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QUANTIFIER SCOPE AMBIGUITIES  
IN HUNGARIAN

– AN EXPERIMENTAL APPROACH –

PhD dissertation

THESES

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## 1 The issue and its background

Doubly quantified sentences — as presented in (1) — potentially have more than one reading.

- (1) [QP<sub>1</sub> Exactly two students] did [QP<sub>2</sub> each assignment].
- a. ‘Exactly two students are such that they did each assignment.’
  - b. ‘Each assignment is such that it was done by exactly two students.’

Ambiguity arises because the interpretation of the two quantifiers can interfere in such sentences. In (1.a) the quantificational phrase (henceforth: QP): *exactly two students* is considered first and the second QP: *each assignment* is rendered to the first QP. The scope reading in (1.a) respects the linear order of the QPs, namely the interpretation is isomorphic to the word order of the sentence, henceforth (1.a) is the so called *linear scope reading* of the sentence. In this interpretation, QP<sub>1</sub> has QP<sub>2</sub> in its scope, i.e. QP<sub>1</sub> has wide scope over QP<sub>2</sub> and QP<sub>2</sub> has narrow scope in the sentence. On the other hand, (1.b) shows just the opposite: QP<sub>1</sub> is interpreted with respect to QP<sub>2</sub>. The linear order of the QPs does not reflect the order of their interpretation; henceforth (1.b) is the so called *inverse scope reading* of the sentence. In (1.b), QP<sub>2</sub> scopes over QP<sub>1</sub>, hence QP<sub>2</sub> obtains wide scope, while QP<sub>1</sub> takes narrow scope in the sentence.

- |                      |                              |              |
|----------------------|------------------------------|--------------|
| (1.a) Linear scope:  | QP <sub>1</sub> exactly two: | wide scope   |
|                      | QP <sub>2</sub> each:        | narrow scope |
| (1.b) Inverse scope: | QP <sub>1</sub> exactly two: | narrow scope |
|                      | QP <sub>2</sub> each:        | wide scope   |

In (1.a), QP<sub>1</sub> is the sorting key, while QP<sub>2</sub> is the distributed share: it lists the two students and assigns each completed assignment to him/her. This interpretation is the *distributive scope reading* of the quantifiers. It has to be noted that there is also an existential scope reading available for such quantifiers, however, this thesis focuses on the distributive scope interpretation.

Not all doubly quantified sentences are unequivocally ambiguous. There are many grammatical and extra grammatical factors that affect scope reading of the distributive universal quantifier. Syntactic structure, as well as grammatical/thematic roles may affect scope relations. The lexical semantic type of the QPs is crucial in their scope taking behavior. Extra-linguistic factors also affect scope interpretation of doubly quantified sentences. For instance, world knowledge overrides other grammatical preferences of scope relation.

At first glance, prosody may also distinguish between two readings of a scope-ambiguous sentence. In a series of studies, Hunyadi (1999, 2002) argues that scope relations can be “read off” from the prosodic structure of the Hungarian sentence. In his framework prosodic prominence indicates the scope relations of the sentences containing more than one scope bearing element, namely the prosodically prominent operator takes wide scope over the less prominent one – illustrated in (2).

- (2) *JÁNOS látott mindenkit.*  
 John.NOM saw everyone.ACC  
 ‘It was John that, for every x, x=person, saw x.’  
 (Hunyadi 2002: 84; ex: 60)

In (2) the pre-verbal focus takes the post-verbal universal quantifier into its scope. In the prosodic structure, the whole sentence forms one Intonational Phrase (IP) headed by the pre-verbal, focal subject. This is the linear scope reading of the sentence in which case the phonological linearization, the syntactic relations and the scope relations are isomorphic. However, in the case of a prosodically prominent universal quantifier, the inverse scope reading is also available for the same linearization, as it is illustrated in (3).<sup>1</sup>

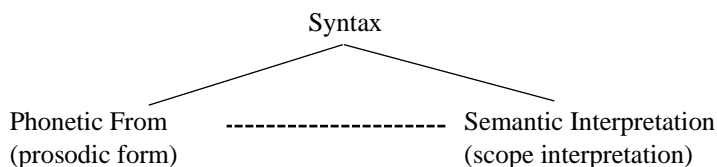
- (3) *JÁNOS látott MINDENKIT.*  
 John.NOM saw everyone.ACC  
 ‘For every x, x=person, it was John that saw x.’  
 (Hunyadi 2002: 84; ex: 61)

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<sup>1</sup>At this point I put the issue of the syntactic structure aside.

