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ON THE ASYMMETRY OF AFFRICATES

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1. Introduction

The problem of affricates is well-known[1]. Consider the Russian sounds /t/, /s/, and /t^s/ in the words /t/'elo 'body', /s/'elo 'village', and /t^s/eloe 'entire' neuter singular. (The apostrophe ' represents palatalization.) As these three words show stops, fricatives, and affricates are each treated as phonemically distinct. German also makes a similar distinction between stops and affricates in pairs like /t/eller 'plate' and /t^s/elle 'cell'. Because both stops and affricates are treated as distinct sounds in each of these languages (as well as many other languages) we know that the stop or [–continuant] portion and the fricative or [+continuant] portion of these affricates are not just two sounds that happen to be contiguous; they make up a single unit. But at the same time "the [+continuant] and the [–continuant] components cannot be implemented simultaneously – they involve the physically incompatible actions of narrowing and widening of the vocal tract" (Kenstowicz 1994: 499). Clearly, a theory is needed that is able to account for both the [–continuant] and [+continuant] aspects of the affricate.

In this paper I review several approaches that have been presented in the literature to deal with this problem that are all, in some crucial way, flawed. I then propose a modification of one of those theories that is able to accurately explain all the data. I also suggest several ways that this theory might be used to explain other contour segments; namely diphthongs, prenasalized stops, and languages with contour tones.

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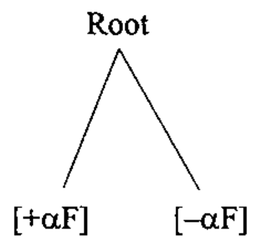
[1] This paper is a revised version of my unpublished MA essay (Baxter 1997) and of a lecture I gave at the Adam Mickiewicz University School of English Phon and Phon lecture series. I would like to thank Monika Pawłowska, Martha Ratliff, Pat Siple, and Ljiljana Progovac and the anonymous PSiCL reviewer for their valuable suggestions on the paper.

2. Sagey's theory

Sagey (1986), building on autosegmental theory developed to describe tone systems, proposed contour segments as a model to describe and explain phonological units containing more than one element. She claimed that her proposal could be used to describe contour tones, affricates, and prenasalized stops. Her model is symbolized in figure 1:

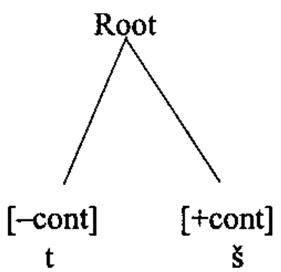
Figure 1. Sagey's model of contour segments.



α = any value (+ or –)
F = any feature

While Sagey's theory has been challenged – Lombardi (1990) has criticized her representation of affricates as ordered segments, Duanmu (1994) has criticized her representation of contour tones, and Herbert (1986) has criticized her representation of prenasalized stops – I believe that with some modifications her theory can be used to accurately describe affricates. Sagey proposed that affricates have two ordered components: a [–continuant] unit or [–cont] and a [+continuant] or [+cont] unit. She represented an affricate such as *č*, which, if subdivided into smaller units, contains a stop or [–cont] portion, *t*, and a fricative or [+cont] portion, *š*, as in Figure 2.

Figure 2. Sagey's affricate model



She argued that since this particular feature, [cont], is ordered, affricates will show edge effects, i.e., they will pattern with stops for sounds which precede them and with fricatives for sounds which follow them.

In order to show that "[affricates] behave as stops with respect to phonological rules sensitive to their left edges" Sagey presented evidence from Zoque (1986: 93-94) which she borrowed from Kenstowicz and Kisseberth (1979) with data originating from Wonderly (1951). In this language there is a rule which states that non-continuants are voiced when preceded by nasals as stated in (1):

(1) [–cont] → [+voice] / [+nasal] __
[–voice]

Kenstowicz and Kisseberth (1979: 35) noted that this rule applies to stops and affricates.

