

Prosodic and Linear Licensing in English Acquisition

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1 Introduction

A common trait of the speech of young children is the replacement of dorsal stops (k, g) with coronal stops (t, d) word-initially (Vihmann & Hochberg 1986). In this paper we examine the phonology of a young girl, Sine, whose speech shows just this pattern and does so in a highly consistent way. Since we began studying her a year ago, Sine has gone through two stages in terms of initial dorsals. First she produced all initial dorsals as coronal (tuki ‘cookie’, tæk ‘quack’); later she produced dorsals before parental [w, r, ʃ] as dorsal but singleton dorsals as coronal (tuki ‘cookie’, kuʃæk ‘quack’). [Since the conference she has begun to produce initial dorsals correctly, regardless of position, but we won’t report on this stage as it is not yet complete.]

We argue here that Sine’s production of dorsal consonants supports a mixed view of featural licensing rather than an exclusively linear one (Steriade 1997, 2000). That is, the distribution of her dorsals is not easily described in terms of what precedes or follows them unless one also factors in information about the prosodic domain within which the dorsals occur. We claim that our data requires *linear licensing within a prosodic domain* (cf. Gerfen 2001), which we take to be the standard view in phonology at least since Kiparsky 1982.

2 Data

We began our study of Sine when she was 2;6 and are still studying her as this paper goes to print. Here we report on the first 10 months of our study. Sine is a monolingual English speaker acquiring central California English. Her mother speaks a standard 10-vowel California dialect and her father speaks a somewhat midwesternized dialect of English with an extra vowel [ɔ]; both parents have velarized (‘dark’) lateral [ɫ].

We look at two stages of her acquisition here: the first (2;9-3;2) from a time when she had no onset clusters (¹dedʌ ‘skater’), the second (3;2-3;6) from the time when she began to produce onset clusters (¹stet ‘skate’). Our general finding is that Sine can produce a dorsal stop *next to another dorsal within the same onset or rhyme*. Crucially, a dorsal stop is licensed by a following dorsal glide (ɥ) or liquid (ʎ) but not by a following vowel, however dorsal.

We note before going on that there is a single but amazingly robust counterexample to the generalizations sketched here: from as far back as we have records Sine has consistently produced the word ‘green’ with a dorsal, first as [gɪn], later as [gɥɪn] once complex onsets come in. Sine’s parents have a friend named Ondine [₁ʌn'dɪn] whose name (with loss of the initial syllable) forms a minimal pair with ‘green’ in Sine’s speech: [dɪn]. We doubt that avoidance of homophony is enough to force the dorsal into the color term, but have no better solution to the problem at present. We note that Sine changes all other such onset dorsals to coronals before high front vowels, so that the quality of the following vowel cannot be the conditioning factor.

Throughout our study we assume that Sine’s lexical representations are the same as her adults output forms (Smith 1973; Pater & Paradis 1995; Pater 1996; Tesar 1996; Curtin 2001). That is, we assume that she perceives the distinctions her parents make but fails to *produce* them in her speech: when asked to choose between *tea* (bag) and *key*, she consistently chose correctly, despite the fact that she neutralized both *tea* and *key* to [ti]. If Sine is like other children and chinchillas, she has been able to perceive all speech differences her parents perceive since she was born; she probably lost the ability to perceive differences not found in English sometime in her second year of life, but this plays no role in our study as we look only at native contrasts here.

2.1 Before onset clusters (2;9-3;2)

Before Sine begins to produce onset clusters (at 3;2), the distribution of her dorsal stops is fairly straightforward. Dorsals are changed to coronal foot-initially (1) and retained as dorsal elsewhere (2). Note that foot-initial covers a multitude of sins: word-initial syllables with primary stress (tæks ‘cracks’; ¹tʌʌ ^ɱcollar’); word-initial syllables with secondary stress (dɪ'baɪ ‘good-bye’); word-initial syllables with no stress (tə'wadi ‘karate’); word-medial syllables with primary stress (o'te ‘O.K.’), word-medial syllables with secondary stress ('pæn,tɛks ‘pancakes’).

