

Quantifier scope in heritage bilinguals: a comparative experimental study*

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1. Introduction

Across three experiments, this paper investigates the interaction of different scope systems in English-Hungarian heritage bilingual speakers. Experiment 1 presents empirical confirmation that Hungarian does not allow scope ambiguities, which has been widely assumed in the theoretical literature (É. Kiss 2002, a.o.). Experiment 2 replicates recent findings of Scontras et al. (2017), namely that there is no transfer in the domain of scope from dominant English to a scope-rigid heritage language. However, Experiment 3 shows that in speakers with the opposite grammatical system, i.e. a dominant scope-rigid language and heritage English, English becomes scope-rigid. Taken together, these results offer evidence that the interaction of different scope systems in heritage speakers results not in general transfer always in one direction, but simplification across the board. I argue that due to processing reasons, speakers always default to scope-rigidity in their heritage grammar.

2. Background

Sentences containing quantificational expressions often give rise to multiple readings, because quantifiers can enter into ambiguous relations both with each other and other types of sentential operators (wh-operators, negation, etc.). These scope ambiguities are demonstrated in (1)-(2), which both give rise to two distinct (surface and inverse) readings.

- (1) Every pirate fed a shark. (Every-A)
 - a. Surface scope ($\forall > \exists$): For every pirate, there is a shark that he fed.
 - b. Inverse scope ($\exists > \forall$): There is a shark such that every pirate fed it.

- (2) A pirate fed every shark. (A-Every)
 - a. Surface scope ($\exists > \forall$): There is a pirate such that he fed every shark.

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- b. Inverse scope ($\forall > \exists$): For every shark, there is a pirate that fed it.

As we can see, English is a language that allows for scope ambiguities (though inverse interpretations are dispreferred), but this is not cross-linguistically universal. In scope-rigid languages, there is a one-to-one correspondence between the linear order and scope relations of quantifiers. The question arises, then, as to what happens when a bilingual's two languages have different scope systems: within an individual, how does a scope-rigid grammar interact with one that allows scope ambiguities?

Heritage speakers represent a particularly interesting type of multilingual language user: simultaneous or sequential bilinguals whose home/native language (L1) is the less dominant one. Heritage speakers speak and hear both the heritage language (L1) and the majority language (L2) while growing up, and it is only around school age that the L2 supplants the L1 as the speaker's dominant language, and the heritage language weakens (Benmamoun et al. 2013a, 2013b). For this reason, studying heritage speakers may be helpful in distinguishing areas of the grammar susceptible to attrition from those that are not (Benmamoun et al. 2013a).

Bringing together syntactic, semantic and pragmatic levels of representation, scope calculations are not only difficult, but are also known to be fragile. This makes them worthy of investigation especially in heritage bilingual speakers, who already face processing difficulty through having to employ a less dominant grammar. Indeed, experimental investigations into the effects of bilingualism on scope interpretation have produced interesting results. Lee et al. (2011) tested the interaction of negation and the universal quantifier in children and adult bilinguals whose first language was Korean, but who were dominant in English at the time of testing (heritage Korean speakers). For sentences such as (3), English speakers prefer the partitioned-set interpretation (b), while Korean speakers prefer the full-set interpretation (a).

- (3) Robert did not cut down all the trees.
a. all > not: Robert did not cut down any trees.
b. not > all: Not every tree was cut down by Robert.

The authors found that the bilinguals differed from monolingual speakers of English in that they over-accepted the full-set interpretation (a) but under-accepted the partitioned-set interpretation (b). This suggests that early exposure to Korean interferes with scope calculations in English, even when that is the dominant language.