Hunyadi argues that there are two intonational phrases in (3): the first IP is headed by the pre-verbal focal subject and contains the verb as well, while the second IP has the post-verbal universal quantifier as its head. This is the first condition of taking inverse wide scope in a Hungarian sentence according to Hunyadi. Beside the two IPs, Hunyadi proposes an Operator Hierarchy which determines the wide scope bearing element in a case of two intonational phrases. Since the universal quantifier is higher in this hierarchy, it takes scope over the pre-verbal subject; this fulfills the second condition of inverse scope taking.

This approach takes the correlation between the prosodic difference and the scope difference at face value and posits that it is the prosodic difference that directly underlies the scopal distinction. We may call this the **Prosodic Approach**. This view would challenge the classic (inverted) Y-model architecture of the grammar (Chomsky 1981), in which the three modules of the grammar have restricted relations: syntactic structure is interpreted separately by the phonological module (phonological realization) and by the semantic module (logical/semantic interpretation), while the latter two have no direct interaction as Figure 1 shows with the firm lines.



**Figure 1**  
The classic Y-model of the grammar and the Prosodic Approach

The Prosodic Approach presupposes that phonological and logical modules are connected, as it is indicated by the dashed line in Figure 1. To be more concrete, the prosodic form of the sentence can determine its scope relations (see the brackets in Figure 1), as it was demonstrated in Hunyadi’s framework above.

Hunyadi also integrates into his theory the observation that the formation of intonational phrases depends on pragmatic information. The special information structural status of a contrastive topic affects the IP structure of

the sentence and hence the scopal relations as well. In example (4), Hunyadi suggests that the universal quantifier functioning as a contrastive topic has an “incomplete tonal contour” and needs the tonal contour of the following phrase to make it prosodically complete (Hunyadi 2002: 117). He takes this to be evidence that the universal quantifier and negation are contained in the same IP. Since it is the negative particle that is prosodically more prominent, it scopes over the universal quantifier, which results in the only available inverse scope reading of the sentence:

- (4) *Mindenkit NEM látott János.*  
 everyone.ACC not saw John.NOM  
 (Hunyadi 2002: 114; ex: 92)
- a. ‘For everyone it is true that John did not see him/her’  
 #linear scope reading
- b. ‘It is not true that John saw everyone’  
 OK<sub>i</sub> inverse scope reading

This special intonation seems to be connected to inverse scope not only in negative sentences but in doubly quantified sentences as well. Again, in the German example presented in (5), neutral intonation of the sentence realizes the linear scope interpretation, namely that there is at least one specific student (e.g. Anna) who read every novel, while the rise–fall intonation of the subject quantifier expresses the inverse scope reading, namely that every given novel was read by at least one of the students in the class (e.g. War and Peace was read by Anna; Wuthering Heights was read by Ben and so on and so forth).

- (5) [QP<sub>1</sub> *Mindestens / ein Student*] *hat* \ [QP<sub>2</sub> *jeden Roman*] *gelesen.*  
 at.least one student have every novel read  
 (Krifka 1998: 80; ex: 16b)
- a. ‘There is at least one student such that he/she read every novel’  
*neutral intonation*: linear scope
- b. ‘Every novel is such that it was read by at least one student.’  
*hat contour*: inverse scope

Based on the observations presented in (2–5), prosody seems to distinguish both between the two scope interpretations of doubly quantified sentences and also between the readings of negative quantified sentences. One could assume that it is the two prosodic forms themselves that disambiguate between the two possible scope-readings in such sentences, without a syntactic difference underlying the two readings.

