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As Kibort and Corbett point out (p.1), "Linguists frequently turn to [features] as they try to understand and model the complexity of natural language." Yet, Corbett points out (p.17), "features are often taken for granted... This is why we have put together this volume." The volume is a good overview of theoretical issues surrounding the use of features (see especially Corbett's chapter on "features: essential notions" and Pullum & Tiede's chapter on "inessential features") and is a great summary of the state of the art in current thinking about features in formal linguistics. The volume is heavily focused on morphosyntax, with only one chapter devoted to phonology.

The volume is largely concerned with patterns of form-meaning mappings and particularly cases where the mapping is not one-to-one, either syntagmatically or paradigmatically. On the paradigmatic dimension, Corbett (Chapter 2) suggests that certain patterns of polysemy provide evidence for semantic features having internal structure. Plaster & Polinsky (Chapter 5) discuss the Dyirbal marker of "women, fire, and dangerous things" (Lakoff 1987) and show that the marker was extended to various words based on phonological rather than semantic similarity so that it now groups together words that are not semantically related.

On the syntagmatic dimension, several chapters are largely concerned with multiple exponence. Corbett (Chapter 2), Kibort (Chapter 4) and Danon (Chapter 6) discuss the distinction between inherent and contextual inflectional markers. Kibort (Chapter 4) proposes a typology of semantic features that are expressed by grammatical markers that is based primarily on whether they can be involved in agreement and government. If a feature can be involved in agreement or government, it is said to be morphosyntactic. Thus a feature can be morphosyntactic only if it can have multiple exponents within a sentence. Multiple exponence is, however, not a sufficient condition. Multiple exponents can be independently triggered by a purely semantic feature if a feature is active throughout a string of words, and multiple words in the phrase allow exponents of the feature. One example Kibort discusses is respect, which is presumably a long-lasting condition, and thus can trigger multiple independent
respect markers. In other words, exponents can be triggered by semantics or syntax in production. Danon's chapter suggests that these two reasons for the presence of an exponent are distinguishable in Hebrew. The presence of an exponent of definiteness in Hebrew does not have to be interpreted as indicating that the referent of the word to which it is attached is definite: the exponent can be interpreted as being triggered by the presence of another exponent of definiteness in the context. Popova (Chapter 7) is concerned with periphrastic constructions, in which a feature can be argued to be associated with a string of morphemes. Popova further argues that the feature can be associated with a string without being associated with any part of that string.

Another topic discussed in the book is the possible relationships between features. Adger (Chapter 8) and Sag (Chapter 10) discuss locality restrictions on dependencies between what Kibort would call morphosyntactic features. Both propose formal accounts for restrictions on locality, e.g., verbs being able to require a direct object but not a direct object that contains a prepositional phrase.

The issue of feature identification is addressed by Dresher (Chapter 2) for phonological features, Danon (Chapter 6) for morphosyntactic vs. morphosemantic features, Copestake & Flickinger (Chapter 9), and Pullum & Tiede (Chapter 11) for features in general. Dresher argues that the same phonemic contrast should be described using different features in different languages depending on the phoneme inventory as a whole. Danon suggests that there are distinct morphosemantic and morphosyntactic definiteness features, only the latter being able to trigger agreement. Chapter 11 by Copestake & Flickinger discusses applications of features in computational semantics, in the sense of engineering projects on natural language processing. They point out that semantic underspecification may be necessary to deal with the fact that semantic features are not always identifiable and can be "neutralized in discourse" in the terminology of Sankoff (1988). Pullum & Tiede (Chapter 11) point out that it is impossible to say whether a feature is useful in general: the usefulness of a feature depends on the power of one's descriptive metalanguage.

In what follows, I address some of the major themes of the volume in greater detail. With the notable exception of Plaster & Polinsky's chapter, the contributions to the volume can be criticized for not situating their work in the broader cognitive science context. Featural analyses are found throughout the
cognitive sciences, and the issues such analyses face are largely the same across domains. A volume on features should therefore have broad appeal across the cognitive sciences. However, most of the present volume does not speak to this broader audience. One aim of this review is to place the volume in a broader context and point out alternative research paradigms that shed light on the topics.

Features as categories of values

The term 'feature' is unfortunately not defined in the volume. I will assume that a feature is a salient parameter/dimension on which units vary. Further, a feature has a finite set of values (typically two). Because the set of feature values is finite, individual values of a feature are recurrent and can be used to identify classes of units with common properties (i.e., one can generalize that a class of words that share a particular feature value behave alike in some respect). A feature is then a category of feature values, which are themselves individuatble elements of generalization (i.e., a feature value is *associable*, Kapatsinski 2009a).

