

An EPG study of the alveolar vs. retroflex apical contrast in Central Arrernte

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Abstract

This study presents EPG (ElectroPalatoGraphic) data from Central Arrernte, an Australian language which has a phonemic contrast between two types of APICAL consonants: ALVEOLAR and RETROFLEX.

Results suggest that some APICAL articulations are highly stable across repetitions, while others are highly variable. More precisely, the most stable and prototypical ALVEOLARS (i.e. with a flat EPG contact profile), and the most stable and prototypical RETROFLEXES (i.e. with a forward movement during EPG closure), occur in the phonologically stressed syllable of the word (i.e. the second underlying VC syllable). By contrast, the ALVEOLAR in an ALVEOLAR-/ə/-RETROFLEX sequence is highly variable in production. Initial contact is generally retracted for this ALVEOLAR, presumably in anticipatory coarticulation with the following RETROFLEX. However, there may also be forward movement of the tongue during closure for the ALVEOLAR.

It is argued that coarticulation and gesture-spreading models cannot account fully for these data. Instead, the formant structure associated with the later RETROFLEX renders the previous APICAL ambiguous, and speaker/listeners may then re-interpret the first APICO-ALVEOLAR as being RETROFLEX.

It is therefore possible that in Arrernte, the APICAL contrast is neutralized not in word-initial position per se (as is typical of most languages containing this contrast), but in the weak initial (V)C syllable of the word.

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1. Introduction

The contrast between ALVEOLAR and RETROFLEX¹ articulations is not unusual in the world's languages, and is particularly widespread in Indian and Australian Aboriginal languages. Despite RETROFLEXES being the focus of much phonological discussion (e.g. Gussenhoven & Jacobs, 2005, p. 172; Steriade, 1995, 2001), there has been comparatively little experimental work on these sounds. This paper presents an EPG (electropalatographic) study of APICAL (ALVEOLAR and RETROFLEX) sounds in Central Arrernte (henceforth simply Arrernte), a language spoken in and around Alice Springs in central Australia. The

APICAL contrast in this language is somewhat complex phonologically, and this study focuses on one particular aspect of the contrast: namely, a restriction on APICAL-/ə/-APICAL sequences, whereby the second APICAL in such a sequence must be RETROFLEX, giving the sequence APICAL-/ə/-RETROFLEX. Section 1.2 gives a brief outline of Arrernte phonology. However, I begin by reviewing some previous studies of RETROFLEXES (Section 1.1) as background to the current study.

1.1. Previous articulatory studies of RETROFLEXES

There is a wide variety of articulations which can be described, acoustically and phonologically, as retroflex (Ladefoged & Maddieson, 1996, pp. 21–30). Articulations can vary in exact place of articulation, being as far back as pre-palatal in some Australian languages, or more alveolar/post-alveolar in others (Butcher, 1995, in preparation). The actual portion of the active articulator involved may also vary, being, for instance, more apical in Ladefoged

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¹Following Butcher (1995), I use small capitals to denote a phonological category. So the term “retroflex” is a phonetic description of an articulation which moves forward during consonant closure, presumably involving the sub-apical part of the tongue; and “RETROFLEX” denotes a phonologically meaningful contrast. I only use this notation system for consonants.

and Bhaskararao's (1983) speaker of Hindi, but more sub-apical in their speakers of Tamil and Telugu.

Ladefoged and Maddieson (1996, p. 28) describe a particularly common characteristic of retroflex articulations: "the tongue tip first bends back into the retroflex position, and then, during the closure phase, straightens out somewhat, so that by the time of the release of the closure it is in a less extreme position." This common articulatory strategy results in the oft-cited phenomenon that acoustic cues to retroflexion are greater in VC sequences than in CV sequences (e.g. Steriade, 1995, 2001), due to the articulation being post-alveolar or pre-palatal at closure, and alveolar at release. Retroflexion results in a general lowering of the higher formants during articulatory closure. Depending on the exact place of the closure, retroflexion may bring F4 closer to F3, or F3 closer to F2; or it may bring all three formants closer together. By contrast, during articulatory release, the tongue may be in an alveolar position, and thus the RETROFLEX may be indistinguishable from a phonologically ALVEOLAR sound.