Scontras et al. (2017) tested English-dominant heritage speakers of Mandarin on sentences such as (1)-(2) to see whether scope preferences are preserved in the scope-rigid L1 when it is weakened by an L2 that allows inverse scope. They found that the speakers' Mandarin grammar is like native Mandarin: it resists inverse scope in doubly quantified sentences. This suggests that there is no transfer from the dominant (L2) to the heritage (L1) grammar in the domain of scope. Moreover, the English grammar of such speakers was also shown to be scope-rigid. This seems to present a puzzle: why would the scope system of the weaker language not only be retained, but even transferred to the dominant

language? As noted by Scontras et al. (2017), their results are compatible with two hypotheses that underlie the grammatical system (in the domain of quantifier scope in particular) of heritage speakers. Under Hypothesis (1), the heritage grammar, by virtue of being acquired first, is preserved and transferred to the L2 even though the L2 is dominant. Under Hypothesis (2), regardless of the temporal order of acquisition, the simpler of the two grammars is the one that is preserved and carried over to the other language. I take the simpler grammar to be the one not allowing ambiguities and not containing the additional syntactic mechanism of Quantifier Raising (May 1977). This preference for simpler grammars might be even stronger in heritage speakers, because as mentioned, they are already facing additional processing costs.

A population that could tease apart these two hypotheses is heritage speakers of English (i.e. weaker L1 English) who are dominant in a scope-rigid language. Hypothesis (1) would predict the scope ambiguity of their weaker but first acquired English to be preserved, while under Hypothesis (2) their English would become scope-rigid. In three experiments, the current study tests these predictions on monolingual Hungarian speakers, and English-Hungarian bilinguals whose heritage language is either English or Hungarian. Hungarian, just like Mandarin, is a scope-rigid language: quantifiers move to scope positions by Spell-Out (i.e. in the Narrow Syntax), with the consequence that doubly quantified Hungarian sentences are not ambiguous (É. Kiss 2002). The Hungarian translations of the doubly quantified English sentences only allow for the surface interpretation. The different scope readings of e.g. (1) above are encoded by different sentences; its surface reading is encoded by (4), the literal translation, and its inverse reading is encoded by (5).

- (4) Minden kalóz meg-etet-ett egy cápá-t.
every pirate PFV-feed.3SG-PST a/one shark-ACC
'Every pirate fed a shark.' (surface scope)
- (5) Egy cápá-t etet-ett meg minden kalóz.
a/one shark-ACC feed.3SG-PST PFV every pirate
'Every pirate fed a shark.' (inverse scope)

3. Experiments

Three sentence-picture rating experiments were conducted on monolingual Hungarian speakers (Experiment 1), English-Hungarian bilinguals whose heritage language is Hungarian (Experiment 2) or whose heritage language is English (Experiment 3). Of the three grammars investigated (monolingual Hungarian, heritage Hungarian, heritage English), none allow scope ambiguities. This supports the hypothesis that the interaction of two different scope systems always results in simplification in the heritage grammar.

3.1 Participants

Participants in Experiment 1 were native monolingual Hungarians, those in Experiment 2 were English-dominant heritage speakers of Hungarian, and in Experiment 3 Hungarian-

dominant heritage speakers of English. Linguistic background was established via a detailed questionnaire and, when necessary, additional personal communication. Participants who did not fit the profile of a heritage speaker were excluded. The data reported in the following is from 77 monolinguals (Experiment 1), 15 heritage Hungarian speakers (Experiment 2) and 8 heritage English speakers (Experiment 3).

3.2 Methods

Participants completed a sentence-picture rating task online, using the experiment software ExperigenRT (Pillot et al. 2012). Two types of doubly quantified sentences were tested, Every-A and A-Every configurations. Two factors, Word Order and Scope Interpretation were manipulated, where Word Order refers to the linear configuration of quantifiers, and Scope Interpretation to the intended reading: whether the picture displayed depicts the surface or inverse interpretation. Experimental items were of the type seen in Table (6)¹. Sentences were recorded by an adult female speaker of Hungarian/Standard Southern British English, using neutral intonation.