While this definition appears compatible with most chapters in the volume, Adger does not seem to share the view of features as categories of values. On p. 195 he worries that "we do not want PAST to be a possible value for NUMBER". This concern is puzzling, for PAST shares nothing with the other NUMBER values and shares much with the other values of TENSE, thus if features are categories of similar values the problem never arises. On p. 196, Adger is also concerned with preventing features from having themselves as values: "we need... constraints to rule out feature structures like A:A " where A:A indicates that A could be a feature value of A. This is again puzzling if features are categories of values, for "A is a subcategory of A" is nonsensical.

Alternative representation of similarity: Geometric models

From reading the volume, one gets the impression that features are the only way to represent similarity and account for similarity-based generalization. However, in psychology, spatial/geometric models are considered to be a plausible alternative to features (see Ashby & Perrin 1988 for a review). A feature-based model represents a unit as a set of feature values. In a geometric model, a unit is a location in a continuous multidimensional space. The element of generalization is the unit rather than the feature value, and units that are "infected" by the behavior of a
neighboring unit do not have to form a class that can be defined using a conjunction of feature values. In phonology, Mielke (2008) presents extensive typological evidence for ubiquity of phonologically active classes (sets of segments that behave alike with respect to phonological processes) that cannot be defined using a conjunction of feature values and argues that a geometric representation of phoneme inventories is preferable to a traditional feature-based one. A geometric model of the phoneme inventory is also implied by Liljencrants & Lindblom's (1972) Dispersion Model. Geometric models have also gained prominence in computational and cognitive semantics (Bybee & Eddington 2006, Croft & Poole 2008, Landauer & Dumais 1997).

While Corbett laments that "features are often taken for granted", the present volume continues this tradition. Geometric models are not mentioned by any of the contributors to the volume. I believe this is a missed opportunity. Just as geometric models have changed greatly to account for effects that were argued to provide support for a featural model (see Ashby & Perrin 1988), so featural models must be able to account for the kinds of findings that appear to support geometric models, including 1) the ubiquity of non-conjunctive categories (Mielke 2008), and 2) subtle cross-linguistic and within-language differences between grammatical expressions that may be thought of as having the same feature value (Croft & Poole 2008).

*Where do features come from?*

As Corbett points out, there is no agreed-upon feature list and no explicit method for identifying features. In contrast, geometric models come with algorithms for inducing a set of dimensions underlying similarity data. A feature-based model can use such an algorithm for feature induction (Lin & Mielke 2008) without abandoning the claim of discrete elemental feature values, since a continuous dimension can be naturally discretized by human language learners. For instance, Maye et al. (2002) find that exposing infants to a bimodal distribution of stimuli along a phonetic continuum results in categorical perception with a category boundary between the two peaks.

*One-to-many form-meaning mapping vs. feature structure: Corbett; Plaster & Polinsky*

Feature structure (subcategories of feature values within a feature), is a recurrent issue throughout the volume, specifically addressed by Corbett, Dresher, and Adger. Corbett (pp. 18-23)
argues that features may have internal structure based on what he terms *facultative values*, which is simply when one grammatical morpheme has a range of uses that subsumes the range of uses for another morpheme. The example described by Corbett (pp. 20-21) is a number system (observed in Larike, and Austronesian language), in which the plural marker can be used to express dual and triple despite the existence of dedicated dual and triple markers. Corbett argues that the fact that dual and triple markers are not interchangeable but both are interchangeable with plural markers provides evidence for a hierarchical organization of the number feature, as shown in Figure 1.

![Figure 1. The number feature in Larike (based on Corbett 2010, p.21). Dual and triple values are facultative (don’t have to be expressed). I am taking the bottom-most PLURAL to mean ‘prototypically plural’.

Figure 2 shows an alternative analysis that assumes that form-meaning pairings can be many-to-many, i.e., a unit at the form level can be linked to multiple nodes on the semantic level. In other words, it is not the case that DUAL and TRIPLE semantic features are optional, rather DUAL and TRIPLE can be expressed either using monosemous forms y and z or the polysemous form w.

![Figure 2. An alternative analysis of number in Larike assuming that a form can be mapped onto multiple meanings.

If we take feature values to be semantic primitives, then features are *categories* of those primitives, and so are the groupings of feature values represented by all non-terminal nodes in the feature structure. A proposed feature structure is then a theory of how semantic primitives within a domain are categorized and an explicit representation of semantic similarity.
among the feature values. Given the possibility of many-to-many mapping, it is not obvious that feature values expressed by a single form must form a **semantic category** (see Plaster & Polinsky for an example).