A recent articulatory study of RETROFLEXES in Norwegian was conducted by Simonsen, Moen, and Cowen (2008) using both EPG and EMA (electro-magnetic articulography). In Norwegian, RETROFLEXES are apical articulations in contrast with ALVEOLARS, which are laminal articulations. Simonsen et al. found that for their four speakers, the only aspect of articulation that the RETROFLEXES had in common across speakers and contexts was that they were produced with the tongue tip. The place of articulation for the RETROFLEXES was not necessarily retracted compared with the ALVEOLARS; there was not necessarily a bending back of the tongue tip; and there was not necessarily a forward movement of the tongue during production. Simonsen et al. attributed this lack of consistency across speakers to the fact that Norwegian has fewer CORONALS than, for example, the Dravidian languages of India or Australian languages. Importantly, the authors found greater variation across speakers for RETROFLEXES than for ALVEOLARS. In addition, they found much variation in RETROFLEX production according to vowel context.

Two previous palatographic studies have looked in some detail at the APICAL contrast in Arrernte. Henderson (1998) presents some static and dynamic (EPG) palatographic data as part of his grammatical thesis. His analysis is more qualitative and focuses on single words which illustrate the various phonological processes he describes (e.g. neutralization of the contrast in initial position). What is clear from the presentation of the data is that there is a great amount of variation between repetitions of even the same word by the same speaker. In addition, the EPG data clearly show that the active articulator moves forward during closure for a retroflex consonant, in line with Ladefoged and Maddieson's observation.

Neutralization of the APICAL contrast in initial position was the focus of Anderson's (2000) static palatography study of (Western) Arrernte. Anderson found that non-

contrastive APICALS (i.e. those which are neutralized in initial position, such as the /t/ in "takwe"—APICALS are in bold) were statistically indistinguishable from contrastively ALVEOLAR productions (i.e. word-internal ALVEOLARS). She also found that ORAL and NASAL segments of a given place of articulation were statistically indistinguishable. In the related acoustic and perceptual study, Anderson found that ALVEOLAR tokens were relatively variable in their acoustic characteristics, and were less auditorily robust than other CORONALS.

A recent study of retroflex harmony in Kinyarwanda, an African language, is also of relevance to the current study (Walker, Byrd, & Mpiranya, 2008), in that the restriction on APICAL-/ə/-APICAL sequences in Arrernte (where the second APICAL must be RETROFLEX) is reminiscent of the restrictions imposed by a harmony system. Kinyarwanda has a contrast between ALVEOLAR and RETROFLEX fricatives /s z ʒ z/. However, a regressive retroflex harmony operates, whereby an ALVEOLAR becomes RETROFLEX if a RETROFLEX occurs later in the word. This process is blocked by the CORONAL /t/, but is allowed by the PERIPHERALS /m/ and /k/, which are transparent to the process. In an EMA (electromagnetic midsagittal articulography) study, Walker and colleagues showed that there is a retroflexed tongue tip during an intervening /m/ and /k/ ("tip up"), but that there is no such retroflexion during an intervening /t/ ("tip down"). Walker and colleagues interpreted this result as showing that the retroflex gesture spreads throughout the word, but that it is blocked when a tip-up coronal articulation is specified as part of the feature geometry.

1.2. A brief outline of Arrernte phonology

Unless otherwise noted, most of the discussion in this section is based on Henderson (1998).

The consonant phoneme inventory of Arrernte is presented in Table 1 (adapted from Breen & Dobson, 2005). As can be seen, the four CORONAL places of articulation (two APICALS—ALVEOLAR and RETROFLEX; and two LAMINALS—DENTAL and PALATAL) contrast in the STOP, NASAL, LATERAL, and PRE-STOPPED nasal series. With the BILABIAL and VELAR, there are a total of six places of articulation in Arrernte.

Arrernte may be analysed as having four vowels—/e/, /ə/, /i/ and /u/. However, /i/ and /u/ have a restricted distribution and an extremely low functional load, leaving only the two central vowels /e/ and /ə/ as the main vowels of the language. Moreover, rounding is usually analysed as a property of the consonant (Henderson, 1998), making the phonemic status of /u/ even more marginal.

It has been argued that Arrernte has an underlying VC syllable structure on the basis of various morpho-phonological processes and word games (Breen & Pensalfini, 1999). It is notable that about half of the words in the language begin with /e/ (see the Henderson & Dobson, 1994 dictionary), and the smaller proportion that begin with a consonant are analysed as being /ə/-initial

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