Table 1. Zoque voicing rule for stops and affricates.

original	changed sound	gloss
/min - pa/	[minba]	'he comes'
/min - tam/	[mindamʌ]	'come' (plural imperative)
/pʌn - čʌki/	[pʌnǰʌki]	'figure of a man'
/N - pama/	[mbama]	'my clothing'
/N - tatah/	[ndatah]	'my father'
/N -čo?ngoya?/	[ñǰo?ngoya]	'my rabbit'

The data in Table 1 contrasts with the data in Table 2 in which the sequences of nasal followed by fricative are either left unaffected or the nasal is deleted.

Table 2. Zoque voicing rule for fricatives.

original	changed sound	gloss
/winsa?u/	[winsa?u]	'he received'
/N - sʌk/	[sʌk]	'my beans'
/N - šapun/	[šapun]	'my soap'

Because this rule applies to affricates and stops and not fricatives it argues for the existence of edge effects and consequently for contour segments because only the stop edge of the affricate – and not the fricative edge – is affected by this rule.

Sagey also demonstrated that "affricates behave as fricatives with respect to phonological rules sensitive to their right edges" (1986: 94-95) with data from Kutep and Sierra Popoluca. In Kutep, she found some data which shows that under certain conditions stops behave differently than fricatives and affricates do in the same environment. This is exemplified by what may be called labiodentalization, a process whereby labials following fricatives and affricates become labiodental, but labials following stops remain bilabial.[2] Since fricatives and affricates pattern together and

[2] Sagey (1986) said that labials following stops are bilabials, but they are /w/ in every case in her data which is actually a labiovelar, not a bilabial.

stops do not, in respect to a sound following them, Sagey concludes that the right edge of the affricate is a [+cont] segment. Her data, which I present in tables 3a-3c, is from Ladefoged (1968: 31,62).

Table 3a. Kutep fricatives.

sound	gloss
basfa	'they kneel'
nsazvakwa	'the water is hot'
bazve	'they washed'
bazvam	'they begged'
açfapaŋ	'groundnuts'

Table 3b. Kutep affricates.

sound	gloss
batcfap	'they chose'
batcfak	'they sleep'

Table 3c. Kutep stops.

sound	gloss
bapwa	'they grind'
bampwa	'they tasted'
batwap	'they picked up'
bandwap	'they wave'
naszvakwa	'the water is hot'

According to Sagey (1986: 95), with data taken from Foster and Foster (1948), in Sierra Popoluca stops at the end of a syllable are aspirated, as shown in Table 4a, while affricates (Table 4b) and fricatives (Table 4c) are not. In other words, affricates act as though they were fricatives when there is a sound change that on the right hand, or fricative, side of the affricate.

Table 4a. Sierra Popoluca stops.

sound	changed sound	gloss
/həp/	[hep^{h}]	'mouth'
/ʔampat/	[ʔampat^{h}]	'I met'
/mək/	[mək^{h}]	'fog'

Table 4b. Sierra Popoluca affricates.

sound	changed sound	gloss	change that did not occur
/mač/	[mač]	'grasp'	*mač^{h}
/ʔapič/	[apič]	'thorn'	*ʔapič^{h}

Table 4c. Sierra Popoluca fricatives.

sound	changed sound	gloss	changed sound
/wəsten/	[wəsten]	'two'	*wəs^{h}ten
/pištək/	[pištək]	'flea'	*piš^{h}tək

Both Kutep and Sierra Popoluca have rules in which affricates seem to pattern with fricatives when there is a sound change occurring on the [+cont] side of the affricate. And since this fricative portion patterns with the rules which involve fricatives her data argues for the existence of edge effects and consequently for contour segments since only the right edge or the [+cont] side of the affricate is affected in these cases.

One may, however, question the significance of the fact that stops may appear aspirated at the end of syllables while fricatives and affricates may not because, as Catford (1988: 60) notes, "aspirated fricatives are much rarer than aspirated stops in the world's languages, but they do exist." If it is rare for fricatives to be aspirated, it is not so significant to find an example of a language with aspirated stops but not fricatives in a similar language. It is, however, significant to note that this language does not have aspirated affricates; because, as Maddieson (1984: 38) points out aspirated affricates are quite common and the voiceless aspirated affricates [ts^{h}], [tš^{h}] are the second most frequent type of affricates in his corpus.

