

# Why Phi?\*

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## 1. Introduction

Phi features present a rare opportunity for syntacticians, morphologists and semanticists to collaborate on a research enterprise in which all have an equal stake and which all approach with proprietary data and insights: syntacticians with intervention effects and the theory of Agree, morphologists with patterns of syncretism and hierarchies of person, definiteness and so on, and semanticists with theories of binding and anaphora and theoretical approaches to the presuppositions and entailments that  $\varphi$ -features engender.

Given  $\varphi$ -features' transmodular relevance, it is inappropriate for syntacticians, semanticists and morphologists to devise three monomodular accounts of  $\varphi$ -features in their own domains. Rather, the study of Universal Grammar must meet the concerns of all three fields with a single unified account and only an account of transmodular generality can be aptly called Phi Theory. Hence this volume's subtitle: Phi features across Modules and Interfaces.

These research concerns were guiding questions at the 2004 workshop on  $\varphi$ -features held at McGill University, Montreal. The purpose of the conference was to bring together established and researchers in the syntax, semantics and morphology of  $\varphi$ -features and to have them present recent advances of intra- and intermodular interest. The current volume derives from the presentations and discussion of the workshop.

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In this opening chapter, we situate Phi Theory in Generative Grammar, focusing on the history of  $\varphi$ -features and how recent theoretical developments have given them greater prominence.

Before doing so a word on what we mean by  $\varphi$ -features. We take  $\varphi$ -features to be those involved in predicate–argument agreement, typically person, number and gender. Other features, such as those involved in honorification and definiteness also fall within this definition, while case, for example, does not. We will refer to the class of such features as  $\Phi$  and to the individual features which make up this class as  $\varphi$ -features. As in any emerging theory, the limits of the empirical domain are not given a priori, and we expect the precise definition of  $\varphi$ -features to emerge only after much more work. This volume is merely a preliminary step in what we hope is a promising direction.

In the next sections, we trace a necessarily brief and incomplete history of attempts to tackle the development of a theory of  $\Phi$ . Because the range of relevant works is enormous, our approach will be to tease out what we see as the major themes that have led to the current situation within transformational approaches to generative grammar. Because of the historical nature of this overview, we have organized the discussion into three domains: syntax, semantics and morphology. However, the common themes that begin to emerge challenge the necessity of treating these domains of enquiry separately, a theme taken up in the papers in the volume.

## 2. Syntax

There are currently a number of areas of syntactic research in which  $\varphi$ -features play key roles: the cartographic analysis of verb movement and clitic placement, displaced agreement phenomena, the theory of case and agreement, to name a few (see references in the following subsections). However, the prominence afforded to  $\varphi$ -features in current syntactic theory is a recent phenomenon. Indeed, although agreement, as a general phenomenon, was afforded a syntactic treatment very early in Generative work, it took a long time for attention to be paid to the properties of the linguistic items that entered into agreement.

There were two major impediments to the development of a Phi Theory: lack of appreciation of the relevance of  $\Phi$  for syntactic theory in general, and lack of a robust theory of features. Syntactic concern tended to concentrate on the extent to which agreement processes could be assimilated to

general syntactic mechanisms, while the substance of what did the agreeing, the internal nature of  $\Phi$ , was largely ignored. Nevertheless, as we trace the history of topics where properties of agreement were argued to be syntactically relevant, we see that attempts to finetune the syntactic debate led naturally to efforts to articulate what the inventory of  $\varphi$ -features is and how their organization impacts on syntactic operations.

It did not take long for generative research to reach the idea that  $\Phi$ , the substance of agreement, was composed of features and that these were manipulated by the syntax. In *Syntactic Structures* (Chomsky 1957), agreement was treated as a context-sensitive transformation, converting one category into another. For English subject agreement, this took the form:

- (1) *Number Transformation* — obligatory (Chomsky 1957, p. 112)

Structural Analysis:  $X - C - Y$

$$\text{Structural Change: } C \rightarrow \left\{ \begin{array}{l} S \text{ in the Context NP}_{sing} \_ \\ \emptyset \text{ in other contexts} \\ past \text{ in any context} \end{array} \right\}$$

The idea is that the inflectional component of non-past sentences is rewritten as the morpheme *S* in the context of a singular NP, but as zero elsewhere. The notion of ‘singular NP’ is technically dealt with via an atomic symbol, although this is clearly unsatisfactory, a placeholder for further analysis. The *S* morpheme undergoes morphophonological rules to surface as the appropriate form: /s/, /z/, /ɪz/. (Clearly, more irregular alternations, *be*~*is*, *have*~*has*, will require special provision.) This structural change transformation is, in essence a rewrite rule, belonging primarily to the part of the grammar that specifies how the pronunciation of syntactic structures is effected (cf, Bobaljik, this volume).

By the time of *Aspects of the Theory of Syntax* (Chomsky 1965), however, the approach to agreement had become both featural and syntactic. Two pieces of work fed into this change of perspective. First, a fully transformational account was offered by Postal (1966). Postal suggested that a Spanish noun phrase like *unos alumnos* ‘some students’ consisting of a determiner and a head noun had the representation:

- (2)  $[_{NP} [_{Article} \textit{un}] [_{Noun} [_{Stem} \textit{alumn}] [_{Affix} [_{Gender} M] [_{Number} Pl]]]]$

A transformation then obligatorily applies to copy the nominal affix to the determiner:

- (3)  $[_{NP} [_{Article} \textbf{un} [_{Affix} [Gender\ M] [Number\ Pl]]] [_{Noun} [_{Stem} \textbf{alumn}] [_{Affix} [Gender\ M] [Number\ Pl]]]]$

This receives the appropriate spellout after the morphophonological rules have applied:

- (4)  $[_{NP} [_{Article} \textbf{un} [_{Affix} [o] s]] [_{Noun} [_{Stem} \textbf{alumn}] [_{Affix} [o] s]]] = \textbf{unos alumnos}$

Second, Harman (1963) had begun to exploit in the syntax the descriptive power afforded by symbols that were internally complex. Chomsky (1965) combined these approaches by positing an N node that branches into a feature matrix containing various features, such as gender, number, case:

- (5)  $Article \rightarrow \begin{bmatrix} \alpha \text{ gender} \\ \beta \text{ number} \\ \gamma \text{ case} \end{bmatrix} / \text{---} \dots \begin{bmatrix} +N \\ \alpha \text{ gender} \\ \beta \text{ number} \\ \gamma \text{ case} \end{bmatrix}, \text{ where } [Article \dots N] \text{ is an NP}$

This rule assigns the features of the noun to the article, effectively restating Postal's analysis with features rather than morphemes. Such feature matrices could then be matched with lexical items. The structure of these features was modeled along the lines of the structure of phonological features, as motivated by Halle in a number of publications following work by Jakobson (Halle 1962, Jakobson, Fant, and Halle 1963).

This approach places  $\varphi$ -features squarely in the syntax: they undergo syntactic operations triggered by their positioning in syntactic structures. However, the goal in *Aspects* was to provide an account for the phenomenon of agreement generally. There was no interest in developing a theory of the individual components of agreement.

Following *Aspects*, little more attention was paid to the development of a theory of  $\Phi$ . In fact, as Gazdar, Klein, Pullum, and Sag (1985, p. 18) observe:

But [after *Aspects of the Theory of Syntax*], development in the theory of syntactic features basically stopped. Although generative grammarians continued to assume features in their descriptive apparatus, hardly any generative grammarians attempted to give syntactic features the kind of well-defined formal underpinnings that, say, the

theory of phrase structure rewriting rules had. George Lakoff's 1965 dissertation (published as Lakoff 1970) was an honorable exception, but it influenced the field more toward the development of abstract deep structures and complex transformational derivations than toward appropriate exploitation of features in phrase structure description, despite the rich proposals for feature analysis that it presented.

