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Introducing Glot International
This is the first issue of Glot International.
Glot International hopes to serve the growing linguistic community by devoting its pages to those aspects of the activity in the field which fall outside the focus of most other journals.
We will, for instance, pay a great deal of attention to dissertations. It seems to be generally acknowledged that much of the groundbreaking and original research in linguistics is conducted by PhD students. Due to the fact that, typically, dissertations are not distributed on a large scale, PhD research hardly ever gets the attention it deserves. Glot International hopes to offer a way out of this paradoxical situation, by offering authors of dissertations an opportunity to present a summary of their work, which will be printed side by side with a review of the dissertation.

Book reviewing is another task that we will take seriously. As a monthly with a relatively short production phase, we will be able to publish book reviews within six to twelve months after publication of the book itself, which is an improvement over what is common practice now.

Another important feature of Glot International is the "State-of-the-Article": every issue will contain such an article — presenting an overview of the most relevant issues involved in a particular subject, enumerating the most important achievements of the past decade or so, while at the same time specifying what the most pressing outstanding issues are. Importantly, a State-of-the-Article includes a bibliography of the most significant publications on the subject at issue. The State-of-the-Article in the present issue deals with metrical theory and provides an extensive metrical bibliography. Future State-of-the-Articles will be devoted to such subjects as coordination, tense logic and the acquisition of phonology.

And this is not all! Every issue of Glot International will present a column, alternately written by Elan Dresher from Toronto and Cric Cremon from Leiden. In addition, we will have conference reports, important news from the field and we hope for lively discussion in our letters-section.

We would like to seize this opportunity to thank everybody who has helped us in the preparation phase, especially the colleagues who spent valuable time writing summaries, reviews, conference reports and State-of-the-Articles for a journal that, for all they knew, was only an idea.
Now the idea has materialized. But this does not mean that we will not continue to need the help and support from the field. If you have any suggestions that could make Glot International serve the needs of the linguistic community even better, please do not hesitate to contact the editor.

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METRICAL PHONOLOGY

Harry van der Hulst

When a man can occupy himself with counting syllables, either he has not yet attempted any spiritual climb, or he is over the hump.

W.H. Auden

Since the 1975 dissertations by Alan Prince and Mark Liberman, the theory on word level stress has gone through a number of important developments. Harry van der Hulst gives an overview.

1. Introduction

This article intends to inform the reader about Metrical Phonology, i.e. the theory about word level stress. I will discuss its original motivation and scope, how it extended its empirical domain, which changes it underwent and what the current situation is. Since we deal with a theory that was introduced twenty years ago, it would be easy to write a whole book dealing with these matters. For these reasons I have cut short the pages that I have here. I will therefore have to limit myself to a selection of proposals (and references) that, in my view, are representative of crucial developments in the theory. I will not present a strict historical overview, but rather organize the discussion around various aspects of the theory, such as the central principles and parameters, the notation and the main problems that have been argued for by members of space I will not discuss the interplay between stress and morphology. Also, I will limit my attention to the word domain and thus not deal with presesic stress at a higher level, nor with the syntax-phonology connection (cf. Selkirk 1982, Nespor and Vogel 1986, Inkelas & Zec 1990), nor with the metrical approach to poetic meter (cf. Hayes 1983a). Finally, I will not discuss the phonemics of stress (or the distinction between stress and pitch-accent languages), nor the role of stress in the analysis of tone languages (cf. van der Hulst, Forch, Dijkstra and Gussenhoven and Bruce, forth.).

The reader must also be warned for the fact that this overview reveals some of my own special interests.

2. The Beginning

Metrical theory was first developed in the MIT dissertation of Mark Liberman (1973). This thesis primarily dealt with the intonational system of English, but Liberman included a new proposal for the representation of English word stress in his work. The proposal owes its ideas put forward by Alan Prince in his 1975 MIT dissertation on Tiberian Hebrew and the theory in its initial form is best known from an article that Liberman and Prince published together in 1979 in Linguistic Inquiry.