(6) *An example experimental item*

	Surface scope	Inverse scope
Every – A	<p>Minden kalóz meg-etet-ett egy cápá-t. Every pirate fed a/one shark.</p>	<p>Minden kalóz meg-etet-ett egy cápá-t. Every pirate fed a/one shark.</p>
A – Every	<p>Egy kalóz meg-etet-ett minden cápá-t. A/One pirate fed every shark.</p>	<p>Egy kalóz meg-etet-ett minden cápá-t. A/One pirate fed every shark.</p>

In each trial, participants were first presented with a picture and asked to play the corresponding recorded sentence by clicking on the audio button. After listening to the sentence, they were asked to rate how accurately it described the picture on a 7-point scale, where

¹All disambiguating pictures come from Benjamin Bruening’s Scope Fieldwork Project: <http://udel.edu/~bruening/scopeproject/scopeproject.html>

1=completely inappropriate and 7=completely appropriate. Using a scalar task across all experiments is motivated by the finding that heritage speakers respond better to them than to binary truth-value tasks, because their grammaticality judgements are less sure than those of native speakers (Orfitelli & Polinsky 2017). A 7-point scale makes results directly comparable to Scontras et al. (2017). Participants completed 16 trials in a randomized order: 8 critical items in a Latin Square design, as well as 4 bad and 4 good fillers.

We must note that the different scope interpretations (surface vs. inverse) of doubly quantified sentences are not logically independent of each other. Where the universal quantifier precedes the existential quantifier (Every-A, shown in (1)) the inverse scope reading entails the surface scope reading: if there is a single shark that every pirate fed, then it is necessarily true that every pirate fed a shark; both of these scenarios are compatible with the surface parse of the sentence. Sentences where in the surface structure the singular indefinite c-commands the universal quantifier (A-Every, shown in (2)) do not have this entailment relation: the scenario with multiple pirates feeding multiple sharks makes the inverse reading true, but the surface reading false. Therefore only these sentences (A-Every, inverse) are good test cases for the availability/lack of inverse scope.

3.3 Hypotheses and predictions

The widely held theoretical assumption about Hungarian is that it does not allow inverse scope (É. Kiss 2002, a.o.). For Experiment 1 (monolingual Hungarian), ratings for the critical A-Every inverse condition are thus predicted to be significantly lower than ratings for the other conditions; in fact they should be close to floor level. As for Experiment 2 (heritage Hungarian), a priori two scenarios could be imagined: 1) the prohibition on inverse scope interpretation in Hungarian is robust and immune to transfer from English, which allows scope ambiguities. In this case, we would predict ratings for the critical A-Every inverse condition to be low in heritage Hungarian, similarly to monolingual Hungarian. Alternatively, 2) if the complex operation of scope calculation is susceptible to transfer (from the dominant language), and therefore heritage Hungarian allows inverse scope, ratings for the test condition are predicted to be higher than in Experiment 1. Scontras et al. (2017)'s findings from English-dominant heritage Mandarin speakers suggest the former scenario would obtain, i.e. that ratings for A-Every inverse remain low.