They conclude that "the theory of features fell gradually into a state of chaos."

For their own part, during the 1980s, Gazdar, Klein, Pullum and Sag did provide a theory of features in Generalized Phrase Structure Grammar in the context of which a theory of  $\varphi$ -features could have been developed. However, the  $\varphi$ -features that they themselves posited merely recapitulated the traditional descriptive labels (e.g.  $\langle PLU, +/ - \rangle$  for plural~non-plural,  $\langle PER, 1/2/3 \rangle$  for first~second~third person) and so did not provide any deep insight into  $\Phi$  itself. The same tendency held sway in the Government and Binding tradition (e.g., Lumsden 1987) and in Lexical Functional Grammar (Bresnan 1982).

However, if the field was in chaos with respect to its views of features, the chaos was neither total, nor uncreative. Notably, Muysken and van Riemsdijk (1986, p. vii) observed:

Syntactic features have played a somewhat marginal role in the development of the theory of grammar over the past fifteen or twenty years. Even basic questions such as 'how many are there?', 'what are they?', 'how do they distribute over syntactic structures?' were hardly addressed, let alone answered. Nevertheless, it is clear that syntactic features do play an important role in syntax. Few, if any, grammarians today hold, that syntactic categories are unanalyzable atomic primitives, and any additional intrinsic properties of syntactic categories are expressed in the form of features. It would appear to be high time, therefore, to examine the theory of syntactic features in a more systematic way.

Moreover, Muysken and van Riemsdijk recognized  $\Phi$  as a potential source of enlightenment in this domain. Indeed, of the several strands of research that were eventually to place  $\varphi$ -features in a prominent position in syntactic theory, they recognized two: the notion of rich agreement (Taraldsen 1980, Rizzi 1982), and hierarchies of case marking (Silverstein 1986). They also drew attention to another work of this period, that was eventually to have major influence (Hale 1973;

see Morphology below.)

In the twenty years since Muysken and van Riemsdijk's volume, four major strands of syntactic research have conspired to place  $\varphi$ -features in a position of prominence. The first and second—work on the pro-drop parameter and, then, later, on height of verb movement—led to a concept of 'rich agreement', the eventual explication of which has led naturally into questions about the nature of  $\Phi$ . Third, the role of case in argument licensing has inspired research into the mechanisms of case and agreement. This, in turn, has led to notions of  $\varphi$ -completeness versus  $\varphi$ -defectiveness, notions that can only be fully justified in the context of an explicit Phi Theory. Fourth, the Person Case Constraint—the impossibility of the certain  $\varphi$ -feature combinations in multiple agreement/clitic systems—has recently received much attention as attempts are made to reduce it to other syntactic phenomena. In the subsections that follow, we review these developments and highlight key contributions, conjectures and results.

## **2.1. Rich Agreement**

The importance of rich agreement was first noted in regard to pro-drop (Taraldsen 1980). Essentially, in languages, like Italian and Greek, where the verb reveals the person and number of the subject, pro-drop is possible; in languages where it only partially reveals it, such as German and English, it is not. The descriptive generalization is that when agreement is 'rich', it licenses a null subject.

The internal richness of Agr, that is, how much information is specified in Agr, became crucial to later analyses of subject pro-drop (Rizzi 1982), and of the generalized pro-drop found in polysynthetic languages (Jelinek 1984). Curiously, however, little attention was paid to what the featural composition of Agr actually was and how it related to the intuitive notion of rich agreement.

However, following Emonds (1978) and then, especially, Pollock (1989), it was noted that rich agreement potentially correlated with height of verb movement: for instance, Romance finite verbs, which show rich agreement, move higher than both English finite verbs and Romance participles, which agree less fully. The idea was thoroughly explored for a wide variety of Germanic languages (beginning with a series of works by Holmberg and Platzack, e.g., 1989). This led

to attempts to show two things: on the synchronic side, that Germanic languages that had retained verb movement possessed correspondingly richer subject agreement (see, especially, Rohrbacher 1994); on the diachronic side, that the decline of subject agreement and verb movement proceeded in tandem (e.g., Roberts 1985). This work ultimately failed to shed light on the nature of  $\varphi$ -features per se, though, for two reasons. First, the biconditional correlation between rich agreement and verb movement proved to be too strong (see Bobaljik 2003 for thorough overview and formulation of a weaker generalization). Second, it focused on the paradigm, rather than the  $\varphi$ -features that generate paradigms, as the basic explanatory unit in terms of which richness was to be explicated. Despite these failings, the research program did succeed in placing  $\Phi$ -related morphosyntax center stage.

In addition, the research programme stemming from Pollock's work, which used the different landing positions of verbs in French and English to argue for a splitting of I(NFL) into separate tense and agreement projections, progressed to more finegrained decompositions. For instance, Shlonsky (1989) argued, on the basis of Modern Hebrew (morpho)syntax, for separate PersonP, NumberP, and GenderP (see Linn and Rosen 2003 for similar arguments based on Eucree); and Poletto (2000) argued, on the basis of the distribution of subject clitics in Northern Italian dialects, for a structure that splits the person features into separate projections:

- (6)  $[_{NegP} [_{NumP} SCL [_{HearerP} SCL [_{SpeakerP} V [_{TP} \dots ]]$  (Poletto 2000, p. 31)

Here we see the connection between syntactic position and richness of agreement captured by projecting  $\varphi$ -features as parts of the basic clausal backbone.

Another vein of research where  $\varphi$ -features are claimed to have a presence in the extended projection of the clause involves the fine structure of the left periphery (Rizzi 1997): like IP, CP has come to be decomposed into several different projections and some researchers have argued for relationships between these and various  $\Phi$ -categories. The general viewpoint taken is that person-like features are represented on high C-domain heads that encode whether sources of knowledge, opinion or belief are shared between the speaker and other discourse participants. This idea has been used to capture a wide range of data, from evidentiality and logophors (Speas 2004, Tsoulas and Kural 1999) to long-distance binding (Sigurðsson 2004) and person hierarchies (Bianchi 2006).

## 2.2. Agreement and Case

We can see the general approach to the connection between  $\varphi$ -features and case licensing emerge in *Lectures on Government and Binding* (Chomsky 1981), which influenced much work afterwards. There, what was important once again, however, was the feature bundle Agr, which was implicated in theories of case and government. Agr was assumed to work as a single syntactic unit, just as in the original approaches to the role of rich Agr in licensing null subjects discussed directly above.

This approach to Case and syntactic licensing allowed a fairly successful implementation of an important generalisation connecting Case and  $\varphi$ -features: overt subjects with nominative case are restricted to clauses specified with tense and agreement features (that is, finite clauses).

Within the Government and Binding framework, this idea was captured by the following kind of specification (see Chomsky 1981):

- (7)  $I_{[+tense +Agr]}$  assigns nominative case to its specifier

Note that Agr is itself taken to be a feature here. The plus value may be taken as suggesting a specification of  $\varphi$ -features, though none in particular are mentioned.

This proposal now extends naturally to a potential challenge for the original generalization which is raised by languages like European Portuguese, where a nominative subject is, in fact, possible in an infinitive just when the infinitive is inflected for agreement (see Raposo 1987 for Portuguese, and George and Kornfilt 1981 for similar data from Turkish inflected gerunds):

- (8) É correto nós ignor-ar-mos isto.  
Is right us-NOM ignore-INF-1PL this  
'It is right for us to ignore this.'

