

CHAPTER 16

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WORD-BASED MORPHOLOGY FROM ARISTOTLE TO MODERN WP (WORD AND PARADIGM MODELS)

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16.1 INTRODUCTION

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THE dominant morphological models developed in the modern period can both trace their origins to ancient Indo-European grammatical traditions. Bloomfieldian models have their ultimate roots in the Sanskrit grammatical tradition, particularly as represented in the work of Pāṇini. These models adopt a formative-based perspective in which the central analytical task of morphology involves the disassembly of words into arrangements of sub-word units.¹ Modern word-based models likewise lie at the end of a continuous tradition that arose from attempts first to describe and subsequently to teach the grammar of ancient Greek and Latin. These models project morphological analysis primarily upwards from the word, and treat the association of words with paradigms or other sets of forms as the most fundamental morphological task. Sub-word sequences figure in the patterns of modification that related basic forms of an item to their ‘inflected’ variants. However, the classical model has no counterpart of morphemes—not even roots (Law 1998: 112)—and its proponents perceived no need for any unit intervening between sounds and words. The primacy of words in the

¹ The legacy of the Sanskrit grammarians is treated in more detail in ch. 11 of this volume, while aspects of the Bloomfieldian program are summarized in ch. 18.

Greco-Roman tradition had been encouraged and was further reinforced by an interest in etymology, which consisted in the main of word histories.

The classical word-based model has, moreover, been relatively stable through most of its history. The Alexandrine model attributed to Dionysus Thrax and Apollonius Dyscolus provides the basis for the Latin grammars of Donatus and Priscian, and in turn for subsequent descriptive and pedagogical treatments of classical grammar. An essentially classical word-based perspective survives into the Neogrammarian period and remains relevant to morphological analysis in the field of historical linguistics. It was not until Bloomfield threw off the yoke of his own classicist training and established an almost purely syntagmatic alternative that the classical model was eclipsed as a general model of analysis.

Yet the heyday of the neo-Pāṇinian morphemic model was remarkably short-lived. Little more than twenty years separate the first definitive presentation of the mature Bloomfieldian programme in Bloomfield (1933) from the last concerted effort to salvage the post-Bloomfieldian model of morphemic analysis in Hockett (1954). Before the end of the next decade, Hockett (1967) had ceased to see morphemic analysis as anything other than a linguist's shorthand for more psychologically plausible descriptions. These more 'realistic' alternatives comprised sets of word forms, organized into paradigms and extended by processes of analogy. Soon thereafter, Matthews (1972) reacquainted modern audiences with the types of morphological patterns that arise in a flectional language and with the classical models developed to provide descriptions and analyses of these patterns. The rehabilitation of these traditional insights in turn spurred the development of distinctively modern versions of word-based models.

In short, from at least the time of Aristotle through to the present, something like the word and paradigm model has occupied a central place in the approaches to morphological analysis developed within the Western grammatical tradition. The body of this chapter now traces this intellectual progression in more detail, focussing on the continuity between variants of word-based approaches.

16.2 ORIGINS OF WORD-BASED MODELS

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On the basis of the surviving evidence about the pre-Socratic philosophers, their interest in language appears to have been linked to a broader interest in rhetoric. In Plato, questions concerning the structure and use of language likewise arose in the context of more general philosophical and logical investigations. Hence a number of terms that originate in Plato have, at least initially, a fundamentally logical usage and only gradually take on a strictly grammatical sense. In particular, when Plato suggests in *Sophist* that a *logos* can be analysed as an *onoma* and a *rhēma*, he can be understood as claiming that a 'proposition' or 'utterance' consists of a 'name' or 'noun phrase' and a 'predicate' or 'attribute.' Not until later did the grammatical meanings 'sentence,' 'noun,' and 'verb' come to predominate.

16.2.1 Aristotle and the Stoics

It is in Aristotle that the first recognizable precursor of a word-based model can be found. Indeed, to the contemporary observer, Aristotle seems remarkably modern in outlook. The fact that he never wrote a treatise devoted solely to grammar resonates with current efforts to reduce the isolation of linguistics within the cognitive and behavioural sciences. His view that words were organized into sets of basic forms and analogically similar inflected variants shares the same fundamental perspective as modern exemplar-based models. Even his insistence on distinguishing nouns from inflected forms of nouns anticipates the later contrast between word forms and lexemes (Matthews 1972: 161).

Some of Aristotle's clearest pronouncements regarding language are in a comprehensive treatment of the relation between logic and language that is usually known by its Latin name, *De Interpretatione* 'On Interpretation' (rather than by the Greek original *Peri Hermeneias*).² The discussion of meaning first identifies sentences as expressing propositions ('judgements') and then proceeds to define the word as the smallest meaningful part of a sentence.

A sentence is a significant portion of speech, some parts of which have an independent meaning, that is to say, as an utterance, though not as the expression of any positive judgement . . . The word 'human' has meaning, but does not constitute a proposition, either positive or negative . . . But if we separate one syllable of the word 'human' from the other it has no meaning . . . In composite words, indeed, the parts contribute to the meaning of the whole; yet . . . they have not an independent meaning. (*De Interpretatione* 16^b, 27–36)

To Plato's *onomata* and *rhēmata*, Aristotle added a third category of *syndesmoi*, containing conjunctions (which are of particular logical importance) along with various other closed-class items that are sometimes grouped together as 'functional' categories. These word classes are notional rather than formal, so that it is reference to time that distinguishes *rhēmata* from *onomata*.³

By a noun we mean a sound significant by convention, which has no reference to time, and of which no part is significant apart from the rest. (*De Int.* 16^a, 19–21)

A verb is that which, in addition to its proper meaning, carries with it the notion of time. No part of it has any independent meaning, and it is a sign of something said of something else. (*De Int.* 16^b, 6–9)

² The quotations from Aristotle below are cited by the Bekker numbers in the translation of *De Interpretatione* by E. M. Edgehill in Ross (1926).

