PROSODY-SYNTAX INTERFACE AND HUNGARIAN NOUN PHRASES

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ABSTRACT

We investigate the prosody-syntax interface of Hungarian noun phrases (NPs) with two types of complex modification: a noun modified by (A) two adjectives or (B) an adjective with an argument. In Hungarian, (narrow, exhaustive) focus is typically marked syntactically in the immediate pre-verbal position. However, [1] found additional prosodic focus marking in modified NPs occupying this position. Replicating [1] with increased complexity of the modification, our results confirm that additional prosodic focus marking is present in syntactically focused NPs. However, the prosodic pattern varies depending on the syntactic structure inside the NP. In Modification A, the prosodic pattern differs between all possible focus domains. In Modification B, the adjective and its argument cluster together forming one modification that mirrors [1]'s results. The variation found in prosody can hence be explained by distinct syntactic structures that match into prosodic structure.

Keywords: Hungarian, prosody, focus, noun phrase, modification

1. INTRODUCTION

Hungarian is a language with a relatively free word order. In the post-verbal domain, it is completely free, while the pre-verbal field is constrained by information structure (IS). This so-called 'discourse-configurationality' (see [2]) is marked in Hungarian by specific positions for topic (sentence-initial) and focus (immediate pre-verbal). Based on recent findings that Hungarian uses additional prosodic focus marking to support or even disambiguate syntactic focus marking (see, e.g., [1], [3]), this study investigates whether the additional prosodic marking is influenced by the syntactic structure of the NP.

We base our study on the IS notions *focus* and *information status*, which have been extensively discussed in the literature on Hungarian (syntax) (e.g., [4], [5]). For focus, we adopt Krifka's [6] definition that focus indicates the selection of an element out of a set of relevant alternatives. Information status concerns the common ground (CG, [7], [8]) of interlocutors. *Given* elements have been previously mentioned. *New* elements, on the other hand, are newly introduced into the CG.

Cross-linguistically, focus is typically marked through prominence and givenness through reduced prominence [9]. Prominence can, for example, be expressed by syntax, prosody or both (see, e.g., [10]). In Hungarian, prominence is typically marked by syntax, i.e. by placing the focused element in the focus position (see, e.g. [2], [4], [11]). The Hungarian prosody supports this syntactic marking: the focused element is assigned the main accent of the sentence, 'reducing' or 'erasing' all following accents. In a neutral (broad focus) sentence without a filled focus position, every content word bears a pitch accent which is downstepped in relation to the preceding one (see, e.g., [2], [11], [12], [13]). Both the main accent on focused elements and 'normal' downstepped accents in neutral sentences are typically realized as falling contours (see, e.g. [14], [15]). However, rising/plateau contours have been observed on, for example, topics (see, e.g., [3]). All accents are word-initial, because Hungarian is a left-headed language (see, e.g. [12], [16]).

In recent years, there has been a growing number of empirical studies investigating the Hungarian IS-syntax-prosody interface (see, e.g. [1], [3], [17], [18]). In particular, [1] found not only supporting but additional prosodic focus marking in sentences where syntactic marking alone can not disambiguate between multiple possible focus domains. Their findings are based on a production study with modified NPs in the syntactic focus position. In these types of sentences, the same linearization leads to multiple possible interpretations. For example, the sentence in (1) can answer each of the three given context questions.

(1) Az idős író-t hívta meg az újságíró.
the old writer-ACC invited VPRT the journalist

'The journalist invited the old writer.'

C1 Who did the journalist invite?
C2 Which writer did the journalist invite?
C3 Which old person did the journalist invite?

As expected, the main accent falls on the focus position with the highest prosodic prominence on the left-edge of the NP. However, the prosodic pattern inside the NP differs depending on the focus domain: if the focus is on the whole NP, the noun keeps its downstepped accent (as in broad focus), if there is narrow focus on the noun, the accent is enhanced, and if there is narrow focus on the adjective, the noun is deaccented. The accent on the leftmost element is enhanced in all three conditions.

Based on these results, our research questions are: (Q1) Are the patterns found in [1] also used for NPs with a higher complexity? (Q2) Do the patterns differ depending on the syntactic structure of the complex modification (Figure 1)? In our production study, we will look at two types of complex modification that differ in their syntactic structure. In complex modification A (Mod-A), the noun is modified by two adjectives (Adj1 & Adj 2), and in complex modification B (Mod-B), the noun is modified by an adjective (Adj) and its argument (Arg). If prosody is assumed to reflect syntactic structures (e.g., [19]), the prosodic patterns of the two modification-types should differ.