We can capture the data by assuming that the following holds universally:

- (9)  $[+Agr]$  assigns nominative case to its specifier

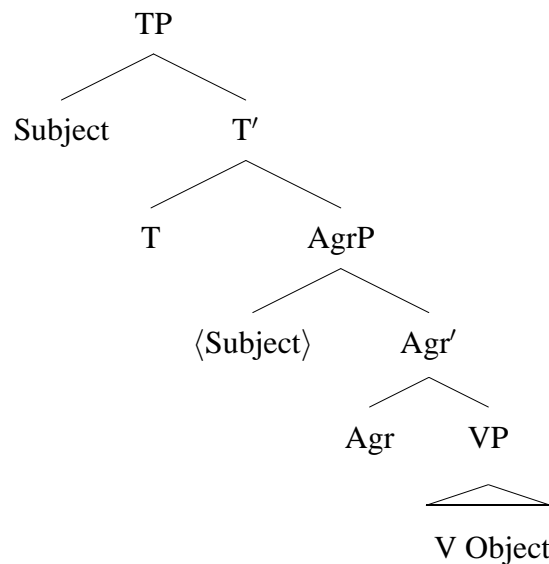
Other analyses treating Agr itself as a feature are Haegeman's (1986) treatment of West Flemish subject licensing, and, later, Rizzi's (1990) theory of wh-movement, where it was used to explain the possibility of subject extraction after certain complementizers. Throughout this period, no attempt was made to explain the features that comprised Agr or to explicate the notion of rich Agr,



[+Agr], in terms of a given inventory of  $\varphi$ -features. As discussed in section 2.1, it was not until the work of Platzack and Holmberg (1989) and Rohrbacher (1994), that there was an attempt to explicate the meaning of [+AGR] in terms of properties of the agreeing verbs: essentially, in terms of how many of a language's pronominal categories corresponded to unique agreement affixes (see also Vikner 1995).

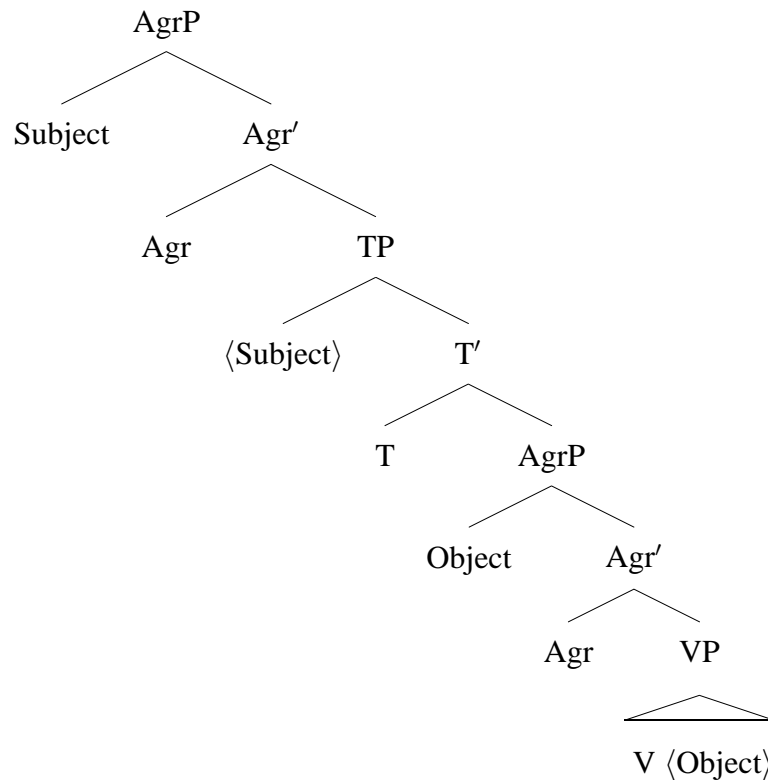
As previously mentioned, Pollock (1989) argued that apparently atomic syntactic categories should be split into their constituent features. Moreover, these features themselves should project as heads which could act as landing sites for verb movement, giving the following clause structure:

(10)



Belletti (1990), on the basis of pursuing a transparent relationship between the internal morphological structure of words, and the syntactic structure of clauses (the Mirror Principle of Baker 1988), suggested that AgrP selects TP rather than the structure in (10), while Chomsky (1989) suggested that there were two AgrPs, one below T, which is associated with object agreement, and one above, associated with subject agreement:

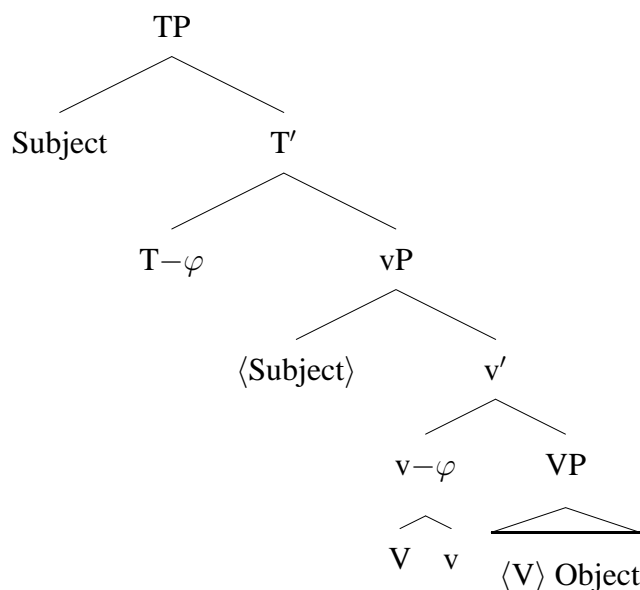
(11)



This enriched system now allowed a more general approach to case assignment, and Chomsky (1993) proposed that structural Case in general is checked in the specifier of Agr heads. Each Agr acted as a ‘mediator’ for the case features of the heads of the phrases they selected (TP and VP). Structural Case checking can then be seen as arising from an agreement relation.

However, there were a number of conceptual arguments against the projection of Agr heads in clause structure. In *The Minimalist Program*, Chomsky (1995, chapter 4) argued that heads which project without semantic effects, such as Agr, should be dispensed with. His alternative suggestion for maintaining the link between  $\varphi$ -features and Case comes from investigations into the syntax of argument structure (especially Hale and Keyser 1993). He proposes that subjects are introduced by a functional head,  $v$  (Chomsky 1995, p. 315 and references therein; see also Kratzer 1996 among many others). This head can be endowed with  $\varphi$ -features and hence accusative case checking capabilities. Similarly, T is endowed with  $\varphi$ -features that Case license the subject, which itself moves to T’s specifier:

(12)



In more recent versions of the minimalist program, Chomsky (2001) has maintained the intuitive link between agreement and structural Case checking, however, he has made proposals for  $\varphi$ -features themselves. Specifically, person and number features play distinct roles in structural Case checking: when one is absent from a head, the head is defective and Case checking is impossible (this is how he analyses the non-finite T of raising constructions).

The idea that the separate features that make up  $\Phi$  act independently in the syntax has been developed in analyses of complex agreement phenomena. These analyses differ from the work discussed above in that their focus is not the connection between Case and agreement, but a general theory of the syntactic dependencies established by the operation Agree (Chomsky 2000). An example of such work is Béjar (2004), which investigates the classical problem of Georgian agreement, where the controller of agreement on the verb is not determined by syntactic position or grammatical function, but rather by  $\varphi$ -featural richness. Béjar concentrates on examples which show that person agreement on a verb can arise from one argument whereas number agreement comes from another. For example, in (13), the second person singular object triggers person agreement and the first person plural subject triggers number agreement:

- (13)    g-    k'lav-t  
          2SG-kill- PL  
          'We kill you (singular)'

(Hewitt 1995, p. 132)

This kind of agreement has been treated morphologically in the past (Anderson 1992, Halle and Marantz 1993). Béjar argues that a more satisfying explanation is available when one allows the features within one  $\Phi$ -set to establish disjoint Agree relations separately in the syntax, and she extends this basic idea to a general analysis of what she terms ‘agreement displacement phenomena’ (see also Řezáč 2003, and for earlier ideas along the same lines Ritter 1995 and Taraldsen 1995).