English word stress had already been extensively analysed in Chomsky and Halle's The Sound Pattern of English (1968; henceforth SPSE). In the approach offered by Liberman and Prince, the SPE rules were not abandoned. As before, word stress was assigned to vowels by a modified version of the SPE Main Stress Rule and the Compound Stress Rule.

The novelty was that the string of segments was now fed into an algorithm that parsed it into a constituent structure. This structure was called metrical because of the central role of a unit called foot, a term that was borrowed from poetic meter. Liberman & Prince assumed that segments are organised in syllables; SPE had tried to do phonology without syllables, but the reintroduction of this unit in phonology led to many phonologists, among others Vennekamp (1979).

Kahn (1976) had proposed a hierarchical representation of syllables and Liberman & Prince introduced this proposal without committing themselves to any particular view on the internal structure of these units.

The metrical algorithm that Liberman & Prince introduced added the syllabified string layer of bisyllabic constituents, called feet. The resulting tree structure was augmented with the labels "Strong" and "Weak". The label was assigned to syllables that contained a stressed syllable:

(1) a. Every sequence of syllables -/---/--- forms a metrical tree (i.e. a foot). The feet are organized into a right branching tree.

b. 

<table>
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<tr>
<th>w</th>
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In this proposal "being stressed" corresponded to being in the strong part of the foot. As shown in (1), a further layer of structure was added, grouping feet into a constituent labeled M (for Moti). This form was chosen to make it clear that the notion of "word" alluded to here was not that of a unit in the morphosyntactic structure, but rather a phonological word, a unit that forms part of the metrical (i.e. phonological) constituent structure.

In (1) we see that in addition to phonological constituent structure, Liberman & Prince introduced a second phonological plane, called the grid. The grid represented relative prominence that could be "read off" from the tree according to the algorithm in (2), Liberman & Prince (p. 310):

(2) In any constituent on which the strong-weak relation is defined, the designated terminal element of the constituent is metrical stronger than the designated terminal element of its weak subconstituent.

At this point, the reader undoubtedly notices a certain redundancy in the algorithm, certainly to the extent that the expression of representation of stress is concerned. In fact, it would appear that stress is expressed three times, i.e. in terms of feet, SW-labeling and grid columns. If other phenomena than stress are taken into consideration, it could perhaps be argued that each level exhibits independent properties. One could, for example, argue that the (address) distribution is the result of a grammaticalization rule that refers to "abstract" levels of representation and is governed by idiosyncratic lexical and morphological information (much as in SPE). The SW labeling could be seen as a projection from segmental structure onto a phonological structure that governs the application of phonological processes such as assimilation and flapping. The grid, finally, could be seen as an independent layer, it could only partly be projected from the tree. The theory contained additional rules that add "beats" to "improve" the rhythm only with reference to this level. Be this as it may, in the next stage of development metrical theory underwent changes that were motivated by attempts to eliminate this overlap.

Selkirk (1980) proposed to build the SPE stress rule into the foot formation algorithm by making the factors that determined the distribution of this feature directly responsible for the distribution of feet. Thus, footing (incl. SW-labeling) became the way in which stress was assigned. This fact was a more precise projection from segmental structure.

Kiparsky (1979) showed that the rules that had motivated the grid level among them the well known Rhythm Rule applying in ThinTrees must also be reformulated with reference to the tree structure alone. His argument was generally accepted and grids disappeared from the scene. In retrospect, it is perhaps the case that the use of SW labeling concealed the fact that Liberman & Prince were actually proposing that phonological constituent structure was hierarchically organized. The daughter labeled "S" was really the head of the foot and the foot that was dominated by S nodes alone was the head feet of the P-word. Pronunciation or stress could simply be regarded as one of the suprasyllabic exponents of headedness. Thus, metrical theory was a first step toward recognizing the central organizing role of head-dependency relations in phonology. Gradually the SW notation was replaced by other graphical means to indicate headedness (cf. below).

