Thus, this unlearning was likely a result of our participants' Chinese grammar affecting their English grammar.

The three groups of heritage speakers that our study identified suggest that the heritage speakers' grammar is more complicated than what the grammar simplification hypothesis can account for. Polinsky and Scontras (2020) argued that since heritage speakers need to hold two sets of different grammars in their heads, they are pressured to simplify their grammars in order to keep more processing resources for maintaining two languages. However, our Group Two participants' data seem to go against this claim: they made a clear distinction between English and Chinese regarding the availability of the IS reading in Q-Neg sentences, suggesting they did not simplify their English grammar. In addition, there were no signs of grammar simplification among our Group One participants, as both their English and Chinese grammars allow negation raising for the IS reading. Only our Group Three participants' data is in line with the grammar simplification hypothesis.

**7. Conclusion.** This paper used an experimental approach to investigate how English-dominant heritage Chinese speakers interpret Q-Neg sentences in English and Chinese. According to previous studies, there is a crucial difference between the two languages regarding the availability of the IS interpretation in Q-Neg sentences: the IS interpretation is allowed in English but is prohibited in Chinese. This is because the negation word *not* can be raised at LF in English but can never be raised in Chinese. Our experimental data showed that there are mainly three different groups of heritage speakers: (i) Group One who allows the IS reading in both English and Chinese; (ii) Group Two who allows the IS reading in English but not in Chinese; (iii) Group Three who disallows the IS reading in both English and Chinese. This finding suggests that the grammar simplification hypothesis, proposed by Polinsky and Scontras (2020), can only account for the grammar of our Group Three heritage speakers. It seems that heritage speakers' grammar is more complicated than what a single hypothesis can account for.

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