### 2.3. Person Case Constraint

The theories of Case and agreement come together in a single grammatical phenomenon that has proved to be a very productive domain of application and refinement of the theory of  $\varphi$ -features in recent years: the Person Case Constraint.

Perlmutter (1971) observed an intriguing restriction on the combination of dative and accusative clitics in Spanish: the accusative in such a situation must be 3rd person. This constraint is known in the literature as the *\*me lui* Constraint, or Person-Case Constraint. We give here an example from French (see Anagnostopoulou 2003 and Haspelmath 2004 for many other cases):

- (14) a. Agnès me la présentera.  
 Agnès 1SG 3SG.F present.FUT.3SG  
 ‘Agnès will introduce her to me.’  
 b. \*Agnès me lui présentera.  
 Agnès 1SG 3SG.F present.FUT.3SG  
 ‘Agnès will introduce me to her.’  
 c. Agnès me présentera à elle.  
 Agnès 1SG present.FUT.3SG to her  
 ‘Agnès will introduce me to her.’

(14a) shows that dative and accusative clitics may cooccur. However, such combinations are only licit if the accusative is third person, hence the contrast between (14a) and (14b). In French, such argument combinations can only be expressed periphrastically, as in (14c).

Bonet (1991) gives a tentative approach to this phenomenon (developed more fully in Bonet 1994) which uses a filter that blocks the morphological realization of non-third person accusatives in the presence of dative clitics. However, more recently, there have appeared a range of syntactic analyses of the PCC, which crucially appeal to the various  $\varphi$ -features that make up agreement. These approaches have attempted to connect the PCC to various other phenomena. For example,

Boeckx (2000) and Anagnostopoulou (2003) have proposed that it is connected to the restrictions on the appearance of first and second person nominative objects in Icelandic; Richards (2005) connects it with cross-clausal extraction in Tagalog; Bianchi (2006) connects it to the kind of inverse agreement systems found in languages like Plains Cree and Bobaljik and Branigan (2006) connect PCC effects to the Spurious Anti-Passive construction found in Chukchi in configurations that are reminiscent of inverse agreement; Ormazabal and Romero (2002) draw a connection to animacy on the basis of *leísta* dialects of Spanish and Adger and Harbour (2005), in a somewhat related vein, have connected it with patterns of case syncretism across different languages. Finally, Nevins (2005a), applying, in the syntax, ideas from phonological feature formalisms, comes the closest of any researcher to tackling the full typological variety of the PCC reviewed by Haspelmath in his (2004) crosslinguistic survey of the phenomenon.

There is an interesting parallel here with the Georgian agreement effects discussed above: what was once thought to be a paradigm case of a morphological phenomenon can be understood syntactically when we pay attention to the behaviour of the components of  $\Phi$  (see especially Béjar and Řezáč 2004 for the impact of the PCC on the theory of Agree).

The research displays an exciting lack of consensus, even if some themes are clear: feature structure—whether in terms of competition, or the behaviour of Agree, or the specification of arguments—lies at the heart of these analyses. The sub- $\Phi$ -structure is crucially implicated in all of these analyses and so a well articulated theory of  $\varphi$ -features is crucial for such work.

### 3. Semantics

Although Phi Theory may have taken a time to come into its own in syntax, related issues have enjoyed long attention in semantics. These begin in the philosophico-semantic tradition, in which philosophers aimed to supplement the Fregean and Tarskian theories of formalized languages (Frege 1879, Tarski 1935) for the analysis of natural language (beginning with Frege 1892 and Russell 1905 and leading to the important work of Davidson 1967, Montague 1970, 1973, Lewis 1972, which attempted to connect contemporary philosophical semantics with grammatical theory). Key amongst the requisite additions relevant here were notions of indexicality and presuppositionality, and mechanisms for the representation of quantities. We address each of these below.

### 3.1. Indexicality and Presuppositionality

The category of person was an early focus of research in the philosophy of language. It arose naturally in two regards: first, indexicals (Jespersen's 'shifters') were an obvious domain that was not embraced by semantic theories designed for the elucidation of mathematics; second, the interest in the logical properties of proper names led naturally to attempts to deal with the semantics of pronouns and deictics (e.g., Russell 1940). The most influential work in the philosophical tradition is that of Kaplan. Kaplan (1977/1989) formulated the thesis that indexicals are directly referential, entailing that their semantic value is fixed purely by the context of the speech act and cannot be acted on by logical operators. Recently, a variety of evidence has called this view into question. Schlenker (2003), for instance (see also von Stechow 2003, Anand and Nevins 2004), has argued against the Kaplanian view on the basis of Amharic sentences such as (15), which can be used to describe John's saying of himself 'I am a hero':

- (15)    ስን ስንግና ነፅ-ኸኸ        ሃለ-ላለ  
         John hero   be.PF-1SO 3M.say-AUX.3M  
         'John says that he is a hero' (Schlenker 2003, p. 68)

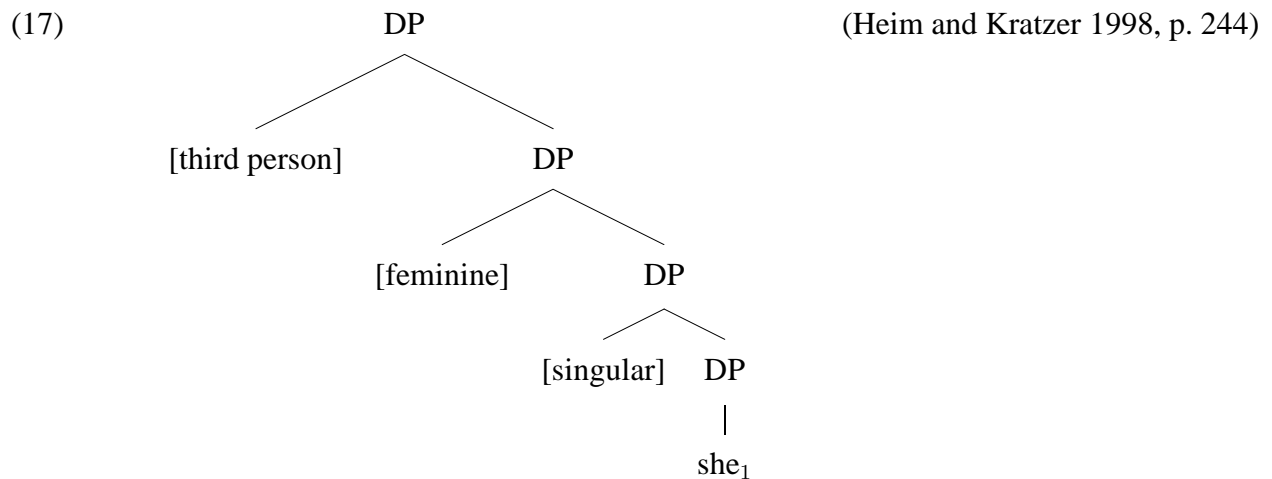
Schlenker demonstrates that the embedded clause in Amharic is not a quotation. This shows, straightforwardly, that the semantic value of 'I' is not fixed by the context of utterance, as 'I' refers to John, not to whoever utters (15).

Schlenker's own treatment of the semantics of person pursues an idea first developed by Cooper (1983) with respect to gender, namely, that it is presuppositional. To see the intuition, consider the following dialogue:

- (16)    'Tell me about Alex.'  
         'Evidently she's married: you can see the wedding ring in this photo of her hand.'