³ Robins (1997: 33) warns in fact that 'the translation of *onoma* and *rhēma* by *noun* and *verb* at this stage in the development of Greek grammatical theory may be misleading.'

Although Aristotle did not use patterns of tense or case inflection to define word classes, he introduced a technical term, *ptōsis* ‘fall,’ to distinguish nouns and verbs (i.e. lexemes) from their inflected variants (word forms).

The expressions ‘of Philo’, ‘to Philo’, and so on, constitute not nouns, but cases [‘inflexions’ in Ackrill 1987] of a noun. (*De Int.* 16^b, 1–2)

In the nominal domain, Aristotle singled out the category of gender, reflecting the influence of the previous classification of Protagoras and his own interest in meaning. It was the Stoics who first restricted the term *ptōsis* to apply solely to case forms (surviving in the German term *Fall* ‘case’), and who then introduced a new term, *klisis* ‘bend,’ to apply to inflected variants in general.

The organization of Greek morphology into words and inflectional variants was governed by principles of analogy, in line with Aristotle’s position on what is known as the ‘analogy–anomaly’ debate. This issue, which appears as the first strictly morphological debate in classical antiquity, was essentially a dispute about the role of regularity in language. On the one side, Aristotle and the subsequent Alexandrine school emphasized the systematicity of analogical patterns, principally within inflectional paradigms. On the other side, the Stoics attached particular importance to irregularities, within inflectional paradigms, but more pervasively within families of derivational formations in Greek.

The positions espoused by Aristotle and the classifications he proposed were significantly refined and elaborated by the Stoic and Alexandrine schools. The Stoics expanded his tripartite division to include additional word classes, and appear to have fired the first volley in the debate about the categorial status of names and common nouns.⁴ The Aristotelian grammatical categories were likewise extended to distinguish verbal properties, including voice and transitivity, whose description in terms of ‘upright’ and ‘bent’ varieties paralleled the description of case forms. Even more innovative was the Stoics’ use of case inflections to establish a formal contrast between *onomata* and *rhēmata*. The fact that adjectives inflected for case (and gender and number) in Greek led to a classification in which they were treated as a subclass of ‘nouns’ (Allan 2010a: 63f.). More significantly, the principle of distinguishing word classes according to form had been established (there appears to be no classical antecedent of purely distributional analysis) and was preserved in the Alexandrine grammatical tradition.

To a striking extent, the organization of a classical ‘word and paradigm’ model, consisting of words organized into sets of basic forms and analogically similar inflected variants, is fully present in Aristotle’s time. The primacy of words resonated with the way that other linguistic issues were framed. For those on both sides of the analogy–anomaly debate, the critical evidence consisted of word forms, which either conformed to or deviated from general morphological patterns in Greek. The study of etymology,

⁴ A debate which was revived in Montague Grammar (Thomason 1974) and lives on in contemporary discussions of the merits of noun phrases vs determiner phrases (Collinge 1998: 64).

which also dates from this period, was similarly word-based. The goals of these early etymological studies were closer to popular conceptions of etymology than to specialist historical or lexicographic views. The point of tracing the history of a word was to not to understand the ways that forms may change or meanings drift over time. Instead, this was designed to reveal the original or even authentic meanings of words. Although these early discussions had only limited direct influence on the subsequent grammatical tradition, the focus they placed on the properties of words and the regularity of relations between words reinforced a general word-based perspective that was carried forward into the classical word and paradigm model.

16.2.2 The Alexandrine Grammatical Tradition

Our understanding of the linguistic traditions that pre-date the appearance of the first written grammars is severely hampered by the fragmentary nature of the surviving materials. There is a particular risk of underestimating the influence of the Stoics, given how few of their own writings were preserved.

No Stoic grammatical treatise of any period survives; indeed, only one text with what can be called, broadly, grammatical interests is extant in even something like its original form; in any case this book of Chrysippus' *Logical Questions* belongs rather in what moderns would call philosophical logic and the philosophy of language. (Blank and Atherton 2003: 310)

Hence in accepting the received view that the Alexandrine school served as the main conduit between the Greek and Latin traditions, one should not lose sight of the fact that the Stoic school remained active and influential during the period of Alexandrine ascendancy. Stoic influences even provide key evidence bearing on the authenticity of the oldest surviving grammatical description of Greek, the *Technē grammatikē* 'art of grammar,' associated with the Alexandrine scholar Dionysius Thrax. It is widely accepted that there was a grammarian known as Dionysius Thrax (the Thracian), who taught in Alexandria around 100 BC, and that he was the author of a grammatical description of Greek. However, the authenticity of the version of the *Technē* that has come down to us is a matter of dispute, and the contemporary consensus appears to be that at most the first section can be securely attributed to Dionysius Thrax (Robins 1998: 15, Luhtala 2005: 28).⁵ One source of scepticism derives from discrepancies between the views attributed to Dionysius in the historical record and the positions expressed in the later sections of the *Technē*. In particular, Dionysius is said by contemporaries to define verbs in terms of their function as predicates and to assign names and common nouns to distinct word classes (Robins 1998: 16f.). Both views

⁵ It is instructive to compare Robins (1957) with the later discussion in the papers in Law and Sluiter (1998) and in Luhtala (2005), which re-evaluates the influence of Apollonius Dyscolus.

endorse Stoic positions, in contrast to the description in the *Technē*, which defines verbs mainly in terms of patterns of inflection and assigns names and common nouns to the same word class.

Reservations about the authenticity of the *Technē* clearly detract from its value as an accurate record of the grammatical assumptions current in Alexandria during the time of Dionysius. Nevertheless, given that the discrepancies reflect the effects of Alexandrinization, the *Technē* can be taken as a record of the grammatical assumptions current at a later stage of the Alexandrine school. From this perspective, what is again remarkable is the extent to which the *Technē* merely refines the Aristotelian conception. The sections dealing with *leksis* (12) and *logos* (13) echo the earlier passages from *De Interpretatione*. Sentences are again defined as meaningful units and words as their smallest parts.⁶

A word is the smallest part of an ordered sentence.⁷ (11, 1)

A sentence is a prose expression that formulates a complete thought.⁸ (11, 2)

The class of *onomata* is again defined as declinable elements, with the consequence that this class contains adjectives along with common and proper nouns. The class of *rhēmata* contains indeclinable elements that are marked for verbal properties. The accidents of nouns and verbs mix a range of inflectional properties with a category of ‘species’ (Gr. *eidos*), which designates types of derivational formations and ‘form’ (Gr. *schēma*), which distinguishes compounds.