3. The Great Developments

In 1979 a very important grey paper came into circulation: J.A. Vergnaud and M. Halle, Metrical Phonology. A Fragment of a Draft. The importance of this paper lies in placing the transformational Liberman & Prince theory of English stress into a parametric theory of stress systems.

The Liberman & Prince analysis of English involved a particular algorithm for foot and P-word formation, which, as Vergnaud and Halle show, can be seen as just one member of a family of algorithms. Other members would involve the same type of foot, but assigned from left to right, or another foot type and so on. Each step in the algorithm was taken to be an "offon", "left-on" or "yes/no" parameter.

Vergnaud and Halle discovered that the word stress rules of a great variety of languages could be "unwrapped" and represented in terms of settings for yes/no parameters. The "yes" were elaborated and richly documented in a 1982 MIT dissertation by Bruce Hayes.

The basic parameters that emerged from these works are given in:

- Foot Form: left-Strong/Right-Strong
- Foot Type: quantity-sensitive/quantity-insensitive
- Foot Stem: bound/unbound
- Direction: left-to-right/right-to-left
- Extrametricality: yes/no
- Edge: left/right
- Word Form: left-Strong/Right-Strong

The settings indicated in the right-hand column characterize (ignoring important details) English word stress.

I will now briefly discuss these parameters by explaining the terminology and looking at some of the theoretical developments that have taken place since the early eighties.

3.1 Foot form and foot type

Foot form allows the choice of "trochee" or "iamb". A system is quantity-sensitive if certain syllables (i.e. heavy syllables) cannot appear in the W position of the foot. The distinction between heavy and light syllables is a highly contested topic in many different languages, but the basic point is that heavy syllables have "something extra" in their rise when compared to light syllables. The "something extra" could be vowel length, syllable closure, a high tone and so on. For the purpose of this footnote it does not matter how many ways there are to bifurcate the class of syllables in heavy and light syllables, nor how the distinction is precisely these are represented.

The term "mora" will be used here to refer to the units in the syllable that contribute to the right (cf. Hyman 1984, Hayes 1989). By definition, light syllables have one such unit, whereas heavy syllables have no more than two; thus h = 1 is called moraic phonology and represents a particular view on the internal organization of syllables contrasting with the traditional so called onsets-rhyme
theory, but for our purposes we do not have to enter into this debate.

In a Qs language, then, strings of syllables making up words are typically parsed in a nice two-by-two fashion. Heavy syllables must be heads. In (4) (a) a string of seven syllables forming a word: in (4) (a) this string is parsed in Qs mode, while (4) (b) shows the typical pattern of Qs parsing. "

Strictly speaking it makes no sense to classify syllables into light and heavy if the language is Qs. Still, it is useful to realize that a Qs language may have distinctions among its syllables that are the same as those of a Qs language. Kager (1989) suggests that Qs languages that contain differences in syllable shapes that in other languages determine weight, often have more subtle weight effects. In accordance with the parameters foot form and foot type, Qs foot types have foot types that maximally contain two lights (i.e., monomoramic) syllables or one heavy (i.e., bimoramic) syllable. The cases that were represented in earlier works with Qs iambic and Qs trochee were in need of an alternative analysis. By allowing certain manipulations at the edges of stress domains (like excluding syllables from the parse by extrametricality or postulating empty syllables (cataphoric), such alternative could usually be found.

The possibility of making these reanalyses showed that the standard theory was overrich anyway. The cases of course of same prononcience patterns but usually led to different constituent structures when compared to the original analyses. The details of foot structure may in principle play a role in the application of segmental phonological rules, such evidence from requires access to details of the phonology that were often not studied or reported in grammars or phonological sketches.