If the first speaker knows that Alex is a man, it would be impossible to attempt to correct the second speaker by saying 'No, she isn't married'; this would be taken as accepting that Alex is a woman and disagreeing about his/her marital status. So, Alex's gender does not form part of the assertion in 'She's married', but rather is a presupposition. This accords with the intuition that 'She's married', said of a husband, is not false, but infelicitous.

An influential implementation of this idea, which pursues Tarski’s intuition that reference arises via an assignment of values to variables, is Heim and Kratzer (1998). They propose that  $\varphi$ -features are syntactically adjoined to pronominals and that their semantic contribution is a presupposition that restricts the range of the assignment of values to variables. For instance, the structure of the pronoun *she*, say, is:



The features are partial identity functions (indicated by the colon in (18)). That is, [feminine] maps individuals to themselves (an identity function), subject to the proviso that the individual is female; it is undefined otherwise (hence, a partial function).

$$(18) \quad \llbracket \text{feminine} \rrbracket = \lambda x : x \text{ is female} . x$$

Applying this to ‘She is married’, we have that the lower nodes of the DP are assigned to Alex, however, when we move up the tree to [feminine], the partial function fails to return a value as Alex is not female.

Schlenker applies this kind of approach to person features too. He proposes a meaning for the first person feature so that it is only defined when the pronoun bearing the feature refers to a group which includes the speaker who utters the sentence in the context, and a similar meaning for the second person feature. He then proposes that third person pronouns are essentially chosen as semantic defaults (see also Sauerland, this volume).

However, an interesting semantic problem arises on the presuppositional approach to person and gender features, with respect to bound variable readings of personal pronouns. Consider the

following example, where gender is relevant: in a coed class, where the only person to have done the assigned homework is Mary, one can say:

(19) Only Mary has done her homework.

The important fact about such uses of personal pronouns (first noted by Partee 1989 with respect to the first person) is that they can break free of their presuppositions: (19) means, informally, ‘Look at the set of people who have done their homework: only Mary is in that set’. So, the pronoun ‘her’ does not constrain the statement to hold only of females, contrary to what one would expect given (18). Elements of this debate have thrown light on the complex interplay between semantic, syntactic, and morphological aspects of  $\varphi$ -features (see, for instance, Déchaine and Wiltschko 2002 and Rullman 2004). Several aspects of the debate are discussed by Heim (this volume).

In addition to person and gender, another  $\varphi$ -category, number, has been a productive area of philosophical investigation (e.g., Goodman and Quine 1947, Quine 1960). Given that philosophical semantics has its origins in the foundations of mathematics, set theory is, unsurprisingly, frequently used to represent notions of singularity and plurality. An influential version of this is the lattice-theoretic treatment of plurals (Link 1983). The concepts this work introduced have been deployed in the treatment of plurality, masshood, distributivity, collectivity, and a wide range of aspectual phenomena (Krifka 1992, Verkuyl 1993, Schein 1993, Lasnik 1995, Landman 1996, Doetjes 1997, Chierchia 1998, Ojeda 1998, Winter 2001, amongst others). Interestingly, in contrast to person and gender, no presuppositional account of number has, to our knowledge, been offered (though Heim and Kratzer 1998, p. 245 suggest the possibility). It may be (Nevins, p.c.) that, if definiteness were incorporated more fully into the treatment of  $\Phi$ , it would be possible to attribute all presuppositionality effects to definiteness and to simplify the representation of person and gender. The non-presuppositional treatment of number would then be the norm for other  $\Phi$ -categories. For steps in this direction, see Kratzer (2006).

### 3.2. Agreement: syntactic or semantic?

We have seen that person, number and gender can be treated as presupposition inducing features. However, gender is of two types: semantically contentful and purely grammatical. An obvious issue for the presuppositional approach is whether grammatical gender is amenable to a purely



semantic approach.

For example, in German, *Mädchen* ‘girl’ is grammatically neuter, as can be seen from the form of the relative pronoun that it controls:

- (20) *das* Mädchen, *das*/\**die* das Buch ließt  
the.NEUT girl that.NEUT/that.FEM the book read.PRES  
‘the girl who reads the book’

The relative pronoun is obligatorily neuter, agreeing with the noun and article. The feminine relative pronoun, required in an example with a grammatically feminine noun such as (21) below, is impossible.

- (21) *die* Frau, *die*/\**das* das Buch ließt  
the.FEM woman that.FEM/that.NEUT the book read.PRES  
‘the woman who reads the book’

However, if the girl is referenced by a pronoun, the feminine, rather than the neuter, is used:

- (22) Das Mädchen sagt, daß sie/\*es das Buch ließt.  
the.NEUT girl say.PRES that she.FEM/it.NEUT the book read.PRES  
‘The girl says that she is reading the book.’

On the assumption that the pronoun’s function is the semantic one of picking out a referent, these examples appear to show that the neuter agreement that *Mädchen* ‘girl’ triggers is sensitive to a syntactic rather than a semantic feature.

Dowty and Jacobson (1988), however, argue against this idea, as part of a general program to minimize the contribution of syntax, and suggest instead that agreement should be treated as an essentially semantic phenomenon. Pollard and Sag (1994) provide evidence for this approach on the basis of a range of phenomena where simple feature matching in the syntax would give the wrong results. A striking case of this is reference transfer of the following sort (a modification of Nunberg’s 1979 *ham sandwich* example):

- (23) The hash browns at table six is/\*are getting angry.  
‘The person at table six, who ordered the hash browns, is getting angry’

Here the agreement on the verb seems to be with the referent of the subject, the person who ordered

the hash browns, rather than with the syntactic specification of *the hash browns*. Collective nouns in British English provide further evidence that differences in number agreement correlate with differences in interpretation:

(24) The committee has/have voted today.

For such dialects, the agreement on the auxiliary correlates with interpretational effects on the subject, independent of singular number marking on the noun. Sauerland and Elbourne (2002) note a number of other semantic phenomena affected by this kind of agreement.

The theoretical point made by Dowty and Jacobson is that verbal agreement features can contribute to semantic interpretation. This constitutes a *prima facie* difficulty for the syntactic approach to agreement outlined above, where agreement on the verb is supposed to lack semantic content.

## 4. Morphology

### 4.1. Precursors

Morphology is a natural place to look for a theory of the internal featural constitution of  $\varphi$ -structures. To see why, consider the Tok Pisin pronoun paradigm (Foley 1986, p. 67):

(25)

Person	Singular	Dual	Plural
1IN	—	yumitupela	yumipela
1EX	mi	mitupela	mipela
2	yu	yutupela	yupela

Observe that the meaning/pronunciation of the first person inclusive is the sum of the meaning and pronunciation of its parts: *yumi*... means *yu* and *mi*. This suggests that first person inclusive, first person exclusive and second person are not *sui generis*, but are composed of more fundamental features. The same conclusion—that traditional categories of description are composites of features—is underlined by number in (25). Observe that the dual, *tupela*, is the plural, *pela*, plus something else. Thus, these numbers share part of their meaning, non-singularity, and part of their sound, *pela*.

The phenomenon of syncretism, as discussed by Hale (1973, see also Halle 1997), reveals the same fact about duals and plurals. In Warlpiri, in certain contexts, plural agreement occurs where, on purely semantic grounds, we would expect dual; call these \*DL-contexts. Hale accounts for this by supposing that dual is a composite [a b], where [a] means simply non-singular (cf., Tok Pisin *pela*) and [b] restricts the non-singularity to duality (cf., Tok Pisin *tu*). What is special about \*DL-contexts is that [b] is deleted, making dual [a b] identical with plural [a].

