TOWARDS A CALCULUS OF INTONATION CONTOURS FOR SENTENCES OF ARBITRARY SYNTACTIC COMPLEXITY

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ABSTRACT

Rules are proposed which describe co-occurrence restrictions for tone units in acceptable intonation contours of sentences and thus generate intonation contours for sentences of infinite length and syntactic complexity.

INTRODUCTION

Roman Jakobson more than anybody else contributed to formation of modern phonology in its present shape, having characterized the phoneme as a bundle of distinctive features; having raised the problem of the laws of combination of phonemes; and introducing the notion of protracted distinctive feature as a supersegment characteristics of a word overcoming phoneme boundaries, cf. protracted feature "voised" in the initial combination of consonants in Russian vzdrognut' or protracted feature "voiseless" in the initial consonant combination in vstreča. Though Roman Osipovich payed relatively less attention to prosody than to segmental phonology, the subsequent development of phonology proved his ideas in prosody to be stimulating for researchers of different schools and trends.

Those who study prosodic aspect of a sentence usually presume that it is sufficient to describe main functional "blocks" of intonation – tone units, – which characterize relatively simple and short sentences: the problem of synthesis of these blocks into sequences which really occur in linguistic activity when the speakers generate utterances of considerable complexity, is left aside. Meanwhile the utterance in a natural language can have theoretically infinite length and cooccurrence of tone units in grammatically correct sentences is governed by sufficiently sophisticated rules. The problem arises – to delimitate these rules.

INTONATION CONTOUR OF A SENTENCE

We accept an assumption – perhaps, a bit simplifying, that intonation structure of a sentence, i.e., its intonation contour, can be represented as a well formed sequence of tone units. This amounts to saying that a tone unit is supposed to be an elementary segmental unit of intonation. There is no generally accepted intonational transcription for Russian. In our transcription we shall use the following symbols. Raising tone (IK-3 according to [1]) is symbolized by /. Symbol ꞁ denotes accent – in the sense of [3], i.e. a fall of the base tone on the stressed syllable of the word, but not a glide; cf. the accent on the word kogda in the sentence Kogdaꞁ on priedet? uttered in a context where the fact of his arrival has already been mentioned. Falling tone \ (IK-1 according to [1]) marks the end of an indicative statement independent of the its textual context. This tone unambiguously expresses the main phrasal stress of the sentence. Falling tone, at least phonologically, is not a primitive – it is rather a conflation of two features: accent and the indicator of the completion of the utterance. Thus, (1) presents a minimal pair: the question (a) contains a pure accent, while the statement (b) – an accent in combination with the indicator of completion:

(1) a. On napišet/ ꞁ ili pozvonitꞁ?

   b. On napišet/ ꞁ ili pozvonit\.

The accent can be conflated with the indicator of noncompletion; this combination is symbolized as \ꞁ (in terms of [1] it is IK-4), and is used to mark either a constituent or a syntactically completed sentence which alludes to a specific textual context of such a type as can be introduced by an adversative conjunction, cf. A vaš \ꞁ gde bilet? < With the tickets of all the rest everything is in order); Pokatal-s'ja, i xvatit \ꞁ (the other should also have an opportunity).

There are contrastive tones corresponding to the raising and to the falling tone; they are symbolized as // and \\. Exact phonetic characterization of the symbols used in transcription is here irrelevant; for concrete details cf. [1], [2].

The borders between tone groups are indicated by a dotted vertical line ꞁ. The symbol of the tone is placed after the word which constitutes the intonation centre of the tone group. More exact indication (e.g., marking the stressed syllable) is not necessary for our purposes. The analysis of a sentence into its tone groups is slightly obscured by the so called binding of accents, described in [2], cf.:

(2) ꞁKakujuꞁ kniguꞁ ty citaeš?

(3) Kudaꞁ ty položil Bulgakovaꞁ?

We assume that sentences like (2) consist of a single tone group with two centers, while in sentences like (3) two tone groups can be delimitated.

It would be natural to suppose that each tone group must have its own phrase accent. But for convenience of marking correlations between intonational and syntactic structure of a sentence it is preferable to make also use of unaccented tone groups. Thus in sentence Posredstvennyj\ poet ꞁ byl Šaxovskoj its second main constituent can be considered a separate tone group. Besides, if we cannot afford of unaccented tone groups then the theme of a sentence (i.e. a component of its topic-comment articulation) usually will not constitute a separate tone group, as in a sentence On xudožnik\. Some by no means relevant intonational distinctions will not be reflected in our transcription, just because they are besides the point – such as tempo and register distinctions which allow to express the accent characterizing a constituent as a whole in contradistinction to the accent of a word, see [2]; different degrees of reduction of unaccented words described in [3] are also ignored.