A noun is a declinable part of speech, signifying an object or an action . . . There are five accidents of the noun: gender, species, form, number and case.⁹ (12, 1–6)

A verb is an indeclinable word, which marks time, person and number and which expresses the active and passive. There are eight accidents of the verb: mood, voice, species, form, number, tense, person and conjugation.¹⁰ (13, 1–4)

The principal deviation from the Aristotelian conception is the formal definition of word classes in terms of declination. The extension of word classes and grammatical categories is largely an elaboration of Aristotle’s classification. Moreover, the treatment of grammar in terms of ‘an accurate account of analogies’ in the initial (and presumably authentic) section is entirely Aristotelian.

⁶ All translations below from French and German originals are my own (JPB). The references to the *Technē* cite the part and line number in Lallot (1989).

⁷ ‘Le mot (*léxis*) est la plus petite partie de la phrase (*lógos*) construite.’

⁸ ‘La phrase est une composition en prose qui manifeste une pensée complète.’

⁹ ‘Le nom est une partie de phrase casuelle désignant un corps ou une action . . . Il y a cinq accidents du nom: le genre, l’espèce, la figure, le nombre, le cas.’

¹⁰ ‘Le verbe est un mot non casuel, qui admet temps, personnes et nombres, et qui exprime l’actif ou le passif. Il y a huit accidents du verbe: le mode, la diathèse, l’espèce, la figure, le nombre, la personne, le temps, la conjugaison.’

16.2.3 The Latin Grammarians

By the Alexandrine period, the die had been cast, and the classical model was to undergo only comparatively minor revisions until the modern period. The Roman grammarians were particularly conservative, and tended to see their role as adapting and applying the Greek model to Latin. Their attitude reflected the elevated position of Greek learning in the Roman world, together with the typological similarity of Greek and Latin. This assessment does not of course deny the real progress achieved within the Latin tradition, particularly in the domain of syntax, or undervalue the broader perspective afforded by expanding the scope of grammatical descriptions to include Latin as well as Greek. However, the general conception of morphological analysis was largely stable and essentially Greek during this time. The towering achievement of the Latin grammarians lay less in the innovations that they introduced than in their success in elaborating and codifying an inherited model in a form that could serve as the basis for the teaching of Latin from the Roman empire until the present day.

Some of the refinements introduced by the Latin grammarians nevertheless bring their model closer to modern conceptions of morphological analysis. The most obvious of these is a principled contrast between inflection and derivation, which is not observed in any general way within the Greek tradition. This distinction appears to originate with Varro, the earliest recorded Latin grammarian, who lived between 116 and 27 BC and was roughly contemporary with Dionysius Thrax (170–90 BC).¹¹ The way that Varro characterizes inflection in terms of implicational structure is almost arrestingly modern.

This part of morphology [i.e. inflection] Varro called ‘natural-word form variation; (dēclinātiō nātūrālis), because, given a word and its inflexional class, we can infer all its other forms. (Robins 1997: 63)

Varro’s insight was only partially preserved in the subsequent tradition. On the one hand, the implicational relations that determine the analogical patterns within inflectional paradigms continued to play a role in the morphological rules of later grammars. The monumental *Institutiones grammaticae* ‘Grammatical foundations’ of Priscian (c.500 AD) exploits these interdependencies in the rules that derive inflected variants of nouns and verbs from their basic forms, which he assumed to be the nominative singular and first person singular indicative active. Yet on the other hand Priscian did not maintain a consistent distinction between inflectional forms and derivational formations.

From the standpoint of the development of the word-based model, the most salient feature of this tradition is again its stability. It is striking that the ancient grammarians, over the course of the millennium that runs from the earliest recorded discussions of language in Greece until the late Byzantine period, did not at any point perceive the

¹¹ Though see Matthews (1994) for a critical reappraisal of Varro’s influence.

need to introduce units intervening between sounds and words. This possibility does not seem to have been entertained by the Greek grammarians. Moreover, to the extent that sub-word analyses occurred to those working in the later Latin tradition, they were roundly rejected.

As with the rest of western Antiquity, Priscian's grammatical model is word and paradigm, and he expressly denied any significance to divisions, in what would now be called morphemic analysis, below the word. (Robins 1997: 70)

16.2.4 The Neogrammarian Turn

The Sanskrit grammarians had of course developed models of sub-word analysis to a high level of sophistication in the course of an even older linguistic tradition. Hence while the classical word-based model would continue to serve as the basis of Greek and Latin pedagogy from Priscian's time until the present, the Western rediscovery of Sanskrit ensured that it did not remain unchallenged as a general model of linguistic description. However, at least initially, there was no perception of a conflict between these models, and one can even see the consolidation of their 'external' and 'internal' perspectives on word structure as one of the factors that contributed to the extraordinary success of the Neogrammarian school. The morphotactic structure recognized by the Sanskritist grammarians contributed syntagmatic insights about the combination of formatives that complemented the paradigmatic analyses assigned by the classical model.

Thus, the dawn of the Neogrammarian period finds Schleicher 1859 echoing Aristotle and the *Technē* in again declaring that 'language consists of words'.¹²

Language consists of words; thus to a first approximation, it is a matter of what kind of form a word can have and how we describe this form in a generally applicable way.¹³ (p. 2)

Yet unlike classical grammarians, Schleicher then proceeds to outline an accompanying model of word-internal structure. He identifies roots (*wurzeln*) as expressions of lexical 'meaning' (*bedeutung*) and inflections (*beziehungslauten* 'relational sounds') as expressions of 'relations' (*beziehungen*) between meanings.