**What is evidence for feature structure?**

A real semantic category should be productive. In other words, when presented with a novel TRIPLE form, would a speaker of Larike be more likely to think that it can also refer to more than three objects than to fewer than three objects? If so, we would then have a case for stronger semantic relationships between TRIPLE and MULTIPLE than between TRIPLE and DUAL for speakers of Larike, which is not captured by the structure in Figure 2 (Baerman et al. 2005).

Evidence for categories of feature values is also provided by patterns of individual variability (DeJong et al. 2009, Kapatsinski 2009b): if two values are related, individuals who react to one feature value in a certain way should also react to the other feature value in the same way, while reactions to unrelated (or more distantly related) feature values should not be (as) correlated. For instance, if TRIPLE and MULTIPLE are more closely related than TRIPLE and DUAL, then knowing that an individual uses w a lot in TRIPLE contexts should predict that s/he also uses it a lot in MULTIPLE contexts but knowing that an individual uses w a lot in TRIPLE contexts should not be as predictive of how much s/he uses w in DUAL contexts relative to other speakers.

In addition to indicating which feature values belong together, feature structure (as shown in Figure 2) provides an indication of which feature values are more prototypical (Tversky 1977). The prototypicality prediction can be tested by examining patterns of underextension during the learning of a marker: the feature hierarchy in Figure 1 suggests that it would be much more likely to be (erroneously) thought to exclude dual than multiple, i.e., DUAL is a less prototypical PLURAL value than MULTIPLE. Some evidence for this prediction is presented by Zapf & Smith (2008), who report that children acquiring English omit -s in DUAL contexts more than in MULTIPLE contexts.

**Many-to-one form-meaning mapping: Danon**

Domains of features are, either implicitly or explicitly, discussed by Corbett, Danon, Popova, Adger and Sag. The domain of a feature can be thought of as either the span over which formal
cues to the feature are distributed or the unit with which the feature can be integrated semantically. Danon argues that the two domains are not necessarily identical. In Hebrew, the definiteness of a "construct state nominal", which consists of "a phonologically reduced head noun immediately followed by an embedded genitive phrase" (p. 150), is dependent on the definiteness of the embedded genitive. However, "it is not the case that both levels in a +DEF construct state nominal are always interpreted as definite; a definiteness feature is always interpreted on at least one of the nodes to which it spreads... but not necessarily on all these nodes" (p. 156). In other words, some definiteness markers are interpreted as cues to definiteness of the noun to which they are attached but others are simply cues to the presence of a semantically definite noun nearby.

A closely related "performance" phenomenon is syntactic persistence. For instance, Poplack (1980) finds that retention or deletion of the prescriptively required contextual plural -s on an adjective in Puerto Rican Spanish depends on whether the -s is retained on the head noun. In Russian, one commonly finds case persistence errors in genitive constructions, e.g., in (1) instrumental persists from 'day' to 'birth', replacing genitive (-jem vs. -ja). Thus in Hebrew definiteness spreading is the norm and done commonly, in Puerto Rican Spanish plural spreading is the norm and done uncommonly, and in Russian case spreading is not the norm and done uncommonly.

However, it is clear that at least sometimes "syntactic" persistence is really morphophonological persistence. For instance, Parubchenko (2004) provides the example in (1) where genitive is replaced by instrumental because the form of the instrumental case suffix on the noun is more similar to the genitive case suffixes on the adjectives than the genitive noun suffix (-ov) would be.

(1)

Vsjo iz-za naš-ix prekrasn-yx mal'chik-ax
All due-to our-GEN.PL wonderful-GEN.PL boys-INS.PL

'It's all because of our wonderful boys'.

Danon argues that definiteness spreading in Hebrew implies that Hebrew has a "morphosyntactic" definiteness feature, whereas languages in which definiteness does not spread (or spreads without resulting in meaningless markers), have a semantic or morphological definiteness feature. Given examples like (1), a viable alternative account is that Hebrew requires phonological
spreading that is active but normatively blocked in most languages, including Russian.

Feature equivalence: Dresher

The simplest featural model would posit that all features are weighted equally (Tversky 1977). This is clearly not true for linguistic features. In Chapter 3, Dresher argues that any given language selects a subset of phonological features to use in contrasting sounds. For instance, in a given language, "do /i/ and /u/ contrast with respect to ROUND, for example, or do they contrast with respect to BACK" (p.38)?