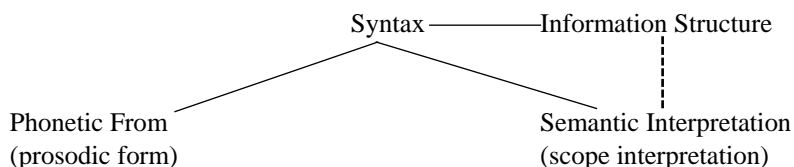
The case of (2–5) illustrates the core theoretical questions this thesis is concerned with. There are at least two conceivable approaches to the facts exemplified by these examples. The first, the Prosodic Approach has already been mentioned in the description of the Hungarian example (2–3). The Prosodic Approach may cover the Hungarian example (4) and the German sentence (5) as well, since it associates the marked prosodic realization with the inverse scope reading.

A second possible approach may be called **Information Structural Approach**. This approach proposes that information structural roles have a direct effect on scope interpretation. In the Hungarian and German examples, it is clear that the information structural status of the subject is different in the two scope readings: “hat contour” marks the contrastive topic. In Büring’s (2018) theory, sentences with contrastive topics are partial answers to the so-called question under discussion (QUD). These partial answers give an answer only to some sub-questions that together make up the QUD. The Information Structural Approach considers that in this case it is not prosody that disambiguates scope but information structure has its own share in this process, since the hat-contour and contrastive topic interpretation go hand in hand. It is commonly assumed that narrow quantifier scope is linked directly to the contrastive topic status of the sentence-initial QP in such cases and the special prosody only reflects this special information structure.

Since it is highly relevant to the main issue of the thesis, at this point I complement the Y-model with Information Structure. Information Structure includes non-truth-functional aspects of sentence meaning pertaining to the relation between the sentence and its discourse context, described through notions such as focus, givenness, topic, contrast etc. Information Structure itself is not truth-functional, and it is autonomous from semantics. This is not to deny that semantic operations (such as semantic identification, exclusion) may be sensitive to it; therefore, Information Structure (IS) may have indirect semantic effects. This modified model belongs to the Information Structural

Approach, based on the classic Y model which takes the interpretative modules separate and takes IS to be directly encoded within syntax, e.g. via information structural formal features, like the [focus]-feature, as in Jackendoff (1972). In this type of model, the generalization according to which the information structural role of focus is associated with prosodic prominence in PF is captured by positing a formal syntactic [focus] feature, which is mapped to the focus role in IS on the one hand, and it is mapped to prosodic prominence in PF on the other. It is syntax (including formal [focus]-features) that mediates between IS and PF. Although the hypothesis of formal IS-features has recently been challenged by what are called “interface approaches” to IS, which argue that formal IS-features are problematic (Zubizarreta 1998, Szendrői 2003, Fanselow 2007), and a direct IS–PF interface should be assumed instead, in this dissertation I put this debate aside and follow the classic approach, since the issue of IS-features is not relevant in the cases I investigate and analyse here.

The Information Structural Approach suggests that prosody reflects only the information structure, and it is the latter one that disambiguates between the scope readings — see Figure 2. If so, no direct link needs to be posited between prosody and scope.



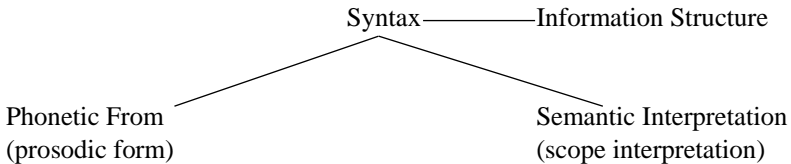
**Figure 2**

The classic Y-model of the grammar and the Information Structural Approach

In a broader theoretical view, not only contrastive topics, but further information structural notions such as common ground, topic–comment, focus–background, given–new, may all have an effect on scope (Ioup 1975, Erteschik-Shir 1997, Portner and Yabushita 2001, Krifka 2001; for Hungarian see Gyuris 2006, 2008), any analysis that links information structure (including IS-features represented in the syntax) without also positing a

concomitant syntactic – structural – effect is categorized as belonging to the Information Structural Approach.