The next step was taken by Kager (1989, 1993) who extended the binomic upper bound of moraic trochees in two ways. Firstly, he proposed that Qs iambic systems do not require (1) (b) feet. He suggested reanalyses for the few cases that were originally analyzed with binomials. Hayes suggested that the binomic requirement was also the lower bound, which implies that so-called monomoramic (also "unary" or "degenerative") feet were banned. Hayes (forth.) accepts Kager ban on monomoramic feet with certain qualifications which I will not discuss here. Both the ban on (6) (b) feet (often called "unbalanced feet") and degenerate feet result in leaving light syllables unparsed. Mester (1994) refers to these as "trapped" syllables and shows that dichotomous changes and variable alternations can sometimes be understood as strategies to avoid trapped syllables. Unparsed syllables raise a problem since it is unclear whether and, if so how, such syllables are incorporated into the prosodic structure. If they are incorporated directly into higher levels, another problem arises, because in all other respects it has been assumed that prosodic structure is strictly layered, i.e. that all units at each level get incorporated into units of the next higher level. Of, Naug and Vogel (1986) and Ito & Mester (forth.) for a discussion of this issue that is essentially unresolved to date.

An interesting consequence of banning unary feet is that so-called minimal weight feet find a principled explanation. This effect involves the absence of monomoramic (Qs) or monomoramic (QS) content words. Mfonc, closed class words, including phonological phemes, are usually allowed to be underlined. If feet must be binary, words must be minimally bimoramic. Cf. Ito and Mester (to appear), for examples and discussion.

Before turning to the parameter foot size, which introduces a distinction between the bounded feet that we have been discussing so far and so-called unbounded feet, I will briefly discuss the need for feet that are bigger than two moras (QS) or two syllables (Qs) but which are nonetheless bounded. In a Qs language the feet have been defined as marginal, but more recently it has become more widely recognized that in some systems feet are headed by two stressless syllables rather than one.

Hayes (forth.) argues that ternary patterns can be produced with binary feet if the footing edge can slip a syllable each time a foot has been assigned. Another, perhaps more interesting proposal can be found in Dreijer and Lethi (1991) and Rice and Rice (1992). In these works a parameter is added to the system which may require that feet heads are branching. Thus, if heads must branch, feet will contain three syllables if the system is Qs and four moras if the system is QS. This proposal is more principled since it is quite common to find that the head-dependency asymmetry is expressed in terms of a greater allowed or required complexity for heads.

3.2 Foot size

In systems that make use of the foot types discussed in this paper, primary stress cannot be further away from the edge than three syllables (QS), or three moras (QS). The maximal distance can be reached by applying extrametricality.

Unbounded feet were considered necessary for systems in which primary stress can be located further away from the edge, in feet, nowhere in the word. Rather than going into the details of how unbounded feet were applied, I refer to the view set out in (1986), who proposed to abandon the unbounded feet. Hayes (forth.) account of unbounded feet yields binary feet which target heavy syllables only, leaving all light syllables unparsed. This proposal, however, naturally leads to the conclusion that unbounded systems are more properly characterized by assuming that in these cases primary stress assignment is not dependent on foot structure at all. This view is partly present in Hayes (forth.) account of unbounded systems and more fully developed in van der Hulst (forth.).

In such cases, then, primary stress is assigned to the edges of the system is Qs or to the left-most heavy syllable if the system is QS. A typical example of the latter type are given in (8):

(8) Stress falls on the rightmost heavy syllable and, if there is no heavy syllable on the telonic syllable (e.g., Classical Arabic) the "default" edge case can be identical or opposite to that of the edge where the primary stress heavy syllable is located. Next to weight-based unbounded systems, we also find level-based systems. In such systems morphaes contain accented syllables (or are accentless). The location of these syllables must be lexically marked. But once morphaes are string together, a primary account is located in much the same way as in weight-based unbounded systems.

A consequence of representing unbounded systems with foot structure (which were bounded or unbounded) is that this necessitates an independent status for a grid representation:

(1) a. 1st level 1 stress heads
   b. 2nd level heavy syllables
   c. 3rd level primary stress
trends in exception marking have been proposed, the most popular being that lexical representations are provided with bits and pieces of the ingredients out of which metrical representations are constructed. So we find premarked "heads", feet, foot-boundaries and extra-metricality or catalexis.