Thus, we see that core morphological phenomena lead quickly to a set of research questions for which the development of a theory of  $\varphi$ -features is necessary. It is, therefore, surprising to discover that  $\varphi$ -features are all but wholly absent from such volumes as *Theoretical Morphology* (Hammond and Noonan 1988) and *The Handbook of Morphology* (Spencer and Zwicky 1998). However, on closer inspection, there are legitimate reasons for this absence. As Spencer and Zwicky observe, morphology was neglected in deference to syntax and phonology in early developments of generative grammar (as we have indicated above, agreement was treated as the result of a rewrite rule or syntactic transformation); only with Halle's (1973) programmatic statement for a generative theory of morphology, did interest begin to center on morphology as research domain in its own right. The Lexicalist interpretation of Chomsky (1970) gave this extra life as the debate about morphology could be cast as in terms of the division of labor between the lexicon and syntax (see Borer 1998 for overview.) To the extent that the nature of inflection was studied at this time, it was as a means of examining how labor was shared between modules of the grammar. For instance, Anderson (1982) uses agreement in Breton verbs and prepositions to argue that agreement is syntactically autonomous and subject to syntactic processes; it is only due to such processes that the agreement comes to be incorporated into the word of which it ultimately forms part. As such, agreement phenomena were counterexamples to the generalized Lexicalist hypothesis. However, in this context, the internal constituency of  $\varphi$ -structures were not overly of interest.

Nonetheless, two major precursors to a theory of  $\varphi$ -features did emerge at this time, namely, the abovementioned Hale (1973) and Silverstein (1986). Both of these works present articulated inventories of  $\varphi$ -features which go beyond the mere 'featurization' of traditional grammatical categories, but give thought to what minimal set of features will generate all of the attested categories. In particular, both authors stress the idea that person categories, like the first person inclusive, and number categories, like the dual, are not features in their own right (e.g., [+inclusive] or [+dual]),

but are composites of features (in Silverstein’s system, [+ego +tu] and [+plural +restricted]).

Hale’s work has been particularly influential for several reasons. He presented analyses of data types that have since become mainstays for the field. For instance, the 1973 paper treats syncretism between morphological categories in a way that prefigures the impoverishment analysis of Bonet (1991) and later authors. Similarly, Hale (1997), versions of which had been in circulation several years earlier, introduced the notion of composed number and emphasized its relevance as an alternative demonstration of the fact that the dual is not a feature in its own right, but an overlap of the feature specification of singular and plural.

- (26) a. Pam **wari**.  
           that run.PERF  
           ‘He/she ran.’
- b. **Puma wari**.  
           those run.PERF  
           ‘They (two) ran.’
- c. **Puma yùutu**.  
           those run.PERF  
           ‘They (plural) ran.’
- (Hale 1997, p. 74)

Hale’s work has been incorporated into key studies of  $\Phi$ -structure, especially, Bonet (1991) and Noyer (1992), and into work on morphology in general, most notably, Halle and Marantz (1993) and Halle (1997).

## 4.2. The composition of $\Phi$

In morphology, the onset of Phi Theory proper must be attributed to the two works by Bonet and Noyer just cited. In these, the authors were concerned issues of what  $\varphi$ -features there are, how they are structured, what operations the morphology can perform on them, and how such operations are constrained.

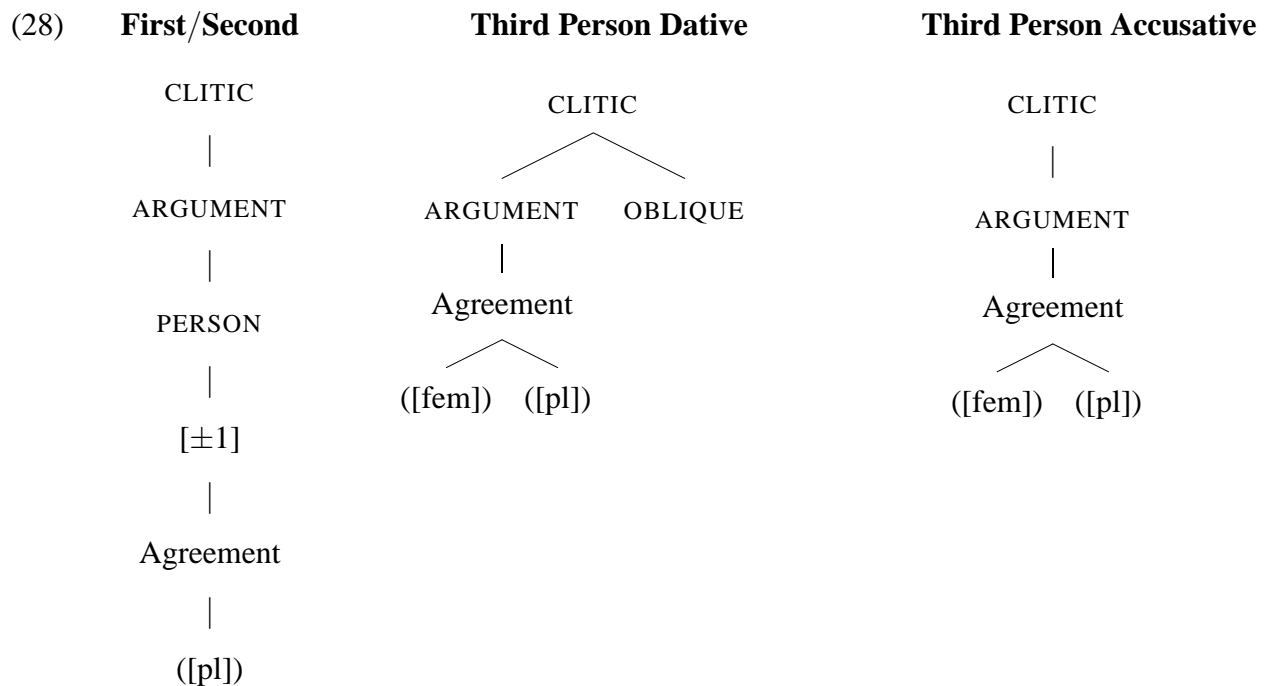
Bonet’s investigation (see also Bonet 1995) was motivated, in large part, by an attempt to account for non-transparent surface outputs in clitic combinations, a topic that (*pace* Hale 1973) had ‘hardly received any attention’ (Bonet 1991, p. 10). A classic case of this phenomenon concerns the combination, in Spanish, of the third person masculine singular clitics for indirect and direct objects, respectively, *le* and *lo*. When the context demands that the clitics cooccur, they surface,

not as *le lo*, but as *se lo*. Perlmutter (1971), who first drew attention to the phenomenon in the Generative context, posited what was, essentially, a phonological rewrite rule:

$$(27) \quad \begin{bmatrix} \text{PRO} \\ \text{III} \\ \text{Dat.} \end{bmatrix} \quad \begin{bmatrix} \text{PRO} \\ \text{III} \\ \text{Acc.} \end{bmatrix} \quad \rightarrow \quad se, 2$$

As Bonet observes, an equally legitimate rule, on this approach, would introduce the syllable *ba* instead of *se*; it is coincidental that what emerges when *le* is prevented from surfacing is another clitic, the reflexive *se*, rather than any other phonological string. The issue, then, that Bonet investigates is how the  $\varphi$ -structure of *le* is transformed into that of *se*.

Bonet's theory involves several notions that have been key to later developments of morphological Phi Theory. First, she adopts (p. 58) a hierarchical organization of  $\varphi$ -features:



Here, the ‘defining properties of the clitics’ are in small capitals, the agreement features themselves, in lowercase. (Bonet is ambivalent as to whether the geometrical feature structure, an idea she attributes to Marantz, constitutes morphological structure in its own right—whether syntax deals in feature bundles that are mapped onto geometrical structures in the morphology—or

whether the geometries are simply syntactic structures ‘pruned’ of extraneous information.)