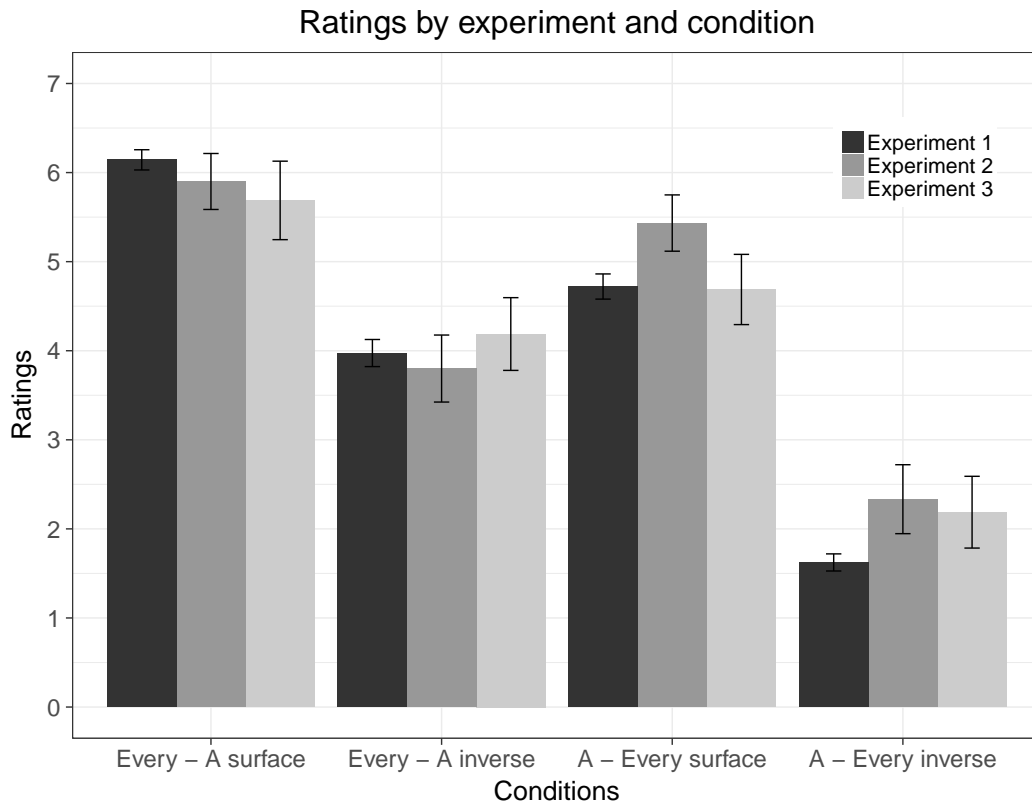
As discussed in the Background section, Scontras et al. (2017)'s results can be explained by two different hypotheses. Under Hypothesis (1), there is a general lack of transfer from the dominant to the weaker language in the domain of scope. Moreover, the heritage grammar, by virtue of being acquired first, is preserved and transferred to the L2 even though the L2 is dominant - as evidenced by Scontras et al. (2017)'s testing of the English of English-dominant heritage speakers of Mandarin. As for the present Experiment 3 (heritage English), Hypothesis (1) would predict the scope ambiguity of the speakers' weaker, but first acquired English to be preserved. This would mean that they rate the critical condition testing the availability of inverse scope higher than the participants of Experiments 1 and 2. Under Hypothesis (2), regardless of the temporal order of acquisition, the simpler (i.e. not allowing ambiguities and lacking Quantifier Raising) of the two grammars is the one that is preserved and carried over to the other language. Hypothesis (2) predicts the

English of the Hungarian-dominant heritage speakers of English to become scope-rigid, and thus the data of Experiment 3 would pattern with that of Experiments 1 and 2.

3.4 Results

Averaged ratings for all experiments are given in (7). For all experiments, a mixed effects ordinal regression model was fit (using the ordinal package in R (Christensen 2018)), predicting ratings by Word Order and Scope Interpretation. Models included maximal random effects structure (random slopes and intercepts for participants and items) where permitted by the data (Barr et al. 2013). Fixed effects predictors were centered before analysis. All reported p values come from likelihood ratio tests, which were conducted between mixed effects models differing in the presence or absence of the fixed effect Word Order, the fixed effect Scope Interpretation, or their interaction. For Experiment 1 (monolingual Hungarian), model comparisons show a significant main effect for Word Order ($p < .001$) and Scope Interpretation ($p < .001$), as well as their interaction ($p < .05$). For Experiment 2 (heritage Hungarian), we see a significant main effect for Word Order ($p < .05$) and Scope Interpretation ($p < .01$). The overall pattern was very similar to Experiment 1, even though the interaction was not significant ($p = .4$). Lastly, for Experiment 3 (heritage English), we find a significant main effect of Word Order ($p < .05$) and Scope Interpretation ($p < .001$), as well as their interaction ($p < .05$).