Finally a third possibility, the **Syntactic Approach**, is based on the theory that the scope of QPs is determined by their syntactic position, namely how “high” they are in the (overt or covert) syntactic structure, namely, the QP c-commands its scope (May 1985, Reinhart 1976, 1983, É. Kiss 2002, 2010). Basically, the Syntactic Approach assumes two different unambiguous underlying syntactic structures of the two different scope readings. In this case, the core concept of the classic Y model (Figure 3.) can be maintained, as syntax is the sole interface between the other modules of the grammar.



**Figure 3**

The classic Y-model of the grammar (and the Syntactic Approach)

The syntactic module is clearly associated with the semantic module of the grammar (cf. the principle of compositionality): this is a shared assumption of each of the approaches reviewed here. The way the Prosodic Approach and the IS Approach differ concerns what additional interface they postulate: one between PF and semantic interpretation, and one between IS and semantic interpretation, respectively. As a consequence, these two approaches have greater descriptive power, since in principle they can explain the relevant phenomena via two interfaces: the syntax-semantics interface and the additional interface they posit. That is why the Syntactic Approach (the Y-model) is the null hypothesis, and the other two come into question only if the phenomena in the experimental data cannot be derived purely in the syntax or the phenomena cannot be described in a principled manner.

This thesis is concerned with investigating these theoretical possibilities with experimental methods in Hungarian, in cases which are less transparent because they do not involve a contrastive topic. The target sentences — which are sampled in (6) — have a pre-verbal quantifier constructed with the



distributive particle *is* ('too, also') and a post-verbal distributive universal quantifier, *mindegyik* ('each'). The other type of the target sentences are illustrated in (7) and (8). In (7) I investigated the scope relations of the negative particle and a post-verbal bare numeral (*four n*), while in (8) I present the other sentence type in which I tested the scope relation of the negative particle and a post-verbal QP (*more than n*).

(6) *Négy előadó is el-énekelte mindegyik melódiát.*  
 four singer DIST.PRT VM-sang each melody.ACC  
 'Four singers sang each melody.'

- a. 'There were four singers each of whom sang each melody'  
*Linear: four > each*
- b. 'Each melody is such that each of four singers sang it'  
*Inverse: each > four*

(7) *Nem romlott el négy nyomtató.*  
 no broke VM four printers  
 'Four printers did not break down.'

- a. 'It is not true, that four printers broke done'  
*Linear: neg > four*
- b. 'For four printers it is true, that they did not break done'  
*Inverse: four > neg*

(8) *Nem romlott el több mint három nyomtató.*  
 no broke VM more than three printers  
 'No more than three printers broke down.'

- a. 'It is not true, that more than three printers broke done'  
*Linear: neg > four*
- b. 'For more than three printers it is true, that they did not break done'  
*Inverse: four > neg*

The foregoing discussion leads to the following general research question. The main empirical research question, RQ.i, is the following:

- (RQ)** i. Does prosody affect the availability of linear and inverse scope interpretations in doubly quantified sentences?

If the answer to (RQ.i) is positive, the second issue to deal with can be formulated as below:

- ii. Does IS mediate between prosodic realization and scope interpretation?

In other words, the prosodic differences only reflect an information structural difference and in this case it is not prosody that determines the scope readings directly. Instead, the different readings and the different prosodic realizations are determined by information structure. If the answer to (RQ.ii) is positive, then a last, theoretical question to raise is:

- iii. Is there a syntactic distinction that underlies any IS difference that is responsible for any detected scopal effects?

If so, there is no need for the revision of the extended Y-model in which syntax is the only interface between the prosodic form and the scope interpretation.

## 2 Method

To address **(RQ)**, the specific methods and experimental questions **(EQ)** were formulated as follows. In experiments that are designed on the basis of the method that I will refer to as (method) **Type I**, the effect of prosody is investigated independently of context (i.e. out of any written context, providing only figures or only paraphrases depicting the possible scope readings), focusing solely on the role of prosody in speech production – in syntactically controlled sentences (i.e. the word order was invariable through the conditions). The question addressed when using method Type I is as follows:

- (EQ)** i. Can prosody disambiguate between linear and inverse scope readings in the absence of context in speech production?