It must be underlined that many types of sentences allow for variation of intonation contours, and it is not claimed that the transcription proposed is the only one possible.

A BRIEF SURVEY OF LITERATURE

The idea of a generative grammar for intonation contours was first suggested by N.Chomsky and M.Halle [3], but with several simplifying assumptions, cf. in this connection [4] with references to some earlier publications. Thus, of all parameters characterizing intonation only the strength of stress (alternatively, the degrees of reduction) was taken into consideration. Meanwhile intonation contour is defined by a far more rich complex of prosodic features (the pitch; tone fallings and tone raisings; the accent; tempo etc.), and it is reasonable to try to generate the complete configuration of such features. As for the strength of the stress, there are no more than two degrees of it which are meaning-differentiating: the original mechanism of word stress reduction depending on the depth of syntactic embedding (the so called Nuclear Stress Rule) proposed in [3], presupposes theoretically unlimited scale of such degrees, but these distinctions are rather phonetical than phonological by nature (i.e. they are automatical and not specifically meaning-differentiating). Besides, it was assumed in [3] that intonation, let alone contrasts, is predicted by the surface syntactic structure of a sentence. But this hypothesis must now be rejected, – indeed, there are at least three groups of arguments that contradict it.

Firstly. The resulting intonation contour is influenced not only by the surface structure but also by the deep structure of a sentence.

Secondly. Intonation contour of a sentence is to a certain extent predicted by prosodic properties of its words, i.e. by its lexical composition and not by its syntax. And the effect of the lexical composition does not always amount to contrasts. Thus, personal pronouns in Russian are normally unstressed, no matter what their syntactic function is, and acquire stress only in a marked context, as, e.g., the following: Čašče/ vsego ꞁ menja\ vidjat v Oblomove ꞁ, govorja, čto ja èto lico/ ꞁ napisal s sebja\. Among particles one are always unstressed (like i, -taki, me), the other always stressed, at least in one of their meanings. Besides, many particles are capable of predicting the stress placement in words with which they are connected, cf. [5]. Quasi-synonyms razve and neuželi are known for their prosodic differences [6]: the former induces the intonation of a question, and the latter – of a statement. There are also non-auxiliary words with idiosyncratic prosodic properties. Thus, Russian adjective redkij (in one of its uses) calls for emphatic stress inside the noun phrase that contains it; usually this noun phrase must occupy the initial position in a sentence: Redkaja\\ ptica ꞁ doletit do ego serediny ꞁ; Redkaja para sapog\\ ne proxodila čerez ego ruki ꞁ. Analogously for the adjective raznyj: Raznyje\\ ljudi živut na ostrove ꞁ; Raznyje\\ byvajut slučajnosti ꞁ. Limited capacities to occupy thematic position in the topic-comment structure usually characterize words with negative and quantifitory meaning. Example (1) shows that thematic position rejects words with negative meaning:

(1) Mne dostatočno/ ꞁ vašego raskajanija\.
   *Mne nedostatočno/ ꞁ vašego raskajanija\.

Nedostatočno must bear main stress, i.e. it must have a falling and not a raising tone. Here are some examples with quantifiers (see also [7], p. 127):

(2) a. Častaja pričina bolezni/ ꞁ – prostuda.
   b. *Redkaja pričina bolezni/ ꞁ – prostuda.

(3) a. Často/ ꞁ on prixodil zapolnoč\.
   b. *Redko/ ꞁ on prixodil zapolnoč \.