3. Hualde's challenge to Sagey's theory

Hualde (1987, 1988) developed a notion of anti-edge effects which challenged Sagey's theory. He showed that in Basque there is a phonological rule which affects stops and affricates but this rule is triggered by a sound which is adjacent to the opposite side of the affricate than the side Sagey would have predicted – it occurs on

the [+cont] side not on the [–cont] side, i.e. it occurs on the fricative side not the stop side. Sagey predicted that any sound that affected the stop portion of the affricate would occur on the left side of the affricate. Hualde showed a sound that occurred to the right of the affricate, but affected the left side of it. He demonstrated this edge effect by analyzing a rule of stop deletion in Basque. When there are two contiguous stops the first of the two is deleted as shown in Table 5 (Hualde 1987: 77-78). His data is taken from Salaburu (1984).

Table 5. Basque stop deletion.

sound		changed sound	gloss
/bat paratu/	→	ba-paratu	'put one'
/guk piztu/	→	gu-piztu	'we light'
/ezdut nahi/	→	ezdu-nahi	'I do not want'[3]

This rule applies to affricate stop sequences as shown in Table 6 in which affricates decompose into fricatives when followed by a stop. In other words, the stop portion of the affricate is deleted when followed by a contiguous stop.

Table 6. Basque affricate decomposition.

sound		changed sound	gloss
hitz + tegi	→	hiztegi	'dictionary'
hotz + bat	→	hozbat	'a cold'
haritz + ki	→	harizki	'oak wood'

The phonological rule presented in example Table 6 shows that the stop edge, rather than the fricative edge, is affected by the rule – it is an anti-edge effect. Since Sagey relied on edge effects to argue for the representation of affricates as contour segments, and since Hualde showed that Basque has a clear problem with the existence of edge effects, it leaves the existence of edge effects in serious doubt, and consequently, it also leaves the notion of affricates as contour segments in serious doubt.

[3] Hualde uses some non-standard notation (1987: 88). As he says:

> Basque has three voiceless sibilant fricatives: dorso-alveolar z [s], apico-alveolar s [ś], and prepalatal x [š]. Corresponding to these three articulations, there are three voiceless affricates tz [c], ts [ć] and tx [č].

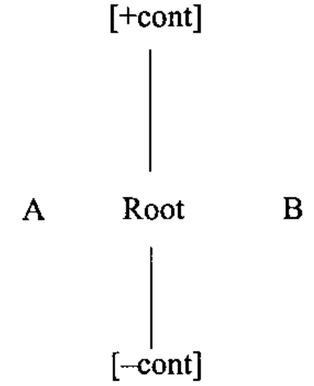
4. Lombardi's solution

Lombardi (1990) recognized the problem that Hualde showed in Sagey's theory, and she proposed her own theory to explain this. In her view affricates are unordered at the phonological level and that they become ordered at the phonetic level. Like Sagey, she recognized that

> Affricates undergo processes that apply to stops and processes that apply to fricatives; they must have both the value of [–cont] that stops have [and the value of [+cont] that fricatives have], yet be distinct from both. ... So, it is necessary to retain two values of [cont] in underlying representation (Lombardi 1990: 378).

However, she claimed that the two values [+/– cont] of affricates "are ... like separate place features, unordered and represented on separate tiers" (Lombardi 1990: 378). And so, bearing these things in mind, Lombardi symbolized affricates as I have in Figure 3 with A and B representing the contexts before and after the affricate.

Figure 3. Lombardi's affricate model.



She noted that, since it is unspecified which value of [cont] is next to A and which is next to B, there is no distinction between those sounds sensitive to edge effects (Zoque (Tables 1 and 2) and Kutep (Tables 3a-3c)) and sounds that are not sensitive to edge effects (Basque (Tables 5 and 6)). She gave more examples of anti-edge effects which her theory is able to explain but which Sagey's theory can not.

In Yucatec Maya (from Straight (1976)) for instance, Lombardi (1990: 383) showed that stops become [h] before homorganic stops and affricates, and affricates become fricatives before homorganic stops and affricates. In other words, both stops and affricates involve reduction, but fricatives do not. Sagey's theory would not have predicted this. Her theory would have predicted that affricates would not pat-

tern with the stops because the context triggering this rule occurs on the [+cont] or fricative side of the affricate. This is illustrated in table 7 below.