Further experiments rely on what will be referred to as method **Type II**. In these experimental designs, the role of information structure is taken into consideration in a well-controlled manner. In these designs not only the scope-reading of the quantifiers were controlled by means of visual stimuli, but the target sentences were also inserted in an appropriately controlled written dialogue context. Since in experiments of Type I the context was not provided, this method minimizes the effect of contextual confounds. However, it probably has the disadvantage that the participants could associate with target sentences any (different) proper information structures, which could bias the scope readings of the sentences. Using method Type II makes sure that the experimental subjects assign a specific information structure to each sentence. With this method, both scope readings can be investigated in identical information structures, thus the results can tease apart the effect of the information structural roles (i.e. focus and given roles in these experiments) on the scope reading of the sentences. The specific experimental questions that were addressed in both speech production and perception are as follows:

- (EQ) ii. a. Can two sentences that have identical information structures have different (linear or inverse) scope interpretations, and  
b. if so, is this reflected in sentence prosody?

There are two sub-parts of experimental question (EQ.ii). If the answer is “no” for question (EQ.ii.a), then, naturally, (EQ.ii.b) does not arise, since it is obvious that sentences with different information structures may have different patterns of sentence prosody. A negative answer for (EQ.ii.a) would mean that the information structural role of a scope taking element has a direct effect on the scope interpretation of the sentence. In this case, it can be argued that information structure determines scope readings.

If the answer is positive for (EQ.ii.a), one can argue that the information structural roles do not have a direct effect on scope reading. In this case (EQ.ii.b) still has two possible outcomes. In the case of a negative answer for (EQ.ii.b), it can be concluded that what disambiguates between the two scope readings is only the (covert) syntactic representation. If there is a positive outcome for (EQ.ii.b), that would mean that prosody reflects the different scope readings, either because there is a direct prosody–syntax mapping or

because prosody reflects differences in syntactic structure that determine different scope relations.

To investigate the role of information structure more rigorously, question (EQ.ii.a) can be approached in a more detailed way. While the wide scope of QPs bearing a topic role seems relatively uncontroversial in the literature (see section 1.1 above), the effect of focus and given information structural roles are contended. The following two experimental questions implement question (EQ.ii.a) for focus status and for given status, respectively:

- (EQ)** iii. a. Keeping information structure constant, does a focused post-verbal quantifier permit only inverse scope or only linear scope with respect to a pre-verbal scope-taking element, or both?
- b. Keeping information structure constant, does a given post verbal quantifier that is part of the background of a focused pre-verbal scope-taking element permit only inverse scope or only linear scope with respect to it, or both?

In other words, experimental questions (EQ.i) and (EQ.ii) scrutinize the effect of prosody on scope-interpretation in a null context and in a controlled information structural context (cf. RQ.i and RQ.ii). Crucially, question (EQ.ii) and (EQ.iii) examine the effect of the focus and given information structural roles on scope taking (cf. RQ.ii).

All in all, the first two parts of the main Research Question (RQ.i and RQ.ii) are targeted at the Prosodic and Information Structural Approaches, which can be teased apart with experimental questions given in (EQ.i–iii.). The third part of the main Research Question (RQ.iii) is more theoretical in nature and targets the theoretical modeling of the results found in the empirical investigations.

### 3 Findings and theses

As mentioned above, the formulated questions were experimentally tested. Experimental question (EQ.i) was investigated in speech production. Experiment 1 involves doubly quantified sentences, Experiment 2 tests

negative sentences which contain a bare numeral NP (*four printers*). Experiment 3A scrutinizes the scope relations of negative sentences which involve a quantified NP (*more than three printers*), while the supplementary Experiment 3B checks to what extent the paraphrases given in Experiment 3A are acceptable for native speakers on a 7-point scale. In the production studies the participants had to read out the target sentences based on a paraphrase or a visual context which displayed the possible scope readings. The recordings were analyzed for standard prosodic features of phonetic prominence, i.e. F0 maxima, F0 range, F0 slope, intensity and duration. The results of the production studies revealed no effect of prosody on scope readings in the case of doubly quantified sentences, although the information structure belonging to the two scope readings was expressed in different prosodic realizations in the case of the negative sentences.