The feature structures in (28) serve to constrain morphological operations and to define metrics of markedness and defaultness. Basically, the more structure, and so features, a  $\varphi$ -set contains, the more marked it is. Bonet accounted for the *le lo*  $\rightarrow$  *se lo* neutralization by supposing that morphology can delink lower parts of the structure. In particular, given that the structure for *se* is a substructure of that for *le*, delinking the lower part of the *le* structure reveals the *se* structure, explaining why *le* becomes *se*, rather than any other syllable of the language.

Noyer (1992), like Bonet, was concerned with the organization of  $\varphi$ -features and operations on them (see also Noyer 1998). In particular, he proposed the process of Fission, whereby a single syntactic terminal node is split into separate positions for multiple phonological strings (see Harbour, this volume, for an overview of the account). However, he also resumed another theme of research, from Hale and Silverstein, namely, the inventory of  $\varphi$ -features. Investigating a wide variety of languages, some of them in great depth and with great insight, he arrived at two number features [ $\pm$ singular] and [ $\pm$ augmented], and three person features, [ $\pm$ author], [ $\pm$ hearer], and [ $\pm$ participant]. Moreover, Noyer showed that languages do not all use every one of the features in their person/number inventories. For instance, a language with singular, dual and plural, such as Kiowa (Harbour 2006a), uses both number features; a language with just singular and plural, such as Mam (England 1983), uses only [ $\pm$ singular]; and a language with a dual-plural distinction in first person inclusive, and a singular-plural distinction in all other persons, such as Ilocano, uses just [ $\pm$ augmented].

Since Noyer’s work, more extensive typological research has been undertaken with regard both to person and to number (Corbett 2000, Cysouw 2003, Siewierska 2004). And so, it remains to be seen whether Noyer’s inventory of features naturally extends to the cases that he did not directly consider.

Not only did Noyer present detailed arguments for the quantity and definitions of his features, but he even argued for the necessity of their bivalence. He did this primarily by appeal to  $\alpha$ -rules, that is, to rules that switch the values of particular features, or that are triggered when pairs of features have opposing values. Most notably, he argued for the bivalence by motivating  $\alpha$ -rules in the treatment of person in Mam and number in Kiowa-Tanoan. This issue has been taken up since by Harley (1994), McGinnis (2005), Harbour (2005), amongst others. The significance of

$\varphi$ -feature valence extends beyond morphology: Béjar's syntactic treatment of Georgian agreement discussed above crucially relies on the absence of a feature rather than its negative specification; bivalence permits a three-way distinction between assertion, negation and absence of a property, that is not replicable with privativity, consequently, the two feature notations can be semantically distinguished.

So long as number features were assumed to be [singular], [dual], [trial], and so on, that is, mere 'featuralization' of traditional descriptive labels, their definition attracted little attention from, and paid little heed to, semantics. A plausible reason for this is that both morphologists and semanticists may have taken semantic methods to be overly complex for the treatment of such apparently simple notions as 'one', 'two', 'three'. Such overlap in interest as there was came in the domains of collectives and distributives (e.g., Ojeda 1998 and Corbett 2000) and in pluralities of events (e.g., Lasnik 1995 and Mithun 1988). However, as work like Noyer's moves morphological definitions of number away from the obvious and into the abstract, questions begin to arise concerning the semantic nature of these definitions: are they exclusive to morphology, or are they shared with other semantic systems?

Developing Noyer's system, Harbour (2006a) has demonstrated that the primitives that morphologists require in the treatment of complex agreement syncretisms are the same as those semanticists require in the representation of collectivity, distributivity and basic cardinality (singular, dual, plural). Subsequent investigation (Harbour 2006b, 2006c), building also on semantic work by Krifka (1992), has shown that the formal notions developed in the treatment of aspect are almost exactly the feature definitions required to generate the number systems attested across the world, including even the rarest, incorporating, for instance, unit augmented, or trial, or greater and lesser paucal.

## 5. Markedness

Markedness has been a major theme in  $\varphi$ -theory; not only was it addressed by many of the authors mentioned already above (Bonet, Harley, Noyer, Ritter, Silverstein), but it goes back to the earliest work on features by Jakobson and Trubetskoy (Haspelmath 2006 for an overview), and has become a focus of some debate since (e.g. Cowper 2005, Nevins 2005b, Sauerland, this volume).

Morphologically, one can distinguish ‘formal’ and ‘functional’ markedness (Dixon 1994). Formal markedness concerns, quite simply, whether a form is overtly marked. For instance, for English nouns, the singular is unmarked, the plural marked: compare singular *book* with plural *books*. Functional markedness concerns which of a group of grammatical categories is distinguished from the others. For example, within the English pronominal system, nominative and genitive appear only in specialized contexts, while accusative is unmarked, being used for, amongst other things, direct objects, indirect objects, predicates (*It’s me*), subjects of gerunds and Jespersen’s (1924) ‘nexus of deprecation’ (*Me dance?*).

There is frequent coincidence between formal and functional markedness. The third person is a well known instance. Silverstein (1986, p. 173) observes a number of pronominalization phenomena in which, although no person is intended, third person forms are used. He concludes that third person is functionally unmarked, whereas first and second are marked. Benveniste, on the other hand, in an often alluded to passage, observes that third person is often formally unmarked:

Certain languages show that “third person” is indeed literally a “non-person”. To take just one example among many, here is how the possessive pronominal prefixes are presented in two series (something like inalienable and alienable) in Yuma (California): first person *?-*, *?an<sup>y</sup>-*; second person, *m-*, *man<sup>y</sup>-*; third person, zero, *n<sup>y</sup>-*. The personal reference is a zero reference outside the *I/you* relationship.

(Benveniste 1971, p. 221; last ‘-’ added—DAH/DJA)

However, this is far from a perfect correlation, as the English present tense *-s* for third person singular attests.

Given the imperfect correlation between formal and functional markedness, there is debate about what the precise criterion of functional markedness consists of, and, indeed, whether there can be a single criterion of functional markedness, or whether, in fact, it is a cluster of notions (see Haspelmath 2006 for discussion).

There are a number of means of representing markedness. At the level of the  $\varphi$ -set, one can regard size of structure (whether a geometry or a feature bundle), as a metric of markedness. Additionally or alternatively, markedness can be attributed to features themselves, rather than to the feature structure. For instance, Harley and Ritter (2002) posit two number features and suppose



that one feature is unmarked in the sense that, if a language uses only one feature in its grammar, it will be that feature. Furthermore, if features are bi- or multivalent (Harley and Ritter's are privative), then markedness can be attributed to feature values, additionally or alternatively to the concept of a feature's being marked itself.

In systems where the feature values are + and –, there is sometimes the assumption made that + is the marked value and minus the unmarked. Silverstein (1976) made an early attempt to maintain this position. Yet, his own analysis shows it to be empirically untenable in its simplest form (see Silverstein, p. 188, on 'markedness polarity' and his footnote 9, pp. 227–8).

One way to capture context-dependent markedness is by directly encoding it as a feature's value (Chomsky and Halle 1968). So, a feature, [ $\mu$ F], would be specified as marked (*m*) or unmarked (*u*), with the eventual +/– value being determined by a rewrite rule which is sensitive to context:

- (29)     $m \rightarrow +$     in the Context [\_\_ F] [ $\mu$ G]  
            $m \rightarrow -$     in the Context [\_\_ F] [ $\mu$ H]  
            $u \rightarrow +$     in the Context [\_\_ F] [ $\mu$ I]  
            $u \rightarrow -$     in the Context [\_\_ F] [ $\mu$ J]

Lakoff (1970) provides specific arguments, attributed to Postal, in this direction. See also Bierwisch (1967), and more recently Wiese (1999).