The spoken expressions of meaning are called roots . . . The spoken expression of relations are relational sounds . . .¹⁴ (p. 2)

¹² The footnoted originals of the following quotations preserve the spelling and capitalization of the source.

¹³ 'Die sprache besteht auß worten; es handelt sich also zunächst darum: welcherlei form kann das wort haben und wie bezeichnen wir dise formen in einer algemeinen, für alle worte gültigen weise.'

¹⁴ 'Den lautlichen außdruck der bedeutung nent man wurzel . . . Lautlicher außdruck der beziehung ist der beziehungs-laut . . .'

The patterns formed by different combination of roots and inflectional affixes in turn provide the basis for a morphological typology. Although rudimentary, the significance of this type of morphotactic classification lies in the fact that is almost entirely without precedent in the classical tradition. It is also unlike the morphemic analyses of the later Bloomfieldian school, in that no particular grammatical importance appears to have been attached to the specific segmentations of word forms. As Davies (1998: 200) notes with respect to the notation that Schleicher uses to represent morphotactic structure, '[i]t is not clear that the symbolism is much more than a form of shorthand.'

This structural agnosticism survives through the Neogrammarian period and interacts with the models of proportional analogy developed during this period. As was observed at the time, assigning analogy a central role in reinforcing and extending the congruence of morphological systems was not original with the Neogrammarians. The basic outlook is, again, fundamentally Aristotelian. What was distinctively Neogrammarian was the interplay between analogy and their model of sound laws, and the view that these mechanisms could account for most if not all of language. A characteristically bold pronouncement in the introduction to Leskien (1876) declares that the inflectional forms of a language at any particular point can be attributed either to sound change or to analogy.

Both factors, sound change-driven reorganization and analogy, account in a definite period for the declensional forms of a language, as with any type of inflection, and only these two factors come into consideration.¹⁵ (Leskien 1876: 2)

Modern commentators are often inclined to regard analogy as a proxy for rules, as expressed in claims to the effect that 'the solution of an analogical equation is practically the same as the application of a word-based rule to a novel word' (Haspelmath 2002: 56). While this may apply to some uses of analogy, it is misleading in relation to the views of Neogrammarians such as Hermann Paul, as it attributes a significance to sub-word units that they expressly denied.

Should we assume that analogy is simply another name for a set of rules which the speaker internalizes? Paul seems to reject this possibility mainly because any set of rules would operate in terms of abstractions to which he is not ready to attribute any validity. (Davies 1998: 257f.)

This structural agnosticism is reminiscent of the attitude towards sub-word sequences in the analogical correspondences of classical grammars.

Priscian organized the morphological description of the forms of nouns and verbs, and of the other inflected words, by setting up canonical or basic forms . . . from these he proceeded to the other forms by a series of letter changes, the letter being

¹⁵ 'Beide Momente, lautgesetzlich Umbildung und Analogie, erklären die in einer bestimmten Periode vorbandene Gestalt der Declination einer Sprache, wie jeder Art der Flexion, und nur diese beiden Momente kommen in Betracht.'

for him, as for the rest of western Antiquity, both the minimal graphic unit and the minimal phonological unit. (Robins 1997: 72)

In the work of the Neogrammarians, at least, this representational neutrality reflects a key insight. Just as the organization of words into paradigms in a classical model is driven by patterns of interdependence, the segmentation of individual forms is motivated by the predictive value of segments. There are no constraints on proportional analogies that would force them to cut forms ‘at the joint’ or to impose a stable and uniform head-thorax-abdomen analysis. Any patterns that are of use in predicting new forms provide a viable analogical base, without the need to attach any significance to their segments. Indeed, much of the attraction of their model of analogy derived precisely from the fact that

it offered an algorithm for a structurally based form of morphological segmentation, without making any claims about the segments in question. More important perhaps is that Paul’s concept of analogy and of analogical proportion is a definite attempt at providing a generalized account at a certain level of detail of how language production occurs and of how the speaker and hearer can produce and analyse an infinite number of forms and sentences which they have not heard before. (Davies 1998: 258f.)

Paul’s account of the creative use of language is framed in essentially Aristotelian terms, in which previously encountered paradigms exert analogical pressures that guide the production (or, presumably, comprehension) of novel word forms.

The creative activity of the individual is also very considerable in the domain of word building and even more so in inflection . . . We see the effect of analogy especially clearly in the grammatical acquisition of inflected forms of a foreign language. One learns a number of paradigms by heart and then memorizes only as many forms of individual words as is necessary to recognize their affiliation to this or that paradigm. Now and then a single form suffices. One forms the remaining forms at the moment that one needs them, in accordance with the paradigm, that is, by analogy.¹⁶ (Paul 1920 [1880]: 112)

Analogy remains the cornerstone of the approaches developed by successors of the Neogrammarians, including de Saussure and, particularly, Kuryłowicz, who developed the most systematic account of the constraints on proportions.

A proportion relates ‘basic’ forms to forms ‘founded’ on them and a relation of foundation $a \rightarrow b$ must exist in order for $a : b = c : d$ to be admissible as a proportion.

¹⁶ ‘Sehr bedeutend ist die schöpferische Tätigkeit des Individuums aber auch auf dem Gebiete der Wortbildung und noch mehr auf dem der Flexion . . . Besonders klar sehen wir die Wirkungen der Analogie bei der grammatischen Aneignung der Flexionsformen einer fremden Sprache. Man lernt eine Anzahl von Paradigmen auswendig und prägt sich dann von den einzelnen Wörtern nur soviel Formen ein, als erforderlich sind, um die Zugehörigkeit zu diesem oder jenem Paradigma zu erkennen. Mitunter genügt dazu eine einzige. Die übrigen Formen bildet man in dem Augenblicke, wo man ihrer bedarf, nach dem Paradigma, d.h. nach Analogie.’

