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ScienceDirect

Lingua 148 (2014) 240–253

Lingua

www.elsevier.com/locate/lingua

Targeting underspecified segments: A formal analysis of feature-changing and feature-filling rules☆

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Received 27 August 2013; received in revised form 22 May 2014; accepted 27 May 2014
Available online

Abstract

In this paper, we discuss how the difference between feature-changing and feature-filling processes has not been adequately addressed in rule-based, derivational phonology. We explore two different theories of these processes. One theory analyzes feature-changing in two steps—set subtraction and then set unification. Another analyzes feature-changing in one step—a function that alters the polarity of features. We argue that empirical evidence favours the two-step over the one-step process. In particular, the two-step process provides an account for the lack of rules that target specified segments independently of underspecified segments (so-called by-passing rules). It also explains why there are no attested examples of purely phonological rules that switch the polarity of certain features (e.g., changing /t/ and /d/ to [d] and [t] respectively).

Keywords: Formal phonology; Derivational phonology; Feature-filling; Feature-changing; Underspecification; Polarity rule

1. Introduction

One reason for the rise of Optimality Theory (OT) in the 1990s was widespread acceptance of the claim that ''rule-based theory hardly imposes any limits on the notion of 'possible rule' '' (Kager, 1999, p. 1). The rejection of rule-based formalism in favour of the constraint-based OT model was accompanied by a rejection of the derivational model inherited from traditional generative phonology, such as in Chomsky and Halle (1968). Thus, nearly all of the research in OT ''assumes a parallel implementation'' (McCarthy, 2000, p. 1) without multiple levels of representation. More recently, many OT practitioners have turned back to serialism (McCarthy, 2010, 2000; Pruitt, 2010; Tessier, 2012; Bermúdez-Otero, 2009; Kiparsky, 2010) in recognition that the parallel model appears to be insufficiently powerful. In this context of a renewed respect for derivations, it is prudent to also revisit questions about the nature of rules.[1] This paper contributes to

☆ We would like to thank Heather Newell, Jessica Coon, Glyne Piggott, Jeffrey Heinz and the anonymous reviewers for comments on versions of this paper. We are also grateful to Patricia Keating, Paul Kiparsky and Donca Steriade for discussion of particular issues, as well as to audiences at the Montreal-Ottawa-Toronto Phonology Workshop (2013) and the Manchester Phonology Meeting (2013). This work was supported by a grant to Bale (P.I.) and Reiss from the Social Sciences and Humanities Research Council of Canada (SSHRC #410-2011-2401 *Language, Number and Mathematics*).

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[1] We agree with a reviewer who points out that there was in fact a history of attempts to constrain rules, such as Chomsky (1967), Jensen (1974) and Wiese (2000)—see below. The reviewer also insists that it is similarly the case that attempts at limiting the nature of constraints in OT are fairly rare, with a few notable exceptions such as Eisner (1997), McCarthy (2003) and Riggle (2004).

http://dx.doi.org/10.1016/j.lingua.2014.05.015

the development of a more formal analysis of derivational, rule-based phonology (Bale and Reiss, forthcoming). We make explicit some of the typically implicit assumptions concerning the structure of segments and the operations that apply to them. Part of this process involves distinguishing feature-filling rules from feature-changing rules. We outline an account of feature-filling rules where underspecified segments are targeted indirectly through an operation called *unification*: a form of set union that can only combine two sets when the result is consistent, otherwise the operation fails.[2] Crucially, the points of failure are a welcome result, yielding the exact empirical effects needed. Unification prevents rules from creating inconsistent sets of features while also allowing for the type of featural changes needed to model phonological systems.

In contrast to feature-filling rules, feature-changing processes—which change feature values from + to − or vice versa—involve two steps: First, the feature targeted for change is deleted (and thus the segment becomes underspecified), and second, the newly underspecified segment is unified with the feature specified in the change.

This account of feature-filling and feature-changing processes makes predictions about phonological rules cross-linguistically. According to the system developed here, it should be impossible to have a rule that targets a fully specified segment for a featural change without also targeting an underspecified segment with respect to a feature-filling rule. This is due to the fact that a critical part of the feature-changing processes, besides deletion, are feature-filling rules that target underspecified segments. As far as we know, this prediction is empirically borne out. Thus, our formalization helps us to discover and explain new empirical generalizations.

The outline of this paper is as follows. Section 2 discusses some of the key characteristics of feature-filling rules in Turkish. Section 3 argues that traditional SPE-style representations of phonological rules are somewhat misleading in that they use the same symbol sets to represent two different theoretical concepts. A new notational convention is proposed that clearly distinguishes between these concepts. With this new convention in place, sections 4 and 5 outline the interpretation of the primary operator symbol traditionally used in rules, namely →. It is in these sections that we discuss the formal differences between feature-filling and feature-changing processes. Section 6 discusses two models for feature-changing and suggests a way of choosing between them. Some of the consequences of our formal system are discussed in section 7, and section 8 concludes the paper.

2. Underspecification in Turkish

In this section, we review an analysis of Turkish consonants that was first introduced by Inkelas (1995) and Inkelas and Orgun (1995). This analysis critically employs underspecification as a way of encoding a three-way distinction among coronal stops. Feature-filling rules are required to account for the surface variation of these segments.

In Turkish, there is evidence for three types of underlying representations for coronal stops at the end of roots. There are those that surface as [t] in all three environments we consider, there are those that surface as [d] in all three environments, and there are those that alternate between surface [t] and [d], with [t] occurring in a syllable coda and [d] in an onset. The nouns for 'art,' 'etude', and 'wing' in (1) illustrate this contrast.

(1) a. Non-alternating voiceless:
sanat 'art', *sanatlar* 'art-plural', *sanatım* 'art-1sg.poss'
b. Non-alternating voiced:
etüd 'etude', *etüdler* 'etude-plural', *etüdüm* 'etude-1sg.poss'
c. Alternating:
kanat 'wing', *kanatlar* 'wing-plural', *kanadım* 'wing-1sg.poss'

Inkelas argues that this three-way distinction can be encoded by representing the non-alternating [t] as voiceless, the non-alternating [d] as voiced, and the alternating coronal (hereon, symbolized as [D]) as unspecified for voice.

(2) Three underlying segments distinguished with one binary feature
a. /t/ = { − Voice, +Coronal, −Continuant ...}
b. /d/ = { + Voice, +Coronal, −Continuant ...}
c. /D/ = { + Coronal, −Continuant ...} (no Voice feature)

Thus, each root ends in a coronal stop, and each coronal stop shares the features +Coronal and −Continuant (among others), but such stops critically differ in that /t/ contains −Voice; /d/ contains +Voice; and /D/ contains no voicing features.[3]

[2] Earlier discussions of unification in phonology include Coleman, 1990; Bird et al., 1992; Scobbie et al., 1996. Interestingly, the earlier work that invokes unification attempts to explain away apparent feature-changing processes, whereas this paper exploits the failure of unification under some conditions exactly for the purpose of capturing the feature-filling *vs.* feature-changing distinction.

[3] As evident from the paragraph above, we follow the common practice of representing segments as sets of ordered pairs. Each ordered pair consists of a value (+ or −) and an attribute, or feature, F_i, drawn from a universal feature set $\mathcal{F}$ that include familiar features described in articulatory terms, such as Nasal, Round, etc. We will use the term *feature* ambiguously to refer to the attributes themselves and to valued features like +Nasal. Context should make the appropriate reading clear.