(1) dorsal -> coronal foot-initially

tæks	‘cracks’	ˈtɑːlɑ	‘collar’
tɪs	‘kiss’	ˈtæbɪz	‘crabbies’
tɪdz	‘kids’	ˈtɑːfɪ	‘coffee’
tek	‘cake’	ˈtæmɪjə	‘camera’
taz	‘cars’	təʊn	‘clown’
təʊ	‘cow’	ˈtɪdi tæt	‘kitty cat’
ten	‘cane’	ˈtɛʊɪt	‘carrot’
ˈtɪkɪt	‘cricket’	ˈtʌmɪŋ	‘coming’
ˈtændi	‘candy’	ˈtɑːk,ɹɒtʃ	‘cockroach’
ˈtʌlɑ	‘color’	ˈtæso	‘castle’
ˈtek	‘cake’	ˈtɪdz	‘kids’
ˌoʊˈte	‘O.K.’	ˈpæn,teks	‘pancakes’
pəˈtʌz	‘because’	ˈtʌp,teks	‘cupcakes’
təˈwɑdi	‘karate’	ˌjækə təˈwækə	‘yacka-kawacka’
dɑɪz	‘guys’	dɛt	‘get’
do	‘go’	dʊl	‘girl’
dɒts	‘goats’	ˈdʊdʌ	‘scooter’
dʊd	‘good’	ˈdedʌ	‘skater’
de	‘grey’	ˈdaɪ	‘guy’
əˈden	‘again’	ˌdʊˈbaɪ	‘good-bye’
ˈpeɪˌdaʊn	‘playground’	ˌdʊˈnaɪt	‘good-night’

The elsewhere case includes foot-medial cases (ˈdɑːkɪŋ ‘stocking’; ˈtɪŋkə ‘twinkle’) as well as foot-final cases (tʊk ‘look’; nek ‘snake’):

(2) dorsal -> dorsal elsewhere

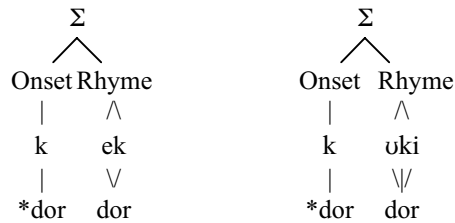
ˈtɪŋkə	‘twinkle’	tʊk	‘look’
ˈmɪki	‘Mickey’	ˈmɪlɪk	‘milk’
ˈbæŋki	‘Spanky’	nek	‘snake’
ˈdɑːkɪŋ	‘stocking’	ˈɑːlɪk	‘Alec’
ˈtʃɪkən	‘chicken’	ˈpæntek	‘pancake’
ˈkʊki	‘cookie’	sɑːk	‘sock’
ˈtʃɑːklɪt	‘chocolate’	dɪks	‘sticks’

bak	‘black’	τΑκ∞οτΣ	‘cockroach’
bɪg	‘big’	dɔg	‘dog’
dɪg	‘dig’	bʌg	‘bug’
ˈpɪɡi	‘piggy’	ˈfʌɡi	‘froggy’
ˈfɪŋɡʊ	‘finger’	ˈtɑɪɡʌ	‘tiger’
ˈtsaɪ,æŋɡɔɡɔɡo	‘triangle’	ˈπɛNɣωIv	‘tiger’
ˈɫʌɡə	‘mom’s reflection’	ˈbɪɡʌ	‘bigger’
ˈbɪɡi	‘Sine’s reflection’	ɛg	‘egg’

The distribution of Sine’s dorsal stops thus mirrors exactly the distribution of her parent’s dorsal nasal. Like most speakers of English, Sine’s parents do not produce [ŋ] foot-intially (*ŋæks, *ŋʊˈbaɪ, *ŋəˈwɑdi, *ˌoˈŋe, *ˈpæn,ŋɛks), but they do produce it foot-medially (ˈhæŋɪ ‘hangar’, dɪŋi ‘dinghy’) and foot-finally (hæŋ ‘hang’; θɪŋ ‘thing’).