[I]f *b* is founded on *a*, this means that the existence of *b* presupposes the existence of *a*, rather than that *b* is constructed by starting with *a* and adding something. Thus, the stem of a paradigm is founded on the various fully inflected forms, rather than *vice versa*.¹⁷ Kuryłowicz regards the grammar as a set of relations among full surface forms (much as de Saussure did: see Anderson 1985), rather than as a set of rules specifying the construction of complex forms from simple components. (Anderson 1992: 369)

The development of more explicit and restricted formats for expressing analogical proportions, like the recognition of word-internal structure, clearly represents a significant refinement to the classical model. Yet, for all that, the basic word-based model remains largely intact, and essentially Aristotelian.

16.3 THE MODERN REVIVAL OF WORD-BASED MODELS

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It is not until the work of Bloomfield (a member of the last generation of general linguists to be trained in the Neogrammarian school) that an exclusively syntagmatic approach to morphological analysis takes hold, and eclipses the traditional model. However, the period of unchallenged dominance by the morphemic model was short-lived. Within a quarter-century after the pioneering work on morphemic analysis in Harris (1942) and Hockett (1947), Hockett had executed a complete *volte-face* and come to regard morphemic descriptions as shorthand for more psychologically realistic descriptions in traditional terms.

To cover the complex alternations of Yawelmani by principal-parts-and-paradigms would take much more space than is occupied in the first sections of this paper by the morphophoneme-and-rewrite-rule presentation. But there would be a net gain in realism, for the student of the language would now be required to produce new forms in exactly the way the native user of the language produces or recognizes them—by analogy . . . A correct principal-parts-and-paradigms statement and a correct morphophoneme-and-rule statement subsume the same actual facts of an alternation, the former more directly, the latter more succinctly. We ought therefore to be free to use the latter, provided we specify that it is to be understood only as convenient shorthand for the former. (Hockett 1967: 221f.)

¹⁷ The notion that stems are abstracted from sets of fully inflected word forms is clear in the treatment of declension outlined by Kuryłowicz (1947: 159): ‘Car la notion du thème est postérieure aux formes concrètes composant le paradigme: on trouve le thème en dégageant les éléments communs à toutes les formes casuelles du paradigme (quand il s’agit de la déclinaison)’ [For the notion of the stem is dependent on the concrete forms composing the paradigm: one finds the stem in disengaging the elements that are common to all the case forms of a paradigm (when dealing with declension)].

In due course, the Transformationalists took over the morphemic model. However, their relation to the Bloomfieldians was akin to the Romans' relation to the Greeks, at least in morphological matters, as they were largely content to refine an approach they had inherited. One of the attitudes that came along with the Bloomfieldian model was disdain for traditional models and, indeed, for traditional grammar in general. Hence, with rare exceptions (Chomsky 1965: §2.2) the transformational tradition has been consistently morphemic in outlook.

Meanwhile, the classical, historical, and pedagogical traditions provided intellectual reservoirs that harboured the classical model until conditions were more favourable for a general reassessment of its merits. Although the first steps towards rehabilitation were tentative, each step nudged the classical model back towards to the linguistic mainstream. The modest mea culpa of Hockett (1954) provoked the more robust defence in Robins (1959), and both works are cited in the opening sentence of Matthews (1965), which offered the first theoretical reappraisal—and formalization—of the traditional model in a general linguistics journal. However, the first bridge between classical philology and modern linguistics was established by Matthews (1972), a dense and highly methodological monograph with the inauspicious-sounding title *Inflectional Morphology: A Theoretical Study Based on Aspects of Latin Verb Conjugation*. The first edition of Matthews' *Morphology* (1991) appeared two years later, in 1974, offering a modern introduction to the study of morphology that integrated a classical perspective.

16.3.1 The Flectional Challenge

In some sense, Matthews' studies are primarily concerned with the basis on which one arrives at and justifies morphological analyses. However, it was the issues that he raised in the course of exploring this question that ultimately had the greatest contemporary resonance. One set of issues were connected to a typology of the patterns that occur in flectional languages. A second set outlined the difficulties that these patterns present for models of morphemic analysis and clarified how they had influenced the development of the classical model.

Two empirical patterns that have since taken on particular importance for morphological models are cases of non-bi-unique exponence and Priscianic syncretism. The first pattern is illustrated by tangled feature–form associations in the classical Greek verb *elelykete* 'you had unfastened,' in Fig. 16.1.

Within a classical model, the word form *elelykete* is analysed as standing in a bi-unique relation to the second person past perfective indicative active cell in the paradigm of *LYO* 'unfasten.' But as Matthews observes, the realization of aspect and voice confounds any attempt to establish the bi-unique relation between features and sub-word units that is dictated by a morphemic model.

But categories and formatives are in nothing like a one-to-one relation. That the word is Perfective is in part identified by the reduplication *le-* but also by the

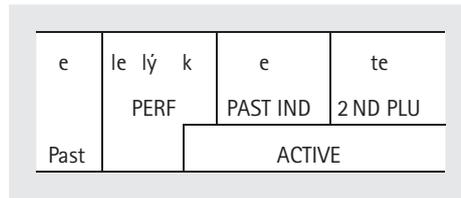


FIG. 16.1 Morphological analysis of Greek *elelykete* (Matthews 1991: 173)

suffix *-k-*. At the same time, *-k-* is one of the formatives that help to identify the word as Active; another is *-te* which, however, also marks it as ‘2nd Plural’.
 (Matthews 1991: 173)

The features past, perfective, and active are all realized by multiple exponents in Fig. 16.1. The perfective exponents *le-* and *-k-* flank the root *lŷ*, and are themselves flanked by the past ‘augment’ *e-* and the past indicative suffix *-e-*, while active voice is expressed by *-k-*, *-e-* and *-te*. There is nothing exceptional about *elelykete* within the inflectional system of classical Greek. On the contrary, the paradigm of *LYO* ‘to unfasten’ is treated as exemplary in traditional grammars such as Goodwin (1894). As Matthews (1991: 174) notes, this paradigm does not show ‘any crucial irregularity’ and it ‘is in fact the first that generations of schoolchildren used to commit to memory.’ Yet the features of *elelykete* are realized at multiple points within this form, so that individual features cannot be correlated with single formatives. This tangle of extended and overlapping exponence presents a different challenge from the one posed by the ‘cumulative’ exponence exhibited by second person plural *-te*. This ‘fusional’ pattern shows that the ‘units of content’ that condition morphological exponence may also be larger than a single feature, so that biuniqueness is violated in both directions.