Table 7. Yucatec Maya.

sound		changed sound	gloss
(a) taaŋ k pak'ik̲ k̲ kool	→	taaŋ k pak'ik̲ h̲ kool	'we're planting our clearing'
(b) le?iŋ w ot̲ čo	→	le?iŋ w oh̲ čo	'that house of mine/my house there'
(c) tun kolik̲ k̲'aaš	→	tun kolih̲ k̲'aaš	'he's clearing bush'
(d) ?uc̲ t̲ iŋ w ič	→	us̲ t̲ iŋ w ič	'I like it' (lit., 'goodness is at my eye')
(e) c'u ho?oč̲ t̲ik	→	c'u ho?oš̲ t̲ik	'he scratched it'

Lombardi (1990: 384) also showed that in Turkish (Clements and Keyser 1983, Lewis 1967, Nemeth 1962) stops and affricates, but not fricatives, are devoiced in syllable-final position. As she noted,

> this presents a problem for a theory where the values are ordered, because again the context is on the right-hand (fricative) side of the affricate, and yet the affricate acts like the stops. But if the values of [cont] are underlyingly unordered, this rule is simply:
>
> [–cont] → [–voice]/__]$_\sigma$
>
> Since affricates are [–cont] [in this context] they will undergo this rule.
> (Lombardi 1990: 385)

In Table 8 I exemplify this with Lombardi's Turkish data. The fricative in *deniz* is voiced in its final position in the nominative case – if it were patterning with affricates it would have to be *denis*. All of the other sounds, the stops and the affricate, are devoiced in syllable final position in the nominative case and voiced before a vowel.

Table 8. Turkish.

Nominative	Plural	case	gloss	sound
deniz	denizler (PL)	denizi (POSS)	'see'	FRICATIVE
kitap		kitaba (DAT)	'book'	STOP
sebep	sebepler (PL)	sebebi (POSS)	'reason'	STOP
sepet		sepedi (ACC)	'basket'	STOP
pabuč	pabučlar (PL)	pabuǰ u(POSS)	'slipper'	AFFRICATE

5. Rubach's challenge to Lombardi's theory

Rubach (1994) attacked both Sagey's theory, which he calls the Ordered Component Theory, and Lombardi's theory, which he calls the Unordered Component Theory. Since Hualde's Basque data served as an excellent demonstration of the flaw within Sagey's theory, I see no need to discredit it further by mentioning Rubach's arguments which it could not explain either. Instead, I concentrate on problems he shows in Lombardi's theory.

Rubach attacked Lombardi's theory by showing some Polish data in which coronal nasals turn into nasal glides before fricatives but not before affricates (1994: 129). His rule may be stated as I have in (1) and (2).

(1) n → w̃ / __ [+cont]
(2) ń → j̃ / __ [+cont]

In Table 9 we see that the first rule, n → w̃ / __ [+cont], is invoked before a fricative in *wstążka* but not before an affricate, *wstędze* or a stop, *krąg*.

Table 9. Polish coronal nasals.

word	sound	changed sound	gloss
wstąż + k + a	/fstonż + k + a/ →	[fstow̃ž + k + a]	'ribbon'
cf. wstędz + e	[fstend^z + e]	(unchanged)	'ribbon' (dat. sg.)
krąż+ek	/kronż + ek/ →	[krow̃ž + ek]	'circle' (dimin.)
cf. krąg	[kroŋk]	(unchanged)	'circle'

In Table 10 we see the second rule, ń → j̃ / __ [+cont] being invoked.

Table 10. Polish palatal coronal nasals.

word and gloss	sound of word with suffix added	changed sound	gloss for changed sound
koń 'horse'	/koń + sk + i/ →	[koj̃ + sk + i]	'equine'
drań 'cad'	/drań + sk + i / →	[draj̃ + sk + i]	'cad' (adjective)
drań 'cad'	/drań + stv + o/ →	[draj̃ + stf + o]	'caddish things'
Poznań (name)	/poznań + sk + i/ →	[poznaj̃ + sk + i]	Poznań (adjective)

In each of these examples in Table 10 the nasal stop is affected by this rule. Rubach neglected to show any examples of nasal gliding before stops, presumably because this rule does not apply to them. I offer a few examples of this in Table 11

and note that according to my source[4] this rule does indeed not apply to them; as Rubach predicted, stops behave like affricates, and this rule can only be invoked when the nasal precedes a fricative – not a stop or an affricate.