We assume the following quantity-insensitive foot, where Onset means ‘foot-initial onset’ and Rhyme means ‘last stressed syllable and all that follows’:

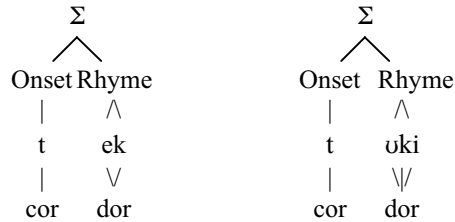
(3) English foot



This is not the same foot that seems to be used in English stress assignment (Hayes 1982; Kager 1989), but it is the same foot used for most segmental phenomena (Kiparsky 1982; Jensen 2000) and in English poetry since 1400 AD.

We have yet to ask why Sine would only produce dorsal stops in the rhyme at this stage. Like most phonologists we do not resort to a purely prosodic analysis here (‘the rhyme licenses dorsal stops while the onset does not’) in part because the rhyme is thought to be a poor licenser of features in the first place. Rather, we assume that something *within the rhyme* licenses the dorsal feature on the stops. Specifically, we claim that it is the inherent dorsality of vowels (Sagey 1986; Golston & Wiese 1995) that supports the dorsal closure of stops within the rhyme. Thus it is the vowels of kek ‘cake’ and kuki ‘cookie’ that support the final and medial [k], while the initial [k]s surface as [t]:

(4) fate of unlicensed dorsals ('cake' and 'cookie')



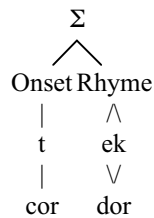
Our claim is then that dorsal stops are licensed within the rhyme because they are there always next to another dorsal, specifically a vowel. Dorsal stops are not allowed in onsets because onsets are (at this stage) always simplex and thus never have another dorsal to support the place of [k, g].

A prediction follows from this, namely that dorsal stops will be allowed in complex onsets that contain another dorsal, once complex onsets are found in her speech. The analysis in fact makes the peculiar prediction that [k, g] will not be licensed in simplex onsets or onsets like [sk] that lack another dorsal, but will be licensed in complex onsets which contain dorsals like [ʈ] and [ʈ]. And this is precisely what we find once complex onsets come in.

2.2 After complex onsets (3;2-3;6)

Sine begins to produce complex onsets at the age of 3;2, including clusters that obey sonority sequencing like 'kuʈak' 'quack' and those that do not like 'stet' 'skate' and 'skuʈɪʃ' 'squish'. Dorsal stops in simplex onsets continue to be produced with coronal articulation, as before:

(5) Dorsals in simplex onsets -> coronal



As before, this occurs in foot initial positions that are word-initial (6) as well as word-medial (7):

(6) foot-initial and word-initial

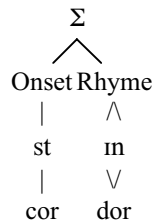
'tɛp	'cape	'tɑfi	'coffee
'tɪlə ,wɛɪ	'killer whale	'dʊd ,tæts	'good cats
'tʌp	'cup	'tɑpɪt	'carpet
ðə 'tɪdz ,tæn	'the kids can	'tʊkɪz	'cookies
'tɒd	'cold	'tɪsɪŋ	'kissing
'tʌlə	'color	'tʌm	'come
'tɔədʒ	'cards	'taʊnt	'count
'tɪz	'keys	'tʌsə	'castle
'tu ,tɛd	'Kool-Aid	'tʌvə	'cover
'daɪ	'guy	'dɒld	'gold
'dem	'game	'dʌl	'girl
'dɒs	'ghost	dɛt	'get
'dʌm	'gum	'dɒt	'got
'dʊd	'good	'dɒ	'go
'dʊd ,de 'sʌn ,ʃaɪn	'good-day sunshine	,dɒ 'dɛt hɪm	'go get him