(though Izredka/ ¦ on prixodil zapolnoč).
(4) a. Nedavno/ ¦ on vernulsja\.
   b. *Davno/ ¦ on vernulsja\.
(5) a. Inogda// ¦ on šel peškom\.
   b. *Vsegda/ ¦ on šel peškom\.
(6) a. Bol'šinstvo/ učastnikov ¦ bylo\ zanjato v pervom akte.
   b. *Men'šinstvo/ učastnikov ¦ bylo\ zanjato v pervom akte.
Cf. also an example from [8], p. 289: in sentence Snegu malo vypalo the verb is obligatory unstressed.
Many adverbs bear obligatory contrastive stress, cf. Naprasno\ ty staralsja (*Naprasno/ ¦ ty staralsja\); Tščetno\ ¦ stal by ja èto skryvat'! (*Tščetno/ ¦ stal by ja èto skryvat'\). The word ran'še (in one of its uses), is on the contrary, invariably thematic: Ran'še / ¦ on byl vsegda mračen\ (*Ran'še\ on byl vsegda mračen). The main stress on ran'še is possible only in the presence of a particle: Èto ran'še\ on byl vsegda mračen.
And thirdly: linear-intonational structure has its own semantics, which is in many respects independent both of syntax and of lexical composition of a sentence; hence the notion of a communicative paradigm constituted by a set of sentences with the same array of lexemes and syntactic structure, which differ from each other in their linear-intonational structure. As the semantics of the topic-comment structure is closely connected with a pragmatic context, usual semantic distinctions caused by variation of tone placement (cf. Ivan poedet v Kiev\; Ivan poedet\ v Kiev; Ivan\ poedet v Kiev) can be accompanied by quite specific ones. Thus, in (a) U menja ostalos'\ nemnogo vremeni dlja osmotra goroda and (b) U menja ostalos' nemnogo\ vremeni dlja osmotra goroda semantic opposition is nearly that of antonymy. See also example (7):
(7) a. Doma/ ¦ Ivana net\.
   b. Doma xleba\ net.
For (b) the contour Doma/ ¦ xleba net\ is practically excluded, but by purely pragmatic reasons. In fact, the semantic contribution of a contrastive theme to the sentence meaning is very rich: it enriches the meaning of a sentence by an implicature which, in this case, can be worded as follows: 'And for other places it is not so' or 'And about other places nothing is known' [7], which is quite sound for (a) but trivial and meaningless for (b).
And the last example of a pragmatic component in the intonation meaning. Cf. sentence Sledujuščaja/ stancija ¦ - Zvenigorod\ pronounced with this intonation by an announcer in a suburban train. This intonation must be treated as a flagrant error. Indeed, in the situation described the adversative context, which is alluded to by IK-4, makes one think that this announ-

cement will be followed, in due time, by an analogous announcement concerning the station which goes after Zvenigorod. But this expectation fails, because Zvenigorod is the last station of the railway.

AN OUTLINE OF THE CALCULUS

The set of all intonation contours can be enumerated with the help of a calculus of the following shape. Suppose that all elementary contours are given, which characterize syntactically non-extended sentences or constituents consisting of one or two tone groups, cf. contour (\) in Nastupila vesna\; raising-falling (RF) contour (/¦\) in Keramika/ ¦ - èto krasivo\; contour (\ ¦ ⌣) in Posredstvennyj\ poet ¦ byl Šaxovskoj. More complex contours owe their existence to the fact that elementary contours (or, more exactly, syntactic constituents with elementary contours) are inserted in a context with a given tone characteristics. Thus we arrive at rules of substitution which generate more and more complex contours from the simplest ones. Rules of substitution may, certainly, refer to the context, as is natural for a context sensitive phrase structure grammar.
When we try to substitute some intonation contour for a tone group in a certain context the following situations may arise: 1) substitution is impossible, i.e. the sequence of tone groups which is the result of the substitution does not correspond to any acceptable intonation contour; 2) substitution is possible but a) the substituted contour must be transformed in a special way; b) the context must be transformed in a special way. Presumably, only such transformations are allowed which do not change the topic-comment semantics conveyed by intonational means. We hope that a finite set of rewriting rules of the type described above will constitute a model enumerating well formed intonation contours. Though only substitution rules have generative power, prohibitions deserve attention as well, for they explicate useful cooccurrence restrictions.

EXAMPLES OF SUBSTITUTION RULES

Rule 1. RF-contour (/¦\) when inserted in a position with inherent raising tone, must be transformed into a subcontour (!¦/); in other words, the former main stress after substitution becomes a secondary stress and the former secondary stress becomes a mere accent. In examples below a is an independent sentence; in b this very sentence is put into an embedded position:
(1) a. Zavtra/ ¦ položenie izmenitsja\.
   b. Esli zavtra! ¦ položenie izmenitsja/ ¦ ja vam soobšču\.
(2) a. Derevjannyj lubok počti isčez/ ¦ ,