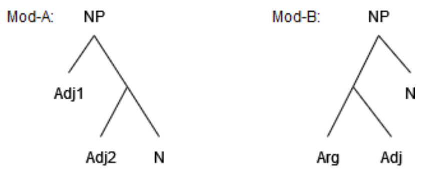

Figure 1: Syntactic structures of the two complex modification types used in the production study

2. PRODUCTION STUDY

2.1. Method

Replicating the method from [1], we conducted a production study with two types of complex modification (mod-types) in the syntactic focus position (Figure 1) as opposed to simple modified nouns in [1]. In Mod-A, a second adjective was added and in Mod-B, the adjective was either *képes* ('able') or *keptelen* ('unable') with a verb as its argument. Examples are shown in (2) (Mod-A) and (3) (Mod-B).

(2) a félénk barna eger-et
the shy brown mouse-ACC
'the shy, brown mouse ...'

(3) az énekel-ni képes eger-et
the sing-INF able mouse-ACC
'the mouse, which can sing ...'

There were five sentences per mod-type, each elicited through contexts ending in a question that prompted one of the five possible focus domains (Table 1), resulting in 50 target sentences in total. All elements in the target sentence were *given* to exclude influences of information status.

	Mod1_F	Mod2_F	Mod_F	N_F	NP_F
Mod-A	Adj1	Adj2	Adj1&2	N	NP
Mod-B	Arg	Adj	Arg&Adj	N	NP

Table 1: Possible focus domains per mod-types

In the experiment, the contexts were presented visually (written form) and auditorily (spoken by a female native speaker). The participants (20 Hungarian native speakers) were then asked to answer the question at the end of the context with the visually presented answer. The order of the contexts (and filler-contexts) was randomized. In total, 50 x 20 = 1000 sentences were recorded.

2.2. Data Analysis

All sentences were manually labeled for word, syllable and vowel with Praat [20]. Using [1]'s Praat scripts, we measured the duration of syllables, f0-minima and maxima per vowel and their position in relation to the syllable. These points were checked manually to prevent calculation errors. At the same time, the number and position of creaky syllables and pauses were extracted. We also measured the overall pitch- and intensity-contours of the NPs at ten equidistant points per syllable. All pitch-values were measured in semitones with speaker-dependent baselines (see, e.g. [21]).

The ten points per syllable were used for generalized additive mixed models (GAMMs - R [22] package mgcv [23])) calculating trajectories of the mean f0/intensity values for each focus condition and windows of significant differences between them. From the f0-minima and -maxima, contour types for every word in the NP and the slope of rising/falling contours were calculated using R scripts. For the contours, we took one semitone as the threshold between a plateau and a rise or fall (see [1]). Words with creaky voice were manually checked and excluded from the slope calculations (240 of 3000 data points), to prevent skewed results. Two datapoints were also excluded from the contour type analysis, because the contour was unclear.

2.3. Results

All sentences show the prosodic pattern of a narrowly focused sentence in Hungarian: the main accent falls on the focus position with reduced prominence on following elements. In the next sections, we will take a closer look at the prosodic patterns inside the target NP.

Intensity and duration do not play a major role in our data. There are small windows of significant differences in the GAMMs for intensity and one ANOVA shows a significant effect of FOCUS on duration (df = 4, f = 4.389, $p < 0.01$): in Mod-B the first syllable of the noun is longer in N_F than in all other conditions. However, while these results support our prosodic analysis they all correlate with effects found in the f0-patterns. Thus, due to space limitations, we'll concentrate on pitch. There are significant results in the mean f0-trajectories (GAMMs), the count of contour types (Chi-square tests) and the slopes on falling contours (ANOVAs). There are not enough pauses for a statistic analysis and no effect of voice quality alone (see [1] for a discussion about its interaction with pitch).

In both mod-types, the highest f0 is on the first syllable of the modification. This is in line with [1]'s findings that the highest prosodic prominence falls on the left edge of the focus domain. However, the patterns inside the NP differ between Mod-A and B.

2.3.1. *Complex Modification A*

In Mod-A, the GAMM (Figure 2) shows a significant effect of FOCUS ($p < 0.0001$ all conditions). The pairwise comparisons reveal that Mod1_F (green) has a significantly lower mean-f0 at the second half of Adj1 and Mod2_F (blue) has a significantly higher mean-f0 at the first half of Adj2 compared to all other focus conditions except N_F (red). It is important to note that the difference on, for example, Adj1 can either be explained by a lower number of rising and/or plateau contours in Mod1_F focus or be due to differences in the slopes of falling contours on Adj1 between the focus domains. Thus, we will now take a closer look at these two measurements.