4. Other (sometimes parallel) developments

4.1 Grid-only theory

In section 2.2 we noted that the original Liberman & Prince theory contained in redundancies. The major trend was to eliminate the grid, but Prince (1983) explores the other logical possibility, arguing that the independent evidence for foot structure is rather limited. There may be a logical reason for footing into "perfect gridding" and word tree construction into "end rules". The latter proposal implied a "flat" view on the prosodic word organisation. By allowing that Perfect Gridding could be specified as "peak first" or "tow first", Prince could minimize the effect of trochaic or iambic parsing. QS systems were represented by projecting heavy syllables on the grid and letting Perfect Gridding apply to stresses of light syllables. This approach, in fact, is comparable to the later developed bimorphic footing idea (section 3.1), since it suggests that heavy syllables are "metrical islands", placed outside the algorithm that distributes rhythm to light syllables.

Prince's paper was also one of the first to bring attention to ideophone prosody for foot constituency. Halle and Vergnaud (1987) provided examples of stress shifts, the direction of which could only be understood if foot boundaries were part of the metrical structure (cf. Dresher 1990 for a critical note and Kenstowicz 1991 for further support). Prince (1985) is an important and influential paper even though foot boundaries were restored. This influence was partly notational (section 4.2), partly terminological ("End Rule") and partly substantial (the "island" treatment of heavy syllables, the flat word structure).

4.2 Bracketed grid theory

Even though Halle and Vergnaud (1987) pleaded for the need of foot boundaries, they were so charmed by the return of the grid suggested in Prince (1983), that they decided to add the foot-brackets to the grid, rather than returning to the graphical shape of trees:

\[
\begin{align*}
(x) & \\
(x \ x \ x) & \\
(x \ x) & \{x \ x \} \\
\end{align*}
\]

Apa iholo osa

My view, representations like (12) are fully equivalent to trees, but they have the definite advantage of being compatible with any word processor. Next to (12), tree notations that were ever in use replace the use of SW labels by graphically marking heads with a "dotted line in a circle". Hammond (1984) criticised the notation and termed it "loopholeotation". Usually heads are also dominated by a vertical line. A similar notation is proposed in Dependenzy Phonology (Anderson and Even 1987).

On the substantial side, Halle and Vergnaud (1987) essentially argue for the standard foot typeology, i.e. they do not follow the line leading to bimorphic accounts of QS systems that we discussed in section 3.1.

4.3 Bracket-first theory

Halle and Idsardi (1964) and Idsardi (1992) propose a new algorithm for constructing bracketed grids. The basic idea is that the algorithm starts out placing left- or right-brackets in the string. Further steps fill in the pairing of brackets and heads.

a. inclined to be sceptical about this approach since the manipulation of brackets seems to imply a conception of phonology that is preoccupied with the notion that sounds are only matched with their "sense", i.e. the content of the theory.

b. Still (but this may very well be a coincidental effect), it could be argued that the bracket-first approach has a unifying effect because it reduces marking extra-metricality and foot structure to the same device, viz. inserting a bracket.

On the other hand, an apparent disadvantage of the approach is that it capitalizes on a prosodification of grammar. In the next section, we will see that current trends in phonology are based on the idea that the only thing that matters is stating a well-formed representation. Like this, it being irrelevant where the representation comes from or how it was constructed (and why).

5. Optimality theory

Optimality theory (Prince and Smolensky 1993, McCarthy and Prince 1994, for instance) is not about a grammar per se. It is a new way to write grammar works. Most of its applications so far are in phonology, but OT work in syntax is also coming available. A fair discussion of this approach deserves a separate contribution, so I will limit myself to a few illustrations.

The central idea is that the grammar consists of a (universally) constructed and parametrically universal and partly language-specifically. The last fact forms the basis for variation among languages.

Constraints state what the output of grammar must look like, but they are ordered and potentially conflicting, output need not conform to all constraints. On the basis of the ranked constraints, the grammar selects optimal forms from a pool of candidates which are freely generated on the basis of the input of lexical forms. Free generation involves providing input forms to all possible syllable formations, metricalifications, and other matters that need not concern us here. The optimal output is the one that (only) violates the lowest-ranked constraint. The following example may illustrate this.