a mednyj prišel v upadok\.
   b. Kogda derevjannyj lubok počti isčez!, a mednyj prisel v upadok/ ¦, voznik lubok iz medi staroobrjadcev\.
(3) a. Čtoby pereexat' v stolicu/ ¦, on soglasen na žertvy\.
   b. Čtoby pereexat' v stolicu! ¦ on soglasen/ na žertvy/?
(4) a. Keramika/ ¦ - èto krasivo\.
   b. Keramika! ¦ - èto krasivo/?
(5) a. Muzyku/ ¦ on ljubit\.
   b. Muzyku! ¦ on ljubit/?
(6) a. Posle spektaklja/ ¦ pozvoni\ mne.
   b. Posle spektaklja! ¦ pozvoni/ mne/! (request)
(7) a. Na nej byla belaja šuba/ ¦ i šljapka\.
   b. Na nej byla belaja šuba! ¦ i šljapka/?
(8) a. On priedet v ijule/ ¦ ili v avguste\.
   b. Esli on priedet v ijule! ¦ ili v avguste/, on ešče uspeet.
(9) a. Ivan/ ¦ živet v Kazani\.
   b. Ivan! ¦ živet v Kazani/ ¦, a ja v Syzrani\.
(10)a. V novom zdanii/ ¦ budet biblioteka\.
   b. V novom zdanii! ¦ budet ta biblioteka/, ¦ kotoraja ran'še byla v podvale\.
It is clear from these examples that the transformation which RF-contour undergoes is independent of syntactic construction it belongs to - it may be a coordinative group, subject-predicate combination, adverbial modifier + extended sentence etc. Equally inessential is the nature of the construction which delivers a position with an inherent raising tone - it can be a prepositive modifying sentence; a general question; the first component of a compound sentence, an utterance with the illocutionary force of request; a sentence with a restrictive modifier, as in (10b), etc. Thus it is clear that tones may interact directly with each other without such intermediaries as syntax or meaning. Substituted RF-contour may belong not to an independent sentence, but to a constituent, cf. Dom otdyxa/ ¦ stoit na beregu reki\ and Dom otdyxa! ¦, kuda my poedem/ ¦, stoit na beregu reki.
Rule 1 shows that raising tone cannot stand syntactic embedding.
Rule 2. RF-contour when embedded into a position with inherent raising tone can be simplified into a contour consisting of one tone group with a raising tone - the intonation centre corresponding to the place of the former falling tone. In other words, two tone groups can merge into one, the former secondary stress having faded away and the former main stress having been transformed into a raising tone:
(11) a. Voprositel'naju/ intonacija ¦ otli-

čaetsja ot predupreditel'noj\.
   b. Voprositel'naja intonacija otličaetsja ot predupreditel'noj/ ¦ tol'ko bolee vysokim registrom golosa\.
(12) a. Ivan/ ¦ živet v Kazani\.
   b. Ivan živet v Kazani/ ¦, a ja v Syzrani\.
This rule does not generate any new contours but it captures one of the most important regularities in behavior of intonational constituents in such conditions when their hierarchy becomes more complicated.
Rule 3. If in a RF-contour the raising component is not obligatory (as, e.g., is the case in a coordinative group), it can be transformed, in a position with inherent raising tone, into a subcontour (/¦!). Thus in (13) utterance a is intonated in accordance with Rule 1 and b - in accordance with Rule 3:
(13) a. Kon"junkcija P&Q istinna! ¦, esli P i Q istinny/ ¦, i ložna/, esli P i Q ložny\.
   b. Kon"junkcija P&Q istinny/ ¦, esli P i Q istinny! ¦, i ložna/ ¦, esli P i Q ložny\.
In (14) the end of the first of the two conjoined clauses is marked by tone V, as if it were a separate sentence:
(14) Idet napravo/ ¦ - pesn'V zavodit!, nalevo/ ¦ - skazku\ govorit.
Rule 4. RF-contour can be inserted into a position with an inherent falling tone (non contrastive); if it gets into the context of a raising tone on the left, this raising tone can be replaced by tone V:
(15) a. Rano utrom/ ¦ Petja otkryl kalitku\.
   b. Rano utromV ¦ Petja otkryl kalitku/ ¦ i vyšel na lužajku\.
Replacement of a raising tone by an accent is also possible: Teatr byl zakryt! ¦, tak kak truppa/ ¦ uexala na gastroli\.
Rules 2 - 4 reveal a general tendency of language to avoid sequences of identical tones; cf. the impossibility of *Ja uveren/ ¦, čto Pavel/ ¦ nam pomožet\. Example (from [1]) where such sequence is allowed, requires explanation: Pojmannyx ptic/ ¦ vyderživajut na karantine/ ¦ i očen' xorošo kormjat\. Even accent, which is the most neutral of all types of phrasal stress, allows for repetition only under very special conditions, cf. an example from [2]: Vy v Telavi! ¦ kogda! ¦ poedete? where the sequence of identical tone groups is conditioned by a split word order.
There are, though, clear cut syntactic exceptions to this regularity; thus, appositive construction, on the contrary, is based intonationally on tonal repetition of the preceding stress:
(16) a. Ostal'nye razmestilis' nemnogo podal'še! ¦, na drugom beregu reki\.

b. Nemnogo podal'še/|, na drugom be-
regu reki/|, razmestilis' ostal'-
nye\.