Experimental method Type II — in which the role of information structure was taken into consideration — investigated questions formulated in (EQ.ii) in speech production in Experiment 4A and in speech perception in Experiment 4B. In the production studies, not only a visual stimulus (namely, a diagram presenting one of the two scope-readings), but also an additional dialogue was displayed as a textual stimulus which kept the information structural status of the quantifiers in check. No main effect of the scope was found in speech production, while the information structure had an effect on prosodic realization. The speech perception paradigm implemented forced choice methodology. The participants listened to a native speaker uttering both possible scopal interpretations of the doubly quantified sentences. A pair of two distinct recordings was played to the experimental subjects who chose one recording out of the two taking the unambiguous visual and textual stimuli into consideration. The results of the speech perception experiment exhibit no difference between the two scopal readings of the doubly quantified sentences, suggesting that prosody alone cannot distinguish between the two available interpretations, although the effect of information structure was detected. Experimental questions given in (EQ.iii) were investigated in acceptability judgments method using a 5-point Likert scale in Experiment 5. The study revealed that the focus status of the post-verbal universal quantifier does not determine its scope taking behavior, namely, it readily takes either wide or narrow scope with regard to a non-focal distributive bare numeral.

The thesis concludes that prosody does not have a direct effect on scope interpretation, although prosody reflects information structure with prosodic cues. These findings are clearly in line with the results of Baltazani's (2002) and Gyuris&Jackson's (2018) experimental investigations which — besides prosody — consider the information structural status as a factor in scope disambiguation. Supposedly, prosody helps the listener to recover the question under discussion (QUD) if there is no explicit context available. The other main conclusion of the thesis is that the focus information structural status of an element does not determine its scope taking properties. This finding challenges the assumption that the focused operator may take either only wide (Williams 1988; May 1988; Langacker 1991; Deguchi and Kitagawa 2002, Ishihara 2002) or narrow scope (e.g. Diesing 1992, Kitagawa 1994, Kratzer 1995, Krifka 2001, Cohen and Erteschik-Shir 2002, Pafel 2006). Furthermore, the scope taking behaviour of the two types of foci (in negative sentences: information focus; in doubly quantified sentences: corrective focus, as a sub-type of contrastive focus) that are dealt with in this thesis does not support the assumption of Erteschik-Shir (1997), according to which the choice crucially depends on the contrastiveness of focus in that while non-contrastive focus is related to narrow scope, contrastive focus triggers wide scope.

Bearing these findings in mind, the overall conclusions of the thesis can be formulated as listed in (9–11).

(9) **Thesis #1** = Answer to RQ.i:

Prosody does not disambiguate between different possible scopal readings of (upward monotonic distributive) quantifier phrases.

When prosody appears to correlate with two different possible scopal readings of a(n upward monotonic distributive) quantifier phrase, then the prosodic distinction reflects an underlying information structural difference.

(10) **Thesis #2** = Answer to RQ.ii:

The information structural focus versus given status of a scope bearing element does not determine its logical scope.

(11) **Thesis #3** = Answer to RQ.iii:

The information structural difference that is found to have a direct effect on quantifier scope taking can be represented by means of structural differences. However, these differences are not located in the sentence itself but in the syntactically represented QUD that the sentence is associated with.

I argue that the relation between the QUD and scope is mediated through narrow syntax. The information structural component checks whether the sentence is congruent with the QUD. Checking congruence must include a representation of scope relations. As scope relations need to be specified as part of the QUD, the QUD can affect the scope interpretation of a sentence that is congruent with it. It is in this manner that QUD plays a role in determining possible scope readings. Crucially, however, as spelled out in (10), it is not focus or given status itself that affects scope.

These finding above favors the classical Y model, which keeps the phonetic form and the semantic module separate, having no direct interface, and which also lacks a direct mapping between information structure and logical scope.

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