Table 11. (The lack of) nasal gliding before stops.

word	sound	gloss	change that did not occur
ogieńki	/ogʲieńki/	'little flames'	*/ogʲiej̃ ki/
maleńki	/maleńki/	'small' (diminutive)	*/malej̃ ki/
kąt	/kont/	'corner'	*/kow̃t/
punkt	/puŋkt/	'point'	*/puw̃kt/
błąd	/bwont/	'mistake'	*/bwow̃t/
lądowy	/londovI/	'land'	*/low̃dovI/

When one considers that each of these sound changes occur before fricatives but not before affricates it "leads to the conclusion that affricates behave like [–cont] segments" (Rubach 1994: 128). He noted that since Lombardi considers the features [–cont] and [+cont] to be unordered, it means that there is a possibility that the [+cont] portion of the affricate could be adjacent to the preceding nasal which would invoke the rule of nasal gliding, but this does not happen. Thus we have an argument against Lombardi's Unordered Component Hypothesis.

While Rubach has a compelling theory, it has some flaws. Kenstowicz (1994: 502-503) pointed out that Rubach is unable to deal successfully with Hualde's Basque data (shown earlier in Tables 5 and 6 in which [t] deletes before the stop in 'put one' while [tˢ] simplifies to [s] in 'dictionary'.

Rubach's model stated that rules will group affricates and fricatives together only to the extent that both are strident.[5] In other words, he believed that affricates should be characterized as strident stops in the same way that Jakobson, Fant, and Halle (1952) characterized them. However, this presents a problem when one considers the Kutep data again (see Tables 3a-3c).

In the Kutep word for 'groundnuts' the fricative, *f*, is the sound in question. Like other fricatives in this language it patterns with affricates. But *f* is clearly not a strident sound. Rubach's theory is clearly not able to explain why this sound patterns with affricates in this language. This is a serious problem for Rubach's theory of affricates as strident stops.

[4] I thank Monika Pawłowska for helping me find these examples.

[5] Stridency refers to the relative amount of acoustic turbulence of a sound. See Kentstowicz (1994: 29) for a more extended discussion.

6. The theory of weighted contour segmentst

I believe that Sagey was essentially on the right track when she proposed her theory of contour segments. But, primarily because of the problem of anti-edge effects in which a rule associated with the [–cont] portion of the affricate is triggered by the context on the [+cont] side of the affricate, it is obvious that her theory can not stand unmodified.

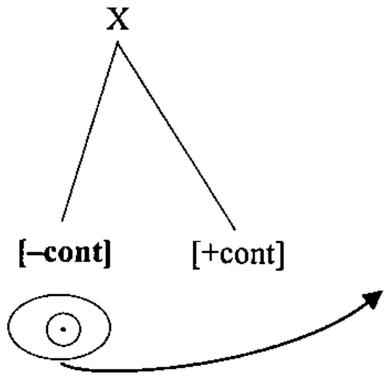
In order to account for anti-edge effects, I propose a modification to Sagey's theory. I claim that one portion of the contour segment is weighted more heavily than the other. More specifically, the stop element or [–cont] portion of the affricate manifests itself more often than the fricative element or [+cont] portion of the affricate does. Affricates behave like stops in respect to phonological rules more often than they behave like fricatives. I call this the principle of stop dominance.

Two things need to be considered to fully understand the theory of weighted contour segments. One, the basic structure that Sagey proposed for affricates is still maintained, i.e., affricates still consist of a single unit with two components. Those two components are still a [–cont] or stop section and a [+cont] or fricative section in that order. Two, these two sections continue to demonstrate edge effects, but the [–cont] or stop section may override the [+cont] or fricative section because it is more heavily weighted than its counterpart and it is able to see through or around it and can be affected by rules on the right hand portion of the affricate to act as though there were a stop portion on that end.[6] The fricative portion may be subject to rules on the right side of the affricate, but it will never be subject to rules on the left side; it is unable to see around the stop portion of the affricate in order to take advantage of rules that may affect it.