In Dresher's theory, the feature weighting appears to be common to all speakers of a language, being determined solely by the phoneme inventory of the language. Furthermore, features vary only in whether or not they are contrastive, with non-contrastive features having zero weight and contrastive features having equal non-zero weights. However, the same inventory can often be described by multiple feature sets. Given multiple possible solutions to the problem of classifying phonemes in an inventory, it seems unreasonable to expect that speakers of a language will not vary in which features they pay most attention to. Empirical evidence to this effect is provided by Escudero & Boersma (2004), who find that English listeners within the same dialect region vary in reliance on length vs. spectral features to distinguish vowels. There is also between-speaker variation in loanword adaptation, the empirical domain from which Dresher draws evidence for differences in feature use across languages. For instance, some Russian speakers (including myself) map English [θ] onto /s/ while others (including my parents) map it onto /t/. It appears that the same phoneme inventory can give rise to different feature representations for different listeners. Thus feature weighting is an attribute of an individual, not a language, and psycholinguistic studies are necessary to determine the degree of individual variation in feature weighting across speakers of a language. Thus it would be very surprising to find a language in which all speakers weighted all features equally and features could only have weights of 1 or 0.

The features of the whole and the features of the parts: Popova

Popova's chapter discusses periphrastic constructions in which morphosyntactic features seem to be associated with a multimorphemic unit. Popova suggests that there are cases in
Bulgarian where some features associated with the whole phrase are not associated with any of its elements. She argues that “the features of the construction could potentially be different from the features associated with its elements” (p.182).

Popova discusses the Bulgarian sequence šte e, which could mean either FUTURE or INFERENTIAL. The FUTURE combines most easily with the negation marker njama, the negation marker ne being less usual, while ne is the only possible negation marker when the sentence is INFERENTIAL. Popova argues that this pattern of form-meaning mapping suggests that FUTURE and INFERENTIAL are connected to the whole construction (šte e verb). However, an alternative compositional analysis seems readily available (Figure 3). On this account, šte and e are both ambiguous, while njama is associated with future (as well as negation) whereas ne is associated with negation and inferentiality with a future interpretation being possible but less likely.

On this account the negative markers serve as independent cues to the meaning of the utterance (FUTURE vs. INFERENTIAL) in perception as well as being triggered by the intended meaning in production. Whether the prediction is correct can in principle be ascertained using the research strategy developed by Bates et al. (1984). Bates and colleagues presented listeners with sentences that contain only some of the normally available cues to the appropriate interpretation. The listeners were then asked to guess at the interpretation from a fixed set of options. In this case, the presence of njama is expected to favor FUTURE interpretations over INFERENTIAL interpretations even in the absence of šte e if forced to choose between FUTURE and INFERENTIAL readings.

![Figure 3. A compositional account of Bulgarian future and inferential patterns. The link with circles at the end is inhibitory, indicating that njama and ne are mutually exclusive. Line width indicates link strength.](image-url)
One pattern of association between forms and features that requires the whole to be assigned a node is the double XOR pattern, which is shown in Figure 4 (Kapatsinski 2009a). Here, the whole is associated with one value of the feature while the presence of any part of the whole without the other part(s) is associated with the other value of the feature.

![Diagram of the double XOR relationship](image)

Double XOR patterns are very difficult to learn if the parts of the whole are perceived when the whole is presented. Whenever AB is perceived, co-occurrence of A and B with Y is detected and the A-Y and B-Y associations strengthened. For AB-Y exposures not to cause the formation of A-Y and B-Y associations, A and B should not be parsed out of the signal when AB is presented (Kapatsinski 2009a). In the case of a multiword construction, this would mean that the construction should be accessed without the individual words that are part of it being accessed. While there is now much evidence for storage and access to multiword chunks (e.g., Arnon & Snider 2010), there is no evidence that the individual words are not accessed (at least for chunk-initial words). In fact, there is much evidence that speech perception is incremental: we do not wait until the end of a construction to interpret it. Rather we constantly access multiple meanings that are consistent with the signal so far in parallel (Trueswell & Gleitman 2007). To allow for this rapid access to meaning prior to the end of a multimorphemic construction, early recurrent elements must be associated with the meanings of the constructions they occur in.

**Conclusion**

The volume succeeds in providing a broad and thought-provoking discussions of some of the issues surrounding the use of features in linguistic theory, particularly as they relate to non-one-to-one form-meaning mappings. The main limitation of most contributions to the volume (with the exception of Plaster & Polinsky) is lack of connection to related work in neighboring domains of cognitive science. There are no comparisons between feature-based and non-feature-based theories: features continue to be taken for granted. There is also no discussion of
experimental and corpus-based studies, resulting in omissions of some key issues in feature theory that are difficult to address using traditional methods (acquisition, individual differences, and gradient patterns of form-meaning mapping). Some of the claims about mental representations made in the volume are questionable given what we know about language processing. While the volume provides food for thought on many topics of cross-disciplinary interest, most papers are written in a way that makes them extremely difficult to read for non-syntacticians. It is therefore only recommended to those who have a background in syntax.

References:


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