The limiting case of markedness is that of the default. Intuitively, if an element has multiple uses, it is relatively unmarked. Default items constitute the most extreme cases of multiplicity of use within a natural class of items. They are negatively defined, informally, as the form used where no other is appropriate. Following on from work by Kiparski (1973), defaults, or 'elsewhere' forms, have been formally accommodated within some theories (e.g., Distributed Morphology, Halle and Marantz 1993).

The markedness metrics above, namely size of structure and number of marked values, do not induce a complete ordering on all possible  $\varphi$ -sets: different  $\varphi$ -sets can contain the same number of features and/or marked values. For instance, if  $\varphi_1$  is marked with respect to person and unmarked with respect to number, and  $\varphi_2$ , conversely, by whatever criterion of markedness, then neither exceeds the other in total markedness. One way past this impasse, if one takes total ordering with respect to markedness as a desideratum, is to claim that person and number, for example, are not

equally marked, but rather that person is extrinsically more marked than number (in which case,  $\varphi_1$  is more marked than  $\varphi_2$ ).

There are some intriguing generalizations in this domain. Both number and gender distinctions are frequently lost with respect to person, but in opposite fashions. Simplifying Corbett (1991, 2000) slightly, if a language makes number distinctions only for some persons, then it will be only for first, or only for first and second (see Siewierska 2004 for some dissent); and if a language makes gender distinctions only for some persons, then it will be only for third, or only for second and third. In other words, in the domain of person, where one tends to find gender, number is rarer, and where one tends to find number, gender is rarer. As for number and gender themselves, Greenberg (1966) observes that no language has more gender distinctions in the plural than in the singular (e.g., German has masculine, feminine, neuter in the singular, but only a common gender in the plural). If we take singular to be the unmarked number, then Greenberg's discovery is that gender distinctions decrease where number markedness increases. This ties in conceptually with the person facts: where language is most likely to make number distinctions (in first, or first and second person), it is least likely to make gender distinctions.

Even if these generalizations do form a conceptually sound cluster, they are tendencies, not universals. A striking example is person/number neutralization in Kuman: person distinctions are lost for some numbers in the (subject) agreement system, but number distinctions are lost for some persons in the pronominal system (Foley 1986, p. 70, citing Piau 1985):

Kuman subject agreement				Kuman pronouns		
Person	Singular	Dual	Plural	Person	Singular	Plural
1	<i>-i</i>	<i>-bugl</i>	<i>-mun</i>	1	<i>na</i>	<i>no</i>
2	<i>-n</i>	<i>-bit</i>	<i>-iw</i>	2	<i>ene</i>	<i>ene</i>
3	<i>-uw</i>	<i>-bit</i>	<i>-iw</i>	3	<i>ye</i>	<i>ye</i>

Observe that the pattern in the pronominal system, right, is reminiscent of Greenberg's generalization concerning gender: fewer person distinctions in the non-singular than in the singular (see Cysouw 2003 for other such cases).

Despite the inherent interest of such generalizations, it must be admitted that their precise formulation and how, or whether, they should be captured by a theory of markedness currently

evades us.

## 6. Themes in Phi Theory

Our focus so far has been on the history of  $\varphi$ -features in the three domains of grammar where they of primary relevance: syntax, semantics and morphology. However, if this volume is to fulfill its aim of motivating a transmodular Phi Theory, then we require a characterization of the research questions that transcends and unites different modules. Above, we have, of course, noted several places where research themes from different domains of the grammar have converged (the end of 3 touches on this for syntax and semantics, and the end of section 4 for semantics and morphology, and syntax and morphology). To conclude, we now tie together the emergent issues in Phi Theory in a way that, we hope, will excite further interest whilst serving to emphasize areas where research into modules can be mutually informative, insightful and stimulating.

Questions of science often reduce to three broad issues: substance, structure, and interaction. In Phi Theory, these lead to the following broad themes.

**Substance** What are the different categories of  $\varphi$ -features? Above, we addressed primarily person and number, and, secondarily gender (reflecting the foci of the papers in this volume). However, recall that, in syntax,  $\varphi$ -features were simply those that were affected by agreement transformations. Corbett (2006, p. 133–141) draws attention to a number of other categories that are agreement-like in their behavior: case, definiteness, honorificity, and even, in some languages, some tense-mood-aspect categories (on this last, see especially, Nordlinger and Sadler 2004. Honorificity, in particular, has received recent attention (Boeckx and Niinuma 2004, Potts and Kawahara 2004, Bobaljik and Yatsushiro 2006).

Within each category, what is the inventory of features? That is, what is the inventory of person features, of number features, and so on, and are they universal? Can the same be maintained for gender and honorificity? It is important to emphasize that asking what the inventory of features is is not the same as asking what values of a category are. Consider, for instance, number. A possible value for this category is dual. However, we reviewed above a variety of morphological evidence that suggests that dual is not a primitive feature, but is featurally complex. Moreover, we

showed how these number features can be naturally defined given semantic research in the domain of number, aspect and Aktionsart. Are other familiar  $\varphi$ -categories likewise complex?

**Structure** Within a given  $\varphi$ -category, how are the features structured? Pursuing further the example of number, why can languages have a paucal only if they have a more basic distinction too (Corbett 2000); why can there not be a language with paucal~non-paucal as its only number distinction? Like questions arise within person (see McGinnis, this volume). Do they arise also within gender? One avenue, mentioned above, is to adopt a geometry, or a filter system. These serve to constrain combinations of features, designating some semantically possible ones as geometrically illicit. However, are geometries and filters themselves submissible to analysis, and, if so, what explains them? Could more careful examination of the syntax or semantics of the features that compose these categories reduce geometries or filters to syntactically or semantically natural conditions?

Like questions arise inter- as well intracategorially. There are a number of well known, if well disputed, correlations between person, number and gender. For instance, if a language has two different verb forms which move to two different heights, then, if only one has person, that is the verb form that moves higher (section 2.1). Or, no language makes more gender distinctions in the singular than in the non-singular (section 5). Where such constraints concern cooccurrence restrictions, they can clearly be captured by a geometry or filter system. However, these raise again the questions just outlined: what is origin of the geometry, can it be derived by syntactic or semantic means? The need for syntactic exploration is particular pressing, given the impact that some of these generalizations have on the syntax (e.g., height of verb movement and clitic placement, or hierarchies and ergative splits). And, if geometric effects can be reduced to questions of syntactic structure, can these, in turn, be derived on semantic grounds?

**Interaction** These questions just outlined begin to touch on issues of interaction between modules: how do module-specific operations interact with the substance and structure of  $\varphi$ -features? On the semantic side, do geometric generalizations stem from demands of the semantic interface, or are they separately stipulated, syntactically, or morphologically? How do  $\varphi$ -features interact with the different modes of semantic composition; for instance, do binding and predication treat

$\varphi$ -features on a par (Adger 2005, Kratzer 2006)? On the syntactic side, the core operations are Merge, Move and Agree. How do  $\varphi$ -features trigger and constrain their application? Can one deduce the nature of feature organization from any such constraints? On the morphological side, do the operations that induce syncretism and allomorphy reveal any hierarchy of  $\varphi$ -features, either organizational or markedness-based?

Doubtless, this list of topics and questions is incomplete. However, at this early stage, where Phi Theory is merely emergent, not fully fledged, incompleteness is inevitable. If we are successful in stimulating research into the issues raised, then the future will reveal just how incomplete a picture we have painted. Hopefully, we are not too far off.

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