The theory of weighted contour segments is represented in Figure 4 presented below. The fact that the [–cont] or stop section is able to occasionally override the [+cont] section and take advantage of rules that would affect it from that side of the sound is shown by the fact that it is in bold type and larger than its counterpart; this bold type emphasizes the fact that it is heavier than the [+cont] or fricative portion. The [–cont] or stop portion is able to occasionally see through or around the [+cont] or fricative portion when there is a rule that affects stops on the right hand side of the affricate. This ability of the [–cont] portion of the affricate to see past the [+cont] portion is represented by an eye. The line and arrow beneath the eye indicate that the [–cont] portion is looking beyond the [+cont] portion.

[6] Throughout this section I talk about how the stop portion of the affricate may be affected by rules to the right of the affricate but I don't say that it could also affect sounds to the right of the affricate. Presumably this is true, but I have been unable to find any data to confirm this, and, hence, I do not make this claim here.

Figure 4. The theory of weighted contour segments.



Sagey's ordered structure, with the [–cont] portion preceding the [+cont] portion, is maintained because the production of the affricate still occurs through time and the [–cont] or stop portion still occurs before the [+cont] or fricative section.

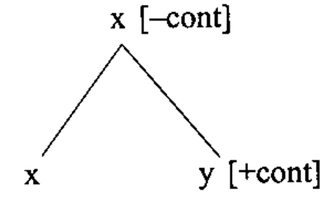
6.1. Reexaming the data in light of the new theory

The theory of weighted contour segments can easily explain Sagey's Zoque, Kutep, and Sierra Popolaca data since the theory is a revision of her theory and the revision does nothing to damage the original explanatory power it had. And while Sagey's theory could not account for Basque anti-edge effects the theory of weighted contour segments can because of the principle of stop dominance. The principle of stop dominance is also able to explain the Yucatec Maya and Turkish data because in both of these languages a sound change took place because the [–continuant] portion of the affricate was able to see around the [+continuant] portion in order to take advantage of the material that would invoke the rule in question. The Polish data, in which a sound change took place before fricatives but not before stops or affricates, is also not a problem for the theory of weighted contour segments because it could be explained by Sagey's original theory of contour segments.

6.2. Expanding the theory

In section 6 I introduced Figure 4 as a model to demonstrate the theory of weighted contour segments. I also noted there that the eye represents the fact that the [–cont] segment can see through or around the [+cont] segment. This model is helpful, but it is not the only way that affricates could be represented in the theory of weighted contour segments. If, instead of this model, I used a tree branching structure, then I would be using a model that is widely accepted in the fields of syntax and morphology. This could be modeled as in Figure 5 below.

Figure 5. Affricate tree branching structure model.



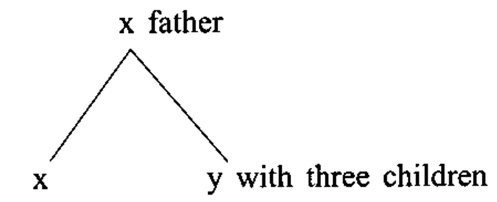
The *x* represents the [–cont] segment and the *y* represents the [+cont] segment. The fact that the [–cont] segment is able to take advantage of rules both to the left of it and to the right of it is captured by the fact that it is at the top of the tree. It is called the head. The fact that the [+cont] segment is subservient to the [–cont] segment is represented by the fact that it appears at the bottom of the tree. It is called the daughter. Because the [–cont] segment dominates the [+cont] segment, the features of the head will be visible from both edges. Because *y* is adjoined to the head segment, *x*, it can not be an individual unit – it continues to be a part of the complete affricate.

A similar phenomenon occurs at the syntactic level. Consider the following examples of agreement with a complex noun phrase in (3) and (4).

(3) A father with three children is waiting outside.
(4) ?A father with three children are waiting outside.

Although the noun phrase is semantically plural, the head of the noun phrase, *father*, determines verb agreement in (3). *Father* demands a verb used to mark a singular noun phrase rather than a plural noun phrase even though the plural portion of the noun phrase is between it and the verb phrase. In other words, its features are visible both on the right and left side of the noun phrase. The noun phrase in (3) and (4) might be diagrammed like I have in Figure 6 below.