(7) foot-initial and word-medial

'bʌbə ,dʌm	'bubble gum	,o'te	'O.K.'
'dʌbɪdʒ ,tæn	'garbage can	pə'tʌz	'because
'tʊkʌ ,dʊə	'cooker girl	'pæn ,tek	'pancake
fɔ'dʌt	'forgot	'dʌbɪʃ ,tæn	'garbage can

Dorsals in complex onsets that contain no other dorsal are also pronounced with coronal articulation, as predicted:

(8) Dorsals in complex onsets -> coronal if there's no dorsal sister ('skin')



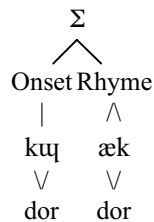
The only such cases involve [sk] clusters, as all other clusters with [k] or [g] involve another dorsal. For the [sk] clusters note that the [k] is indeed in the onset, but not foot-initial since the preceding [s] holds that position:

(9) in the onset but not foot-initial

'stet	'skate'	'studΛ	'scooter'
'stuʔ	'school'	'stidoz	'skittles'
ˌmædʒɪk 'stuʔ bΛs	'magic school-bus'	'stup	'scoop'
'strɪn	'skin'	'stufʃ	'scooch'

The data in (9) is not surprising given the data in (8), but the data in (10) is. Here we see that although Sine is not able to produce dorsals in simplex onsets or in sC onsets, she is able to produce them in complex onsets that contain a dorsal approximant:

(10) Dorsals in complex onsets remain *if* there is a dorsal sister



Crucially, the [k] is retained both when it is foot-initial (11) and when it is not foot-initial but foot-medial (12):

(11) in the onset and foot-initial

'kʌo ˌtau	'Clo the cow'	'gʌæsɪz	'glasses'
'aɪs ˌkʉɪm	'ice cream'	'gʌæs	'glass'
'kʉæk	'quack'	'gʉoŋ ʌps	'grown-ups'
'kʉaɪət	'quiet'	'skʉɪʃ	'squish'
'kʉɪs	'Chris'	'skʉæps	'scraps'
'kʉækʉ	'crackers'	'skʉəʉəʔ	'squirrel'
'dæns ˌkʌæs	'dance class'	ə 'kʌ	'a clue'

Note the lovely example ‘Clo the cow’, where the first [k] is retained because of the following dorsal [ŋ] but the second is changed to a coronal because there is no other dorsal consonant within the onset.

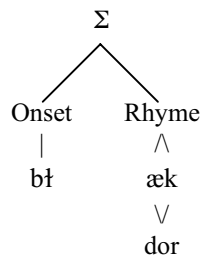
The foot-medial cases are equally instructive. They clearly show that it is not being foot-initial that licenses the dorsality but being next to another dorsal (ʉ or ʈ) within the onset.

(12) in the onset and foot-medial

'skʉɪʃ	'squish'
'skʉæps	'scraps'

Finally, dorsals within the rhyme remain dorsal (13), as before and as predicted:

(13) Dorsal within the rhyme remain dorsal



This applies to all dorsal in the rhyme, whether foot-medial or foot-final:

(14) in the rhyme and foot-medial

ˌmaɪ 'ɛgi	'my egg-y'	'ʉɪksəz	'whiskers'
'spæŋki	'Spanky'	'bʈæŋkɪts	'blankets'
ˌspeʃo 'taɪgʌ	'special tiger'	'tʉɪŋko	'twinkle'
'ʈʌgə	'Lugga'	'fɪŋgʉ	'finger'
'bɪgi	'Biggey'	'tʃʉɪɹaŋgo	'triangle'

(15) in the rhyme and foot-final

'bʈʌk	'block'	'bɪg	'big'
'ʈʌk	'look'	'dɔg	'dog'
'nek	'snake'	'ʌɪk	'Alec'

To recapitulate: Sine produces dorsal stops within an onset or rhyme only if there is another dorsal within that onset or rhyme. We turn now to two current proposals for featural licensing and show that neither adequately captures the pattern Sine's dorsals exhibit.