Patterns of Priscianic (or parasitic) syncretism present a different sort of challenge. The Latin example described below involves a regular correspondence between present active infinitives and imperfect subjunctives.

For any Verb, however irregular it may be in other respects, the Present Infinitive always predicts the Imperfect Subjunctive. For the Verb ‘to flower’, *florere* → *florerem*; for the irregular Verb ‘to be’, *esse* → *essem*, and so forth without exception.
 (Matthews 1991: 195)

This correlation is expressed by the traditional proportional analogy in (1) below. One significant feature of these types of proportions is that they do not demand that any general meaning be associated with the shared ‘units of form’ *florere* and *esse*. The value of these elements resides in their predictive force, and it is only the full word forms in (1) below that are assigned grammatical meanings, in the context of their inflectional paradigms. A stem such as *florere* is non-meaning-bearing or ‘morphomic’ in the sense of Aronoff (1994). However, in this respect it is not fundamentally different from stems and formatives in any other proportional analogies. In the classical model, the grammatical features of exemplary word forms define their place in their paradigms, while

the features of principal parts guide the matching with exemplary forms. There is no need to assign grammatical meanings to sub-word units, and cases like (1) suggest that it is counterproductive to try to impose meanings on shared units of form. This difficulty serves in fact to reinforce the traditional insight that the value of these units of form resides in the predictions that they sanction about other forms.

(1) *florere* : *florerem* = *esse* : *X* (*X* = *essem*)

The problems and insights that Matthews rescued from classical obscurity inspired the development of nearly all modern word-based approaches. Yet this tradition evolved in an intellectual climate that was, at least initially, not entirely conducive to a modern formalization of the exemplary patterns and (possibly sub-symbolic) processes of analogy that make up the classical model.

16.3.2 A Modern Adaption

Hence the formalization of the traditional model that Matthews outlines takes the form of a rule system that constructs complex forms from roots. The basic organization of this system can be understood by examining the analyses assigned to forms such as *elelykete* and patterns such as *florere* ~ *florerem*.

Consider first patterns of extended exponence. These are characterized by a set of EXPONENCE rules that realize partially overlapping feature bundles. The point of departure for the analysis of *elelykete* is the structure in Fig. 16.2, which combines the grammatical features of the surface form *elelykete* and the root form *ly:* of the verb *LYO* ‘unfasten’. This structure does not represent the root entry of *LYO*, which would only contain whatever intrinsic features are taken to characterize uninflected roots. The features in Fig. 16.2 instead characterize the abstract paradigm cell that is realized by the surface word form *elelykete*.¹⁸

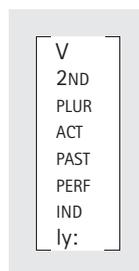


FIG. 16.2 Root and 2nd plural active paradigm cell of Greek *LYO* ‘unfasten’

¹⁸ Matthews (1991) also subscripts the category label ‘V’ to identify the word class of this form, though it turns out to make no real difference whether features are considered part of the ‘content’ of a feature bundle or as specifying the ‘context’ in which the bundle is spelled out. Hence nothing hinges on whether category labels are included within feature bundles or subscripted to them.

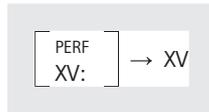


FIG. 16.3 Perfective 'shortening' rule

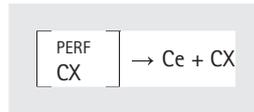


FIG. 16.4 Perfective reduplication rule

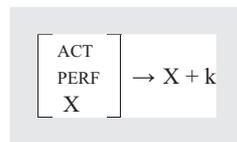


FIG. 16.5 Active perfective stem rule

Features	PERFECTIVE	PERFECTIVE	ACTIVE, PERFECTIVE
Rule	XV: → XV	CV: → Ce + CX	X → X + k
Output	<i>ly</i>	<i>lely</i>	<i>lelyk</i>

FIG. 16.6 Spell-out of the active perfective stem *lelyk*

The form *elelykete* is obtained by applying rules that realize the features in Fig. 16.2 by successively modifying the root *ly*:. For the present illustration, the rules that define just the perfective active stem *lelyk* will suffice.¹⁹ The shortening rule in Fig. 16.3 applies first. This rule realizes Perfective by reducing a long root vowel, shortening *ly*: to *ly*. The reduplication rule in Fig. 16.4 then repeats the initial stem consonant, obtaining *lely* from *ly*. The rule in Fig. 16.5 applies next, defining the perfective active stem *lelyk* by suffixing *-k* to *lely*. Fig. 16.6 summarizes the ordering of exponence rules in the 'derivation' of *lelyk*.

Matthews (1991: 178) demonstrates that a sequence of further exponence rules define the full word form *elelykete*. However, the multiple realization of perfective in the derivation of *lelyk* suffices to show how realization rules admit patterns of extended exponence. The fact that spell-out neither alters nor consumes features allows each of

¹⁹ Accent placement is suppressed, as it is predictable here (Goodwin 1894: 29).

the rules in Figs 16.3–16.5 to realize the same perfective feature. Hence vowel shortening, reduplication, and suffixation of /k/ can all function as exponents of the feature Perfective. One could seek grounds for identifying one of these as the ‘primary’ exponent and relegate the others to a supporting role. But there is no compelling reason to enforce this distinction.