(7) *Results for all experiments*



3.5 Discussion

The results of Experiment 1 are consistent with the consensus in the theoretical literature that inverse scope is prohibited in Hungarian. As discussed in the Background section, the Every-A inverse condition is not very informative because of its entailment relation with the surface variant; instead the critical test case is the A-Every inverse condition. A-Every sentences and inverse sentences received lower ratings, and the critical A-Every inverse condition received the lowest rating, crucially even lower than predicted by the addition of the main effects. Ratings for the critical condition were at floor level: 1.62 out of a possible 7 points. This provides empirical confirmation of the prohibition on inverse scope in Hungarian, i.e. isomorphism at both LF and surface structure.

We can see that the Every-A order received higher ratings than the A-Every order, no matter what the scope condition. The same overall preference for Every-A Word Order has been observed for both Mandarin and English (Tsai et al. 2014). For the former, contact with Taiwanese has been suggested as the cause, due to definite/specific expressions (and therefore phrases containing *every*) being banned in Taiwanese. However, a similar explanation is not available for English, but the dispreference for A-Every is still found. Tsai et al. (2014) conclude that it remains to be seen how cross-linguistically common the degraded status of the A-Every configuration is, and why. The results from Hungarian provide further support for the same Every-A vs. A-Every asymmetry.

Experiment 2's results suggest that English-dominant heritage Hungarian speakers retain scope-rigidity in their weaker Hungarian. Experiment 2 thus replicates on a Hungarian-English population the Mandarin-English findings of Scontras et al. (2017). Even though the critical A-Every inverse condition is only as low as predicted by the two main effects, it is still close to floor level: 2.33 out of 7 points. Moreover, this is considerably lower than the comparable ratings in a language that allows scope ambiguities: the monolingual English speakers investigated by Scontras et al. (2017) gave A-Every inverse sentences a rating of 4.46. That the ratings are higher than those in Experiment 1 ($2.33 > 1.62$) is likely due to the yes-bias of heritage speakers, who have been observed to accept ungrammatical constructions to a greater extent than native controls due to being less comfortable with their L1 heritage grammar (Benmamoun et al. 2013a). This was in fact also observed in Scontras et al. (2017)'s experiments, where the comparable heritage Mandarin rating was 2.79 out of 7.

Similarly to Experiments 1 and 2, in Experiment 3 the critical A-Every inverse condition received the lowest rating; in fact lower than would be predicted based on the combined main effects. The average is again very close to floor level at 2.18 out of 7 points. Even though the average rating given by heritage English speakers to the critical condition is higher than that given by native Hungarians in Experiment 1 ($2.18 > 1.62$), it is comparable to that of heritage Hungarian speakers in Experiment 2 ($2.18 \approx 2.33$). As discussed earlier, the slightly higher ratings can be due to the yes-bias observed across heritage-speaker studies: heritage speakers rate unacceptable structures higher than native controls.

Given that the materials used in all experiments closely match those used by Scontras et al. (2017), we can compare the results presented here to those obtained by them. Table (8) compares the heritage English data (from Experiment 3) to monolingual English

(from Scontras et al. (2017)) and monolingual Hungarian (from Experiment 1). A-Every inverse ratings in the crucial heritage English group are over 2 points below the monolingual English baseline. We can see here that monolingual English speakers rate the critical condition higher than the heritage speakers: a 4.46 acceptability rating is taken to characterize the availability of genuine inverse scope. The reason it is slightly lower than the corresponding surface interpretation (A-Every surface) even in monolingual English is that, as mentioned, calculating inverse scope is costly even in a language where it is possible. The data from Experiment 3 thus pattern in general similarly to the Hungarian data of Experiments 1 and 2, and not like the monolingual English baseline, which together suggest that Hungarian-dominant heritage speakers of English are employing an ambiguity-free scope-rigid grammar in their English.