3 Alternative accounts

We have shown that an analysis of these data requires reference both to other sounds (dorsals) and to prosodic domains (onset, rhyme). In this section we'll show the inadequacy of limiting oneself to one type of environment or the other. First we show that neighboring sounds alone do not account for the data (3.1) and then we show that prosodic environment alone does not account for the data. The first of these claims is controversial since Steriade has recently claimed that phonotactics can indeed be described without reference to prosody. The second claim is less controversial and probably the consensus view among phonologists, most of whom use both prosody and segmental environment.

3.1 Linear licensing (Steriade 1997, 2000)

Steriade has argued in recent work that features are licensed not hierarchically by onset and rhyme, but linearly by preceding and following sounds. Laryngeal contrasts, she claims, are not licensed by onsets but by following vowels and/or sonorants.

Of concern presently is the licensing of major place contrasts like dorsal. Steriade claims that these are licensed by *following* vowels and/or sonorants, like laryngeal contrasts, which she calls 'right-anchoring' because the place contrast is anchored in the vowel or sonorant to its right:

(16) Major place contrasts ($b \approx d \approx g$) are 'right anchored'

'right-anchored place contrasts...typically neutralize in the absence of a following vowel or sonorant' (Steriade 2000, 20)

Right-anchored licensing of this sort predicts that the dorsal/coronal contrast will be neutralized in the absence of a following vowel or sonorant and maintained in the presence of a following vowel or sonorant. But this is the opposite of what we find in Sine's data (17).

Specifically, the contrast is often neutralized in the presence of a following vowel (^ltɪs 'kiss') and maintained in the absence of a following vowel (^ltʊk 'look'). Checked (√) rows indicate data that is consistent with linear licensing of dorsal, while starred (*) rows indicate data that is inconsistent with linear licensing of dorsal:

(17) mispredictions if dorsal is *right*-anchored

'tɪs	'kiss'	* (shouldn't neutralize but does)
pə'tʌz	'because'	* (shouldn't neutralize but does)
tə'wɑdi	'karate'	* (shouldn't neutralize but does)
ˌdʊ'baɪ	'good-bye'	* (shouldn't neutralize but does)
'lʊk	'look'	* (should neutralize but doesn't)
'bɪg	'big'	* (should neutralize but doesn't)
'pɪɡi	'piggy'	√
'bæŋki	'Spanky'	√
'kʊæk	'quack'	√
'stet	'skate'	* (shouldn't neutralize but does)

The problem does not lie with the choice of *right*- vs. *left*-anchoring. If we try a left-anchored analysis (going against Steriade's actual claims) the predictions are significantly better but still wrong:

(18) mispredictions if dorsal is *left*-anchored

'tɪs	'kiss'	√
pə'tʌz	'because'	* (shouldn't neutralize but does)
tə'wɑdi	'karate'	√
ˌdʊ'baɪ	'good-bye'	√
'lʊk	'look'	√
'bɪg	'big'	√
'pɪɡi	'piggy'	√
'bæŋki	'Spanky'	√
'kʊæk	'quack'	* (should neutralize but doesn't)
'stet	'skate'	√

There are really two problems here. The first lies with the dorsals that appear to be left-anchored (19) and serve as a simple counterexample to (16):

(19) 'left-anchored' dorsals

'buk	'book'	'bɪg	'big'
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The second problem lies with dorsals that appear to be licensed by a following sonorant consonant but *not* by a following vowel:

(20) licensing by sonorant but not by vowel

'kʷæk	'quack'	right-anchored by following sonorant
'tɪs	'kiss'	not right-anchored by following vowel

The logic of Steriade's proposal demands that vowels be better licensors for things like laryngeal and place features than sonorant consonants, which are better licensors than obstruents. Here we find the opposite of what the theory leads us to expect: a major place contrast is maintained before a sonorant consonant but neutralized before a vowel.

