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Grounded constraints and the consonants of Setswana☆

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ABSTRACT

The article examines the phonology and phonetics of Setswana obstruents and the well known and controversial post-nasal devoicing rule, which has been cited as a counterexample to the claim that markedness constraints are phonetically grounded (Hyman, 2001). We re-examine the case of Setswana and argue that it must be analyzed in terms of grounded constraints. Our evidence comes from two sources. First, we report on the results of a phonetic study of six speakers of the Sengwato dialect of Setswana. We found that some of our speakers did not have voiced obstruents in any context. Those speakers that did devoice post-nasally also devoiced in other contexts. Thus, a phonetic examination of the purported counterexample to phonetically grounded constraints fails to support the traditional descriptions. Second, we examine the larger phonological context in which the Setswana alternations occur. Setswana has a gapped system of laryngeal contrasts, so the evidence for post-nasal devoicing comes almost entirely from labial stops. The language also has a series of so-called strengthening alternations that affect consonants such as liquids and fricatives post-nasally—alternations that we propose to analyze in terms of the Syllable Contact Law.

1. Introduction

1.1. Setswana and grounded constraints

One of the most important unsettled issues in phonological theory is how phonology is connected to phonetics. In the most extreme functionalist view, there is no need for a special phonological component at all—what some call phonology is just an artifact of phonetics, perception, and historical change. In the most extreme formalist view, the phonological grammar is completely dissociated from any sort of substantive grounding. The middle ground is to hypothesize that at least some of the phonological constraints are grounded in acoustic and articulatory principles. The framework of Optimality Theory (Prince and Smolensky, 1993/2004, McCarthy and Prince, 1993 et seq.) does not take an official stand on this issue, but much of the work in OT has taken the middle ground on the phonetics-phonology interface. The earliest example in this vein is Prince and Smolensky's proposal for sonority-based constraints on syllable peaks and margins, which are derived from the sonority hierarchy and which are special in that their ranking is universally fixed. Another well-known case is Pater's (1996, 1999) aerodynamically grounded constraint $*\mathrm{NC}_{\circ}$, which prohibits voiceless obstruents after nasals. Pater's

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cross-linguistic survey finds that the constraint has a wide variety of effects, from the relatively obvious post-nasal voicing to the less expected, including deletion of nasals, deletion of obstruents, and nasal-stop fusion. One pattern that is completely unexpected, however, is devoicing only after nasals, and this is exactly what is reported to happen in the Bantu language Setswana (Schaefer, 1982; Dickens, 1984; Cole, 1985; Kruger and Snyman, 1988; Hyman, 2001). According to traditional descriptions, initial prevoiced stops alternate with voiceless stops[1] when the nasal first person singular prefix is attached:

(1) Setswana post-nasal laryngeal alternations, according to traditional descriptions

b̲at'a	'look for'	m-p̲'at'a	'look for me'
d̲irela	'do something for'	n-t̲'irela	'do something for me'

Hyman (2001) is the first to note the significance of Setswana to the issue of phonetic grounding and constraints such as $*\widehat{\text{NC}}$, which he views with some skepticism. The problem he points out is that no constraint seems to favor alternations just post-nasally, and constraints such as $*\widehat{\text{NC}}$ actively disfavor such a mapping. Cases such as this feed skepticism of the Optimality-Theoretic approach to phonological typology and phonetic grounding (Odden, 2003; Yu, 2004; Vaux and Samuels, 2005, and others), and it is of utmost importance to examine the facts closely if theories are to rise and fall on them.

The goal of this article is to reconsider the evidence that Setswana presents against grounded constraints. We look at the phonology and phonetics of Setswana obstruents and conclude that not only do many speakers fail to devoice just postnasally, but it is also both possible and necessary to analyze the language in terms of constraints that are grounded in phonetic scales such as voicing and sonority (discussed in detail in the next section). Our evidence comes from two sources. First, we report on the results of a phonetic study of six speakers of Setswana. We found that some of our speakers did not have voiced obstruents in any context. Those speakers that did devoice post-nasally also devoiced in other contexts. Thus, a phonetic examination of the purported counterexample to phonetically grounded constraints fails to support the traditional descriptions. Second, we examine the larger phonological context in which the Setswana alternations occur. As it turns out, Setswana has a peculiarly gapped system of laryngeal contrasts, so the evidence for post-nasal devoicing comes almost entirely from labial stops. The language also has a series of so-called strengthening alternations that affect consonants such as liquids and fricatives post-nasally—alternations that we propose to analyze in terms of the Syllable Contact Law (Hooper-Bybee, 1976; Murray and Vennemann, 1983; Gouskova, 2004). Syllable Contact concerns sonority, and there is some evidence that sonority distinctions can hinge on laryngeal features. An analysis in a similar spirit has been proposed before (Schaefer, 1982), but ours is the first proposal that analyzes Setswana alternations in terms of a universal sonority hierarchy.

1.2. Grounded constraints and laryngeal features

In this article, we will argue for a middle ground view of the phonetics-phonology interface. Markedness constraints are based on scales of well-formedness, which arrange linguistic structures from best to worst (Prince and Smolensky, 1993/2004 et seq.). The relationship between constraints and scales is mediated in Con by various mapping principles such as Harmonic Alignment (Prince and Smolensky, 1993/2004; de Lacy, 2002a; Kenstowicz, 1996), Relational Alignment (Gouskova, 2004), and functional filters (Smith, 2002). Thus, there is a relationship between the constraint set and substantive principles, but it is not the case that phonology *is* phonetics.

Substantively grounded constraints can be broadly divided into two types. The first type includes markedness constraints based on phonetically defined scales of "difficulty." A prime example of this type is *[g], a constraint against voiced dorsal stops. This constraint reflects the aerodynamic challenges of producing a voiced velar: the cavity between the glottis and constriction is so small that it does not allow sub-glottal pressure to be higher than supra-glottal pressure for very long. Voiced labials, on the other hand, are easier to produce, since the oral cavity is large and there is more pliable tissue that can expand and allow aiflow to continue (Ohala, 1983; Westbury and Keating, 1986, see especially Hayes, 1999 for a proposal that encodes this difference in phonological constraints). We will see that Setswana provides evidence for this constraint in its inventory: it lacks voiced [g] entirely, even though [b] and [d] do occur, at least for some speakers. Pater's (1999) $*\widehat{\text{NC}}_{\circ}$ falls squarely into this type of constraint, as well.

The second type of markedness is also based on phonetically defined scales, but it has more to do with how a sound is suited to its phonological role than with articulatory difficulty. A classic example of this type is constraints on the sonority of syllable nuclei and margins (Prince and Smolensky, 1993/2004). Sonority is a phonetically defined scale, corresponding to intensity (Parker, 2002, 2008). It is not a scale of difficulty, however—there is nothing inherently difficult about producing the least sonorous segment (stop) as opposed to the most sonorous one (vowel). Sonority becomes relevant to markedness only in the context of phonological positions. Prince and Smolensky (1993/2004) capture the well-known restrictions on the syllable roles of segments of various sonority levels in their constraint hierarchies that penalize highly sonorous segments in

[1] The literature on Tswana is inconsistent as to how non-voiced unaspirated stops are transcribed. Sometimes, what we transcribe as [mp'at'a] 'look for me' is written [mpata], but there is general agreement that these stops are weakly/variably ejective (see the works cited above). In Tswana orthography, stops in the ejective series are written <p, t, k>. An acoustic study of these stops is described in section 3.3.