Yet contrastive tone is not repeated by
an apposed phrase: Takoj// on | čudak\\|,
vaš Vanja!.

PROHIBITED SUBSTITUTIONS

1. RF-contour cannot be inserted into an
unstressed position after a contrastive
tone:
(1) a. Ja sčitaju, čto Whorf/| byl ling-
vistom osobogo \ roda.
b. *Ja znaju\\|, čto Whorf/| byl ling-
vistom osobogo\ roda.

In such position RF-contour is simplified
into a contour with two accents; thus,
(1b) ⟹ Ja znaju\\, čto Whorf! byl lingvis-
tom osobogo! roda. Cf. also: Tol'ko to/
prekrasno|, čto ser'ezno\ and Ne tol'ko\\
to! prekrasno, čto ser'ezno!.

2. Contrastive tone groups allow of no
syntactic embedding; they are confined to
independent sentences, thus belonging to
the so called main clause phenomena:
(2) a. Da, ja kot\; no ljudi inogda tak//
nevnimatel'ny.
b. Ja ne znal/, čto ljudi tak\ nevni-
matel'ny.

Specific tone on tak disappears in the em-
bedded position. Sentence Vernulis'\\ naši
guljaki, being embedded, sounds unnatural:
*Nesmotrja na to, čto vernulis'\\ naši gu-
ljaki...; cf. also: Kogo// on tol'ko ne
sprašival\ but *Ja dumaju, čto kogo// on
tol'ko ne sprašival\.

Prohibitions 1 and 2 taken together pro-
vide an explanation to the fact that a
sentence cannot contain more than one con-
trastive tone (of the same direction).
Thus, sentence (3) is not well formed be-
cause it combines two contrasts:
(3) *Jasno, čto imenno ètot\ smysl| pere-
daetsja predloženiem (a)//|, a ne (b)\\.

Moreover, contrastive falling tone func-
tions as the main sentence stress; thus,
if there is another candidate for the
post of the main stress bearer in a sen-
tence, a conflict is bound to arise:
(4) *On ni s togo ni s sego/| vzjal da i
rasskazal\\ mne|dovol'no zamečatel'nyj
slučaj\ (Turgenev).
(5) *Už on dostaval\\| - dostaval! iz-za
pazuxi|skomkannoe pis'mo na imja Ob-
lomova\.

Syntactic and lexical peculiarities of
these sentences create conditions for pre-
posed, and thus contrastive, accent; whi-
le final noun phrase, being indefinite,
also longs for the position of the main
stress bearer. Though contrastive stress
is usually treated as a phonetic phenome-
non, it seems that contrast cannot be
identified on purely phonetic grounds:
means of expression for contrast are
scarce and disparate (e.g., in [1] it is
mentioned that contrast can be conveyed

by strengthened word stress or by more
distinct pronounciation of phonemes). Con-
trast is definitely opposed to its absen-
ce only when it is confirmed by structu-
ral or semantic factors. On the other
hand, phonetic means must be quite expli-
cit if without intonation the intended
meaning will be lost, cf. ⟨- A sbežavšij
byl vaš dvorovyj čelovek? - Kakoe dvoro-
vyj čelovek? Èto by ešče ne takoe bol'šoe
mošenničestvo.⟩ Sbežal// ot menja|...
nos\ : it is contrast that transforms
this sentence into an identity statement.
Tone group bearing the main stress (in
particular, contrastive stress) can easi-
ly change its place in a sentence if the-
re is no other contrasts in the same sen-
tence. If there are, then removel of a
contrastive tone group from its final po-
sition destroys the communicative structu-
re. Example: Lož'//| - religija rabov'| i
xozjaev\\. Pravda\\| bog svobodnogo čelove-
ka!. For the second sentence underlying
word order and intonation are as follows:
Bog svobodnogo// čeloveka | - pravda\\. In-
deed, svobodnyj čelovek is the theme of
this sentence, and a contrastive one, be-
cause it is opposed to raby i xozjaeva
from the first sentence: pravda is the
rheme, also contrastive, for it is oppos-
ed to lož' in the first sentence. Empha-
tic preposition of the contrastive rheme
destroys this structure: communicative
meanings which were expressed explicitly
by the underlying word order in the re-
sulting sentence are only guessed due to
lexical associations.

We may add now that Roman Jakobson's favo-
rite idea about iconic character of langu-
age works in the sphere of word order
much better than with intonation: falling
and raising tones give way to one another
in intonation contours without any direct
relation to the meaning of the utterance.

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