More generally, the definition of *lelyk* identifies the fundamental building blocks of a modern stem and paradigm model. Abstract paradigm cells like Fig. 16.2 specify a set of distinctive features and a root form. Realization rules apply successively to define the surface form that realizes the features in a cell. The first rule in this sequence modifies the root *ly*: associated with the cell in Fig. 16.2 and the remaining rules modify the output of a previous rule. Many of the intermediate outputs in an analysis will underlie a family of surface word forms. Apart from cases of stem suppletion, roots will underlie the full conjugational paradigm of a verb. The reduplicated form *lely* likewise underlies perfective passive/middle forms of *LYO*, while *lelyk* underlies perfect and pluperfect active forms. At each point in the derivation of a surface form like *elelykete*, there may then be a number of inflectional choices. In a modern stem and paradigm model, these choices correspond to the exponence rules applicable at that point.

As this treatment of cumulative and extended exponence shows, realization rules offer a flexible analysis of morphological patterns. Yet not all of the patterns described by traditional proportional analogies can be expressed as the spell-out of morpho-syntactic features. The correspondence between present active infinitives and imperfect subjunctives in (1) is instructive. In the rule in Fig. 16.7, the form that realizes the present active infinitive defines the base for the imperfect subjunctive. However, the correspondence between the cells in Fig. 16.7 is purely at the level of form; there is no relation between the features of these cells and, in particular, no sense in which the features of the present active infinitive underlie or contribute to those of the imperfect subjunctive.

Relations of this nature plainly do not involve the spell-out of a paradigm cell. But, as in a proportional analogy, one feature–form pair in a morphological transformation PREDICTS another pair. Thus the features in Fig. 16.7 have essentially the same role that the features of a principal part do when they guide a process of matching the principal part against an exemplary paradigm.

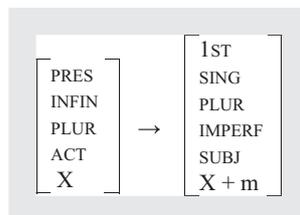


FIG. 16.7 Latin infinitive–imperfective correspondence (Matthews 1991: 194)

16.3.3 The Stem and Paradigm Model

Just as Bloomfield's work inspired approaches that adapted the Bloomfieldian model beyond all recognition, the word-based tradition that Matthews revitalized led off in a number of quite different directions. The Extended Word and Paradigm model (Anderson 1982)—subsequently A-Morphous Morphology (Anderson 1992)—combined an exponence-based perspective with a model of grammar in which feature bundles were relocated from abstract paradigms to the preterminal nodes of syntactic representations. The model of Paradigm Function Morphology (Stump 2001) moved in the opposite direction, attaching even greater importance to paradigms by assigning a central role to paradigm functions that mapped cell features and roots onto fully inflected forms. The descriptive challenge presented by patterns of Priscianic syncretism likewise prompted the general model of 'autonomous' morphology in Aronoff (1994).²⁰

Despite differences in their theoretical orientation and device inventories, these modern approaches form a fairly cohesive block. They are all, in effect, theoretical hybrids that reject the most doctrinaire aspects of morphemic analysis, while adopting other prevailing ideas about the organization of a grammatical system and the composition of the lexicon. As should be clear from the preceding discussion, the most significant divergences from classical models lie in the treatment of content-form relations and in general morphotactic assumptions. Traditional models exhibit content-form correspondences by sets of exemplary patterns, together with proportional analogies that extend patterns to new items. In modern approaches, analysis is an interpretive process, in which bundles of distinctive features are spelled out by realization rules. Traditional and modern models can also both be described as 'word-based' in the sense that the word is the smallest grammatically meaningful unit. Yet traditional models are also morphotactically word-based. They treat surface word forms as the basic elements of a system, and, to the extent that they recognize roots, stems, and exponents at all, they regard these elements as abstractions over a lexicon of full word forms. In contrast, the morphotactic assumptions of modern models pattern more with those of morphemic approaches, in which surface word forms are assembled from more basic elements. Unlike Bloomfieldian models, they do not encapsulate formatives in discrete morphemes. But modern approaches still assume a model of the lexicon in which open-class items are represented by roots and/or stems, and surface word forms are constructed from these units through the successive application of realization rules. Thus, overall, modern approaches agree with morphemic models in treating surface words as derived units, but disagree about the nature of the devices that derive these units.

²⁰ Approaches that show a less direct influence include 'lexeme-based' or 'realization-based' models of Zwicky (1985) and Beard (1995) and the 'seamless' model of Singh and Starosta (2003).

More insidiously, although the use of a general mechanism for spelling out properties of abstract paradigm cells addressed some of the empirical challenges described by Hockett (1947, 1954) and Matthews (1972), it also led to a natural expansion of the class of morphosyntactic ‘features’ to be spelled out. The process seems to have begun with the ‘declension class features’ proposed in the brief excursion into word and paradigm morphology in Chomsky (1965: 171). Inflection class features are subsequently introduced without comment in Matthews (1972) and assumed in most subsequent word-based models. As the tradition extended its empirical scope, the role of indexical features expanded as well. Anderson (1992: 150) incorporates ‘series indices’ of the form [\pm Series II] to govern case marking in Georgian. Indices for individual lexemes are assumed in one form or another in most models, while stem indices are adopted in analyses of Priscianic and other types of stem syncretism (Aronoff 1994, Stump 2001).

In each of these cases, features or indices serve as assembly instructions that determine the choice of an element from a set of alternatives, or trigger the application of a particular rule. In languages where inflection class, series, or stem choice is not predictable from grammatical or phonological properties, encoding class membership as a separate morphological feature permits the selection of the appropriate stem or exponents. By cross-referencing cells, entries, and rules, it is possible to introduce elements of form that are underdetermined by grammatical features and a root (or stem) form. Yet the use of indexical features radically changes the nature and orientation of a morphological model. It is not clear that exponence rules remain interpretive in any meaningful sense if they can be taken to spell out class and series features and stem indices.²¹

16.3.4 The Neo-classical Model

These contrasts between traditional and modern word-based models highlight the profound ways in which the post-Bloomfieldian school had come to frame the form in which morphological questions were posed and answers were formulated. Although Robins, like Hockett (1954, 1967), had advocated a reassessment of the traditional model, none of the models proposed between the initial publication of his defence of WP in 1959 and its reprinting in 2001 attempted to formalize the exemplar-based intuition of the classical model.