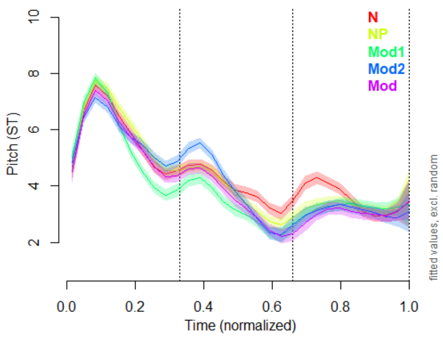

Figure 2: Mod-A: GAMM of the five mean-f0 trajectories (in semitones) per focus in the NP

Table 2 shows the counted contour types on each word in the target NP. The Chi-square test shows a significant correlation between FOCUS and CONTOUR TYPE on Adj2 (X-squared = 24.932, df = 8, p-value < 0.01) and N (X-squared = 20.895, df = 8, p-value < 0.01). Both words have significantly more falling contours when they are narrowly focused and more plateau contours post-focally, and Adj2 has significantly more rising contours when it precedes the narrow focus (N_F).

	Adjective 1			Adjective 2			Noun		
Focus	F	P	R	F	P	R	F	P	R
Mod1_F	89	5	6	67	28	5	49	22	29
Mod2_F	68	13	19	87	12	1	59	21	20
Mod_F	74	7	18	77	18	5	48	34	18
N_F	78	10	12	66	20	14	69	13	18
NP_F	77	9	14	74	19	7	49	24	27

Table 2: Mod-A: Distribution of contour types on each word; F = Fall; P = Plateau; R = Rise

While position (timing) of the f0-peaks does not play a role in our data, their height differs between focus domains, resulting in different slopes of falling contours (Figure 3). The ANOVA shows significant effects of WORD (df = 1, f = 82.07, $p < 0.001$) and the interaction of WORD and FOCUS (df = 2, f = 4.29, $p < 0.001$). The post-HOC TukeyHSD test shows no significant difference between the slopes on Adj1 and Adj2 per focus condition. The slopes on Adj1 are significantly steeper than all other accents, except accents on narrowly focused elements. The only difference between focus conditions is on the noun: it is significantly steeper in N_F (red) than in Adj1&2_F (blue&green).

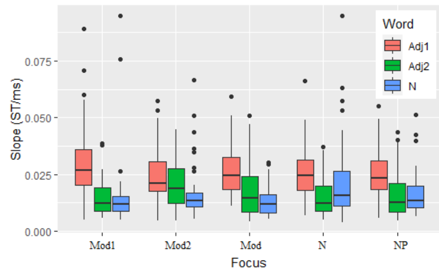

Figure 3: Mod-A: Slopes of the falling contours on the words in the target NP per focus condition

2.3.2. *Complex Modification B*

For Mod-B, the GAMM (Figure 4) shows a significant effect of FOCUS ($p < 0.0001$ in all conditions). The pairwise comparisons reveal that N_F has a significantly higher mean-f0 than all other conditions on the Adj and the noun. NP_F has a significantly higher mean-f0 at the first half of the Arg than Mod2_F and Mod_F.

The Chi-square test for the counted contour types (Table 3) shows significant correlations between FOCUS and CONTOUR TYPE on the adjective (X-squared = 15.742, df = 8, p-value < 0.05) and the noun (X-squared = 21.894, df = 8, p-value < 0.01). N_F has significantly more plateau contours on the Adj and more falling contours on the noun.

Figure 5 shows the slopes of falling contours in Mod-B. The ANOVA shows significant effects of WORD (df = 2, f = 67.09, $p < 0.001$), FOCUS (df = 4, f = 3.64, $p < 0.01$) and the interaction of WORD

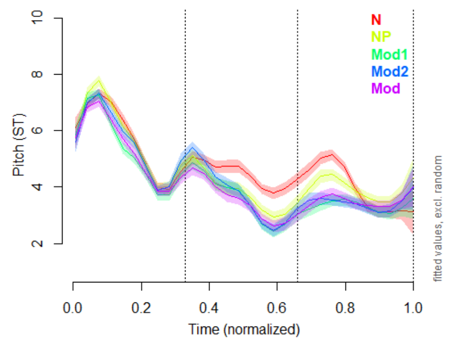

Figure 4: Mod-B: GAMM of the five mean-f0 trajectories (in semitones) per focus in the NP