If our analysis of the data is correct, dorsals are both left- and right-anchored in Sine's speech. They are left-anchored in the rhyme ('buk 'book') and right-anchored in the onset ('kʷæk 'quack'). What matters is that there be another dorsal within the onset or within the rhyme in which the dorsal stop occurs. Some prosodic conditioning is necessary here because *being in the same onset or rhyme* as another dorsal is crucial.

[Edward Fleming suggested at the conference that applying developmental data like this to a model designed for adult phonology is inappropriate. We disagree fundamentally, but point out that even if this developmental data is ruled out, linear licensing theory must still contend with parallel data in adult speech, specifically the phonotactics of the dorsal nasal in English. As pointed out by Bruce Hayes at the conference, the velar nasal patterns the same way in adult speech as the dorsal stops do in Sine's speech.]

3.2 Prosodic licensing (especially Jensen 2000)

Kiparsky (1979) shows that fortition is generally a foot-initial process while lenition tends to occur foot-medially and foot-finally. Drawing on this observation, Jensen 2000 provides an elegant analysis of a number of segmental phenomena central to the phonology of English. We show here that such an analysis fails to account for our data because Sine neutralizes the dorsal/coronal distinction foot-initially and retains it medially and finally.

If the place of maximal contrast is the foot-onset (Jensen 2000), we get the following mispredictions for the data at hand:

(21) mispredictions if foot-initial position *licenses* contrasts

'tɪs	'kiss'	* (shouldn't neutralize but does)
pə'tʌz	'because'	* (shouldn't neutralize but does)

tə'wadi	'karate'	* (shouldn't neutralize but does)
du'baɪ	'good-bye'	* (shouldn't neutralize but does)
'lʊk	'look'	* (should neutralize but doesn't)
'bɪg	'big'	* (should neutralize but doesn't)
'pɪɡi	'piggy'	* (should neutralize but doesn't)
'bæŋki	'Spanky'	* (should neutralize but doesn't)
'kʌæk	'quack'	√
'stet	'skate'	√

If we turn Jensen's analysis on its head we get a better set of predictions, but still the wrong set:

(22) mispredictions if foot-initial position *fails to license* contrasts

'tɪs	'kiss'	√
pə'tɪz	'because'	√
tə'wadi	'karate'	√
du'baɪ	'good-bye'	√
'lʊk	'look'	√
'bɪg	'big'	√
'pɪɡi	'piggy'	√
'bæŋki	'Spanky'	√
'kʌæk	'quack'	* (should neutralize but doesn't)
'stet	'skate'	* (shouldn't neutralize but does)

The problem is with the last two types of word: foot-initial dorsals are allowed but only if there is another dorsal in the onset. In words like 'quack' or 'cookie', we expect the foot-initial dorsals to neutralize, just as the foot-initial dorsals in 'kiss' and 'because' neutralize, but they don't. In words like 'skate' and 'skittles' we expect the foot-medial dorsals to remain, just as the foot-internal dorsals in 'piggy' and 'Spanky' remain, but they don't.

This type of purely prosodic account fails to work when a neighboring sound is required: the dorsal stops in 'quack', 'cookie', 'skate' and 'skittles' are retained if they're next to another dorsal within the onset or rhyme in which they occur, and changed to coronal otherwise. Some linear licensing is necessary here because *being next to another dorsal* within a given prosodic domain is crucial.

4 Conclusion

Sine's later data follows a simple pattern. Dorsals are licensed by

- (i) a dorsal in the same onset, or
- (ii) a dorsal in the same rhyme

These are both hybrid environments, using elements of both linear and prosodic licensing. We suspect this is what most proponents of prosodic licensing assume anyway, that prosodic domains define the domains within which (across which, at the edge of which) phonotactic restrictions hold (Selkirk 1980; Itô 1986; Nespor & Vogel 1986). To our knowledge, nobody has ever seriously suggested that licensing is *exclusively* prosodic, but we provided evidence against such a claim just in case. Steriade has recently claimed that licensing is *exclusively* linear with no prosodic conditioning and we have provided evidence against this claim as well.

Note

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