Ironically, a framework for this formalization had already been developed during Bloomfield’s time, and had even attracted the early attention of Harris (1951) and Hockett (1953). The theory of information pioneered by Shannon (1948) provided all of the formal prerequisites for a modern formulation of the classical model. In

²¹ Quarantining indexical features in class indices so that they provide the context rather than the content of an exponence rule does not make any real difference as long as context and content both condition the application of the rule.

particular, the use of entropy-based measures to model implicational structure offered solutions to a number of the seemingly intractable problems associated with classical and philological formulations of this model. Many of these problems reflect idealizations that arose from the pedagogical application of the classical model. Motivating the choice of principal parts and exemplary paradigms presents one set of problems, identifying valid proportions raises another set, and even the assumption that inflectional systems can be factored into a discrete number of inflection classes is problematic in its own way. Avoiding these problems by recognizing that they derive from practical idealizations rather than core properties of the classical model leaves a conception of paradigms as structured networks of interdependent elements

It is this interdependence that can be modelled by information theory. Specifically, each cell in a paradigm can be associated with a measure of variability or UNCERTAINTY that correlates with the number of realizations of the cell (and the frequency of those alternatives). A given cell is of diagnostic value in identifying the realization of another cell (or set of cells) if knowing the realization of the first cell reduces uncertainty about the realization of the second cell (or set). These intuitions can be formalized by regarding paradigm cells as random variables that take realizations as their values. The uncertainty associated with the realization of a cell C is then defined in terms of the ENTROPY (Shannon 1948) of the cell, $H(C)$. Example (2) adapts a standard definition of entropy, in which RC represents the set of realization outcomes for C , x represents outcomes in RC , and $p(x)$ represents the probability that C is realized by x .

$$(2) H(C) = - \sum_{x \in RC} p(x) \log_2 p(x)$$

Uncertainty is reduced in a system that has fewer ‘choices,’ either few outcomes in total or else outcomes with highly skewed distributions. The cumulative uncertainty associated with a paradigm P depends in turn on the uncertainty of its cells C_1, C_2, \dots, C_n . On a traditional model, cells are generally assumed to be interdependent, so that the entropy of a paradigm, $H(P)$, will correspond to the JOINT ENTROPY of its cells, $H(C_1, C_2, \dots, C_n)$. Given a general measure of uncertainty, the diagnostic value of an individual cell can be defined in terms of uncertainty reduction. The relevant notion can be based on CONDITIONAL ENTROPY, $H(C_2|C_1)$, which measures the amount of uncertainty that remains about C_2 given knowledge of C_1 . It should be intuitively clear at this point how the traditional selection of principal parts is implicitly guided by entropy reduction. The more information that C_1 provides about C_2 , the lower $H(C_2|C_1)$ will be. A fully diagnostic cell will reduce the uncertainty of the remaining forms in its paradigm to a value approaching 0. A fully non-diagnostic cell will preserve uncertainty. Most cells will fall between these extremes, reducing uncertainty about some cells while preserving the uncertainty of others.

The brief discussion so far has adopted what might be termed a speaker-oriented or production-based perspective, in which the choice of paradigm cell is fixed and what is uncertain is the realization of the cell. Inverting this perspective yields a hearer-oriented or comprehension-based standpoint. In this case, the realization is fixed and

what is uncertain is which cell it realizes. This entropy measure is expressed in (3), in which r is a realization, C represents a cell in P , x , and $p(C)$ represents the probability that r realizes C .

$$(3) \quad H(r) = - \sum_{C \in P} p(C) \log_2 p(C)$$

The uncertainty associated with paradigms, and the uncertainty reduction attributable to knowing the cell realized by a given form are then defined as above.

Exactly the same notions of uncertainty reduction offer a means of validating proportional analogies. From either a hearer- or speaker-oriented perspective, the reliability of a proportion $a : b = c : X$ will correlate with the degree to which knowledge of a reduces uncertainty about b . In valid proportions, $H(b|a)$ will greatly reduce the uncertainty of b (whether this represents the realization of a given cell or the identification of the cell that a given form realizes), whereas in spurious proportions, the uncertainty of b will not be reduced.

This neo-classical model reflects the convergence of an implication-based tradition of morphological analysis (Wurzel 1984, Blevins 2006, Finkel and Stump 2007, Ackerman et al. 2009) with information-theoretic approaches to morphological processing (Moscoso del Prado Martín et al. 2004, Milin et al. 2009). A highly promising aspect of this approach is that it holds out the prospect of a unified model of morphological description. As Matthews (1972) notes, variation in the morphological systems of the world's languages poses acute challenges for any unified model of morphological analysis.

Finally, it has become clear at least that different languages raise quite different problems in morphological analysis. It is therefore possible that they also require quite different sorts of description. (Matthews 1972: 156)

However a more uniform description can be assigned if the classical model is reconceptualized as an instantiation of a more general 'item and pattern' grammar (Blevins to appear) that analogically extends patterns that are of predictive value in a language. In many languages, words will be the most informative items and inflectional paradigms the patterns that sanction the most reliable deductions. But in other languages, sub-word units may be of predictive value.

16.4 CONCLUSION

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There is general agreement that word structure constitutes the basic subject matter of morphology. There is, however, a fundamental split within the field concerning the nature and direction of this structure. Bloomfieldian models, with their roots in the Sanskritist tradition, take the central analytical task of morphology to involve the disassembly of words into formatives, so that word structure principally reflects

combinations of sub-word units. The other dominant model, word-based morphology, approaches morphological analysis more as a classification task, and treats the association of words with paradigms or other sets of forms as the basis of the main grammatically distinctive structure in a morphological system. From its origins as a framework for the description of classical Greek to the present, this model has remained remarkably stable and useful, and even now may offer new insights into the structure of language.