There is a constraint which states that heavy syllables must be heads. We will call it Weight. If this constraint was universally top-ranked, all languages would be QS. Since this is not the case, there must be another constraint with which Weight potentially conflicts. If this constraint outranks Weight, the language is QG. What could this constraint be? Recall that in QG languages heavy syllables "disturb" a nice two-by-two pairing, leading to stress on adjacent syllables. Let us therefore assume that there is a constraint that militates against such clashes.

By ordering Weight and NO Clash in two ways, we now produce two types of languages:

(a) QI NO Clash >> Weight
(QI) >> Weight NO Clash

It will be clear that a parametric system can easily be translated into a constraint-based system if we declare both settings to be separate constraints.

In this respect the example in (18) is more interesting since it might be argued that this constraint on extra-metricality is not exactly opposite, but rather independent and overlapping.

Even typical procedural parameters like "direction of footing" can be accommodated in a constraint-based approach. The relevant constraint type states that feet must be on the left or right edge of the word. Clearly, if the complete word must not violate the constraint, but on the assumption that violation is minimal, (15a) does better than (15b):

(a) Foot-alignment: foot must be on the left edge

(b) a. b. c. d.

to describe a left-directional language, foot alignment (left) must dominate the foot-alignment (right). Another application of OT involves extra-metricality (which OT proponents now limit to the right edge). But that is an independent issue. It is well-known that extra-metricality is suppressed if the word would become small to foot. Thus, we may see this as a case in which extra-metricality is a (constraint) is outranked by a constraint that requires (context) words to have a foot. This idea of ever-ruling extra-metricality by "something higher" was already implicit in the parametric approach.
and since the running in this case is taken to be universal it does not support the specific conception of language-specific ranking that is the hallmark of OT. OT and its application to stress can be found in the work of investigators such as Hewitt (1992), Hung (1993), Kayser (1994), Kenstowicz (1994) and McCarthy and Prince (1994).

For a similar approach, see Durie (1994).

One point to notice is that OT does not solve and is not intended to solve, issues of representationality. For example, when one wants to provide an OT account of stress patterns, one must first decide on what type of foot is needed to represent such systems. Then, constraints can be formulated which pick out the appropriate representations from the admissible options.

OT is an important development in the field in proposing solutions to old problems in a strikingly simple way. The idea to reflect the "ranking forces" that operate on units of language directly in the design of the grammar is appealing. OT is also incredibly popular and some of the factors that determine its spread would be interesting to study in the context of a treatise about "fashion" in science. At present, the theory is in the expending phase. Every new analysis adds new constraints to the universal inventory, at the same time increasing the mass of observable phonological patterns. Developing surface patterns are too easily declared to adhere to a novel constraint. This leads to situations in which what one feels needs an explanation is presented as one.

6. Summary

In this overview I discussed several aspects of metrical theory, focusing on representational issues. I ignored derivational matters, i.e. the mapping of one level to the next. For instance, we did not consider the interactions between stress and level-ordered morphology. Our discussion of representational issues dealt with constructional and notational points, which must be separated. Constructional issues are dependend on a procedural view on grammar and such a view is not the only and perhaps not the preferred one. Notational issues, unfortunately, most easily catch the eyes of the casual observer, are in themselves irrelevant, although it stands to reason that one adopts notations that are user-friendly. What matters most is being explicit on what the notation is meant to express, i.e. the theory that one proposes of how phonological representations are organized, what the primes are and how these form well-formed structures. Storing with Vergnaud and Halle (1978), metrical phonology has been concerned with a broad range of languages, sometimes perhaps languages of which too little is known. This is partly due to the fact that grammatical stress systems often contain only the traditional holistic statements and no dynamic stress markings, and partly to the "typological" favor that many metrical studies on stress have. Despite this drawback, metrical theory has made enormous advances since its inception, and I regard the issues discussed in section 3 as representative of the refined theoretical debates that take place.

Acknowledgements

Thanks are due to Jan Koenig and Jeron van de Weijer.