Figure 6. A model of how a head determines agreement.



Because *x*, *father*, is the head of the phrase and above *y*, *with three children*, it can determine agreement from both edges.

The features of the adjunct, *with three children*, can, at least for speakers of some varieties of English, determine agreement if it is adjacent to it (as in 4), but not if the agreement precedes the adjunct as in (5) and (6).

(5) There is a father with three children waiting in the backyard.
(6) *There are a father with three children waiting in the backyard.

Like the affricate examples throughout this essay, the head can determine agreement from both edges, while the adjunct can determine agreement only if it is adjacent to it. Since both affricates and syntax can be accurately described using this model it suggests that this phenomenon of heads dominating their adjuncts is not limited to syntax.[7]

6.3. Dealing with a potential counterexample

There is a phenomenon that might be considered a problem for the theory of weighted contour segments which I would like to take up in this section. In Polish fast/rapid speech fricatives are place assimilated to the [+cont] portion of the following affricate over the intact [–cont] portion. Affricates are also affected by the same rule. However, stops are not affected by this rule. This is shown below in tables 12 and 13 (data taken from Dukiewicz and Sawicka 1995: 151).

Table 12. Pre-fricative place assimilation.

word	sound	gloss
z+szyć	ššIč	'to sew' (perfective)
z+śnieć	ššiɲEč	'to turn blue' (perfective)

Table 13. Pre-affricate place assimilation.

word	sound	gloss
z+czepić	štšEpič	'to connect/to combine' (perfective)
z+cisnąć	štšisnonč	'to squeeze/to press hard' (perfective)

This certainly appears to be a problem for the theory of weighted contour segments because the affricates in this data appear to have their stop portion undergo a rule which normally applies to fricatives, and this rule does not apply to stops. This is not something that the theory would have predicted.

This problem can, however, be explained quite easily. Polish has alveolar fricatives and affricates, but it does not have alveolar stops (Stone 1987: 352-353).

[7] While their work is concerned primarily with prosodic morphology rather than contour segments, McCarthy and Prince (1990, 1991) use a model that has similarities to the tree-branching structure I have outlined here.

The reason why alveolar fricatives and affriacates pattern together and alveolar stops do not is because there are no stops available in Polish to pattern with the fricatives and affricates in this case.

7. Summary and suggestions for further research

In this paper I discussed whether or not affricates could be viewed as weighted contour segments. I began by describing Sagey's original notion of contour segments and the evidence from edge effects that she used to argue for their existence. I then showed that this theory was flawed and I presented the other theories that have been suggested to replace it. However, each of these theories also had a crucial flaw. To remedy this problem I proposed the theory of weighted contour segments which was able to explain all the data thus far. I then demonstrated that this theory is quite similar to the notion of head adjuncts used in syntactic theories.

I believe that the theory of weighted contour segments does an excellent job explaining the behavior of affricates, but I also believe that it could be used to help explain sounds other than affricates. Specifically, I believe that it would be fruitful for other scholars to explore how this theory may be able to explain three other types of sounds that Sagey considered to be contour segments: diphthongs, prenasalized stops, and tones. I suggest three thought experiments that suggest that these three types of sounds may be described using the theory of weighted contour segments.

First, consider diphthongs. They are often described as having two elements: a dominant element and a recessive element more commonly called a glide. If the recessive element is the first element it is called an onglide; if the second element is the recessive element it is called an offglide[8]. If there were a language with diphthongs in which the first vowel element was the dominant element and the second element was an offglide this diphthong could be tested to see if it behaves like weighted contour segments. If the dominant element was affected by phonological rules that had to pass through or around the offglide in order to be invoked, then it would be clear that the diphthongs in this language are weighted contour segments.

Second, consider prenasalized stops. They are often thought of as a single unit with a recessive first unit and a dominant second unit. If there were evidence that these units did, in fact, work like this there would be some evidence for them acting as weighted contour segments. Stop rules that are invoked by material before the stop would be an ideal test case. If prenasalized stops were also affected in such a case, then this would mean that the phonological rule was looking beyond the nasal segment to the stop – a clear case of a weighted contour segment.