(8) *Comparing heritage English to monolingual English/Hungarian*

Word Order	Scope Interpretation	Heritage English	Monolingual English	Monolingual Hungarian
Every - A	surface	5.68	6.5	6.14
A - Every	surface	4.68	5.6	4.72
Every - A	inverse	4.18	5.5	3.97
A - Every	inverse	2.18	4.46	1.62

Scontras et al. (2017) also observed that heritage speakers of English who are dominant in a scope-rigid language employ a scope-rigid grammar in their English, basing their discussion on testing a few Japanese-dominant heritage English speakers, who rated the critical condition 2.13 out of 7. The present study confirms this conclusion in Experiments 2 and 3 on English-Hungarian bilinguals whose heritage language is either Hungarian or English, thus keeping the language pair constant and allowing for a more direct comparison. To sum up, then, none of the three grammars tested here (native and heritage Hungarian, heritage English) allow inverse scope.

4. General discussion

The present paper confirms and extends the conclusions drawn by Scontras et al. (2017) regarding the interaction between a system that allows scope ambiguities (though disprefers them) and one that prohibits them altogether, specifically in heritage speakers (who are independently known to be an interesting testing ground for theoretical issues). They found that the Mandarin grammar of English-dominant heritage speakers of Mandarin is like native Mandarin: it resists inverse scope in doubly quantified sentences. Such speakers did seem to accept inverse scope to a slightly higher degree than native controls, which might initially suggest some transfer from English. However, the English grammar of these speakers was also shown to be scope-rigid, lending support to the idea that ratings are elevated due to the yes-bias of heritage speakers, but in fact they do lack scope ambiguities in both their Mandarin and English. These results, in turn, are compatible with two hypotheses: Hypothesis (1), the heritage grammar is preserved and transferred to the L2 even though

the L2 is dominant, or Hypothesis (2), regardless of the temporal order of acquisition, the simpler of the two grammars is the one that is preserved and carried over to the other language.

The critical population in this paper is that of Experiment 3: heritage speakers of English (i.e. weaker L1 English) who are dominant in a scope-rigid language (Hungarian). Under Hypothesis (1) their English is predicted to retain scope ambiguities; while under Hypothesis (2) it would become scope-rigid. The ratings for the A-Every inverse condition are low across all three experiments, suggesting that none of the three grammars (native and heritage Hungarian, heritage English) allow inverse scope. Crucially, the heritage English speakers of Experiment 3 also do not seem to accept scope ambiguities, which clearly supports Hypothesis (2). Thus, coupled with Scontras et al. (2017)'s results, the present experiments demonstrate that the interaction of different scope systems in heritage speakers results not in general transfer always in one direction, but rather simplification across the board, i.e. defaulting to a less complex scope calculation system.

The simpler grammar here is defined as one not allowing ambiguities and thus keeping a one-to-one mapping between interpretations and surface structures, as well as lacking the additional mechanism of Quantifier Raising. This preference for isomorphism can be given a processing-related explanation. Even monolingual English speakers, whose grammar allows scope ambiguities, are known to prefer surface interpretations, which can be observed both in grammaticality judgment and reaction time data. That is, the calculation of inverse scope is independently known to be costly, cf. e.g. the principle of Processing Scope Economy (Anderson 2004).

(9) *Processing Scope Economy*

The human sentence processing mechanism prefers to compute a scope configuration with the simplest syntactic representation (or derivation). Computing a more complex configuration is possible but incurs a processing cost.

Additionally, heritage speakers already face processing difficulty through having to employ a less dominant grammar. Thus it is not surprising that a preference for simpler grammars is especially pronounced in the case of heritage speakers, to the extent that they default to scope-rigidity across the board, regardless of whether that comes from their L1 or L2.

5. Conclusion

Testing the Hungarian of monolingual Hungarian speakers, the Hungarian of heritage Hungarian speakers dominant in English, and the English of heritage English speakers dominant in Hungarian, the present paper finds that none of the grammars allow scope ambiguities in doubly quantified sentences. Monolingual English does allow them, so the data presented here is evidence that in the domain of scope, the interaction of a dominant and a heritage grammar results in simplification (i.e. loss of ambiguity) across the board. This can be explained by a processing preference against calculating inverse scope readings, and thus favoring a scope-rigid grammar, which may be especially strong in heritage speakers, who are already taxed by the task of employing their weaker grammar.

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