Focus	Argument F	P	R	Adjective F	P	R	Noun F	P	R
Mod1_F	90	2	8	75	17	8	57	23	20
Mod2_F	87	5	8	70	16	14	55	27	18
Mod_F	89	4	7	62	26	12	52	23	25
N_F	86	9	5	52	31	17	78	8	14
NP_F	93	2	5	67	19	14	56	19	24

Table 3: Mod-B: Distribution of contour types on each word; F = Fall; P = Plateau; R = Rise

and FOCUS (df = 8, f = 4.97, $p < 0.001$). The post-hoc TukeyHSD test shows no significant differences between the slopes on the Arg and Adj. The slopes on Arg are significantly steeper than all other accents except the accents on the noun in N_F and NP_F. On the noun, N_F has a significantly steeper slope than the other focus types except NP_F.

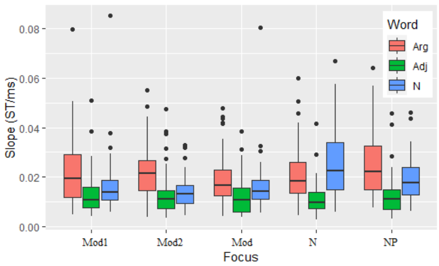

Figure 5: Mod-B: Slopes of the falling contours on the words in the target NP per focus condition

3. DISCUSSION

Regarding our research questions, the data show that (Q1) the patterns found in [1] are also found in NPs with a higher complexity. The exact pattern however differs depending on the syntactic structure of the complex modification (Q2).

In general, the highest prosodic prominence (f0) falls on the leftmost element of the NP (see also [2], [11], [12], [13]). In the majority of the data (77% Mod-A; 89% Mod-B) this element has a falling contour. Similar to [17], no systematic difference between the acoustic details of this contour, i.e. f0-minima, -maxima and slope, was found. While there is some variation in the data (similar to [3]'s results), as in [1], the default-pattern consists of falling contours on (pre-)focal elements and a higher number of plateau contours post-focally. The relatively high number of rises on the noun (Table 2&3) can be explained by a high boundary tone at the end of the NP.

In Mod-A the prosodic pattern differs between all five possible focus domains and follows the patterns found in [1]: the accent on the left edge of the target NP that contains the focus and on narrow focused elements is enhanced (see, e.g., [24] for 'boosting by focus'), post-focal elements have a reduced accent and elements that are part of a broader focus domain, for example in NP_F, are 'normal' (downstepped, see neutral sentences as in [14]). However, not all of the distinctions are as clear as in [1]. This is presumably due to the limited pitch range that speakers can use. The longer a phrase is, the smaller the differences can be. Follow up experiments should test, if the subtle differences between the three accent-types are relevant in perception, or if a more basic distinction between presence or absence of an accent suffices.

Mod-B differs from Mod-A in that the two parts of the modification cluster together. There is no significant difference between Mod1_F, Mod2_F and Mod_F. This is predicted by the syntactic structure where the adjective and its argument are syntactic sisters as opposed to the recursively embedded Adj1&2 in ModA (Figure 1). If they are analyzed as being one single modification, Mod-B perfectly mirrors [1]'s results on simple modification with a single adjective: the left edge and narrowly focused elements have enhanced accents, post-focal elements are reduced and elements that are part of a broader focus domain keep their downstepped accent.

4. CONCLUSION

Our study replicates the results from [1] that prosody does not only support (see, e.g., [3], [11], [12], [13], [17]) but adds to syntactic focus marking in Hungarian. While the main sentence accent, as expected, falls on the syntactic focus position, the prosodic patterns inside the position disambiguate between multiple possible focus domains that syntax alone cannot. However, the exact prosodic pattern is based on syntactic structure (Figure 1). In Mod-B, where adjective and argument syntactically form one modification, the prosodic pattern is the same as for simple modification [1]. In Mod-A, the recursive syntactic structure is mirrored in the prosodic pattern. Thus, predictions from the syntax-prosody interface impact phrase-level prosody in Hungarian.

5. ACKNOWLEDGEMENTS

We are grateful to our student assistant Noémi Ecsedi for her help with creating stimuli, recording and data processing. This work was supported by the DFG (KU2323/4-1). Many thanks to the anonymous reviewer of the 'International Congress of Phonetic Sciences 2023' for the feedback.

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