Third, consider tones. A Tone language like Mandarin Chinese, with its rising tones and falling (and other types of) tones, is an example of a language with con-

[8] See Kenstowicz (1994: 45-46) for further discussion and references regarding this notion of diphthongal onglides and offglides.

tour tones because three of its four tones are multiple tones associated with a single tone bearing unit. A language with contour tones might have tonal units in which the high tone dominated the low tone. If this were the case, then one would expect that if there were a rule that affected high level tones, and not low level tones, then contour tones would behave the same as high level tones. If there were such an example it would show that tones can be seen as weighted contour segments.

REFERENCES

Baxter, S. 1997. Affricates are weighted contour segments. Unpublished M.A. Essay. Program in Linguistics: Wayne State University, Detroit.

Catford, J. C. 1988. *A Practical Introduction to Phonetics*. Oxford: Oxford University Press.

Clements, G. N. and S. J. Keyser. 1983. *CV Phonology: A Generative Theory of the Syllable*. Cambridge, Mass.: MIT Press.

Comrie, B. 1987. *The World's Major Languages*. Oxford: Oxford University Press.

Duanmu, S. 1994. "Against contour tone units". *Linguistic Inquiry* 25. 555-608.

Dukiewicz, L. and Sawicka, I. 1995. *Fonetyka i Fonologia* [Phonetics and Phonology]. Kraków: Instytut Języka Polskiego PAN.

Foster, M. L. and G. M. Foster. 1948. *Sierra Popolaca Speech*. Washington: U. S. Government Printing Office, Smithsonian Institute, Institute of Social Anthropology.

Herbert, R. K. 1986. *Language Universals, Markedness Theory, and Natural Phonetic Processes*. Berlin: Mouton de Gruyter.

Hualde, J. 1987. "On Basque affricates". *Proceedings of the West Coast Conference on Formal Linguistics* 4. 77-89.

Hualde, J. 1988. "Affricates are not contour segments". *Proceedings of the West Coast Conference on Formal Linguistics* 7. 77-89.

Jakobson, R., Fant, G., and M. Halle. 1952. *Preliminaries to Speech Analysis*. Cambridge: MIT Press.

Kenstowicz, M. 1994. *Phonology in Generative Grammar*. Cambridge, Mass.: Blackwell.

Kenstowicz, M., and C. Kisseberth. 1979. *Generative Phonology*. New York: Academic Press.

Ladefoged, P. 1968. *A Phonetic Study of West African Languages*. Cambridge: Cambridge University Press.

Lewis, G. L. 1967. *Turkish Grammar*. Oxford: Oxford University Press.

Lombardi, L. 1990. "The non-linear organization of the affricate". *Natural Language and Linguistic Theory* 8: 374-425.

McCarthy, J. and A. Prince. 1990. "Foot and word in prosodic morphology: The Arabic broken plural". *Natural Language and Linguistic Theory* 8. 209-284.

McCarthy, J. and A. Prince. 1991. "Lectures on prosodic morphology". Linguistic Society of America Summer Institute: University of California, Santa Cruz.

Maddieson, I. 1984. *Patterns of Sounds*. Cambridge: Cambridge University Press.

Nemeth, J. 1962. *Turkish Grammar*. The Hague: Mouton.

Rubach, J. 1994. "Affricates as strident stops in Polish". *Linguistic Inquiry* 25. 119-143.

Sagey, E. C. 1986. The Representation of Features and Relations in Non-Linear Phonology. Ph.D. dissertation. Cambridge, Mass.: MIT.

Salaburu Etxeberria, P. 1984. *Arau Fonologikoak: Hizkuntz Teoria Eta Batango Euskalkia: Fontetika Eta Fonologia*. Bilbao: University Pais Vasco, Il.

Stone, G. 1987. "Polish". In Comrie, B. (ed.). 348-366.

Straight, H. 1976. *The Acquisition of Mayan Phonology: Variation in Child Language*. New York: Garland.

Wonderly, W. L. 1951. "Zoque phonemics and morphology". Reprinted from *International Journal of American Linguistics*. 17: 1-4 and 18: 1-4.