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EMERGENT STOPS IN ENGLISH AND IN POLISH: AGAINST SYLLABLE-BASED ACCOUNTS•

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ABSTRACT

Consonant epenthesis has been used to provide support for syllable-based approaches. In Optimality Theoretic accounts, epenthesis serves to reduce the markedness by providing missing onsets. In this paper, I look at a different type of apparent insertion, the emergence of stops in consonant clusters. In search for a possible driver of the process, I consider syllable structure, syllable contact, and sonority distance. It is demonstrated that the syllable cannot be held accountable for the appearance of stops in consonant clusters. More generally, reference to markedness results in wrong predictions. It is argued that a diachronic phonetically-based explanation referring to aerodynamic requirements and articulatory gestures has significantly more explanatory power. The mis-timing of phonetic gestures may lead to structural reinterpretation, giving rise to the phonologization of emergent stops. Historical and modern English, as well as dialectal Polish, provide the primary illustrative examples for this phonetically-based analysis.

KEYWORDS: Epenthesis; emergent stops; evolutionary phonology; syllable; phonetic explanation.

1. Introduction

Two types of explanation for linguistic patterns are in common use: synchronic and diachronic (evolutionary).[1] Synchronic explanations are used in most generative models

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• I am truly grateful to the anonymous reviewers for their feedback. Any errors or omissions are solely my responsibility.

[1] An anonymous reviewer points out that the biological term "evolutionary" (inspired by Blevins 2004) is not fully applicable to the theories of language development. Blevins is aware of this limitation: "Evolutionary Phonology is of course not a theory of language evolution based on natural selection. Though it is sometimes useful to draw parallels between the evolution of sound patterns and Darwin's theory of natural selection, these parallels are largely metaphorical, and are used to highlight the non-teleological character of sound change" (Blevins 2004: 18). The use of the "evolutionary metaphor" is justified by the aspects of language development which find analogs in biological evolution. For example, the imperfect transmission of

such as Optimality Theory (Prince and Smolensky 2004). Markedness, a synchronic phonological bias, is argued to give rise to typological asymmetries.[2] For example, the relative rarity of onsetless syllables stems from their markedness. Conversely, the unmarked status of CV syllables makes them the most widely attested syllable types cross-linguistically. A synchronic grammar of a speaker incorporates constraints that reflect the relative markedness of linguistic structures (Prince and Smolensky 2004). Markedness constraints ensure that grammars are inherently optimizing (goal-oriented).

Advocating the diachronic approach, Ohala (1981) proposes that explanations for recurrent sound patterns in the world's languages are historical and not goal-oriented. Natural sound change, which gives rise to linguistic patterns, is phonetically-based and stems from systematic errors that occur during language transmission between the speaker and the listener. Ohala's (1981) model relies on "innocent misapprehensions" because the basic mechanism of innovation involves misparsing a structure and assigning it an interpretation that differs from that assigned by the previous generation. There is no role for synchronic phonological biases in this model (see Blevins 2004 for an in-depth overview of the model).

In this paper, it is argued that the stops which commonly emerge in consonant clusters are inexplicable in synchronic generative accounts relying on markedness. An Optimality Theoretic analysis fails to make the right predictions. In fact, if markedness was the driver, one would expect exactly the opposite repair strategies, including consonant deletion. A listener-oriented evolutionary analysis invoking a structural reinterpretation of the phonetic signal offers a more plausible explanation for emergent stops in consonant clusters.

Section 2 offers an Optimality Theoretic analysis of intervocalic consonant epenthesis. In Section 3, an overview of emergent stops in consonant clusters in historical and modern English is presented. Section 3.1 provides a syllable-based analysis of emergent stops and demonstrates its inadequacy. An evolutionary account which relies on phonetic gestures offers an insightful alternative in Section 3.2.

2. Intervocalic epenthesis

We begin with a look at intervocalic consonant epenthesis and attempt to relate it to syllable structure. Optimality Theory (Prince and Smolensky 2004) provides the appropri-

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sound patterns across generations corresponds to imperfect DNA replication and variation across speakers corresponds to variation in the gene pool in a population. What is more, many recurrent sound patterns may be viewed in terms of such biological concepts as parallel evolution, convergent evolution, direct inheritance, adaptation, and disaptation (Blevins 2004: 26–27).

[2] In fact, as a reviewer suggests, the explanatory value of Optimality Theoretic accounts and appeals to markedness is questionable. He/she argues that such accounts are not meant to explain anything; they are mere labels and descriptive terms for what "is". Therefore, the term "explanation" might not be appropriate in relation to Optimality Theoretic accounts.

ate tools to handle the epenthesis in (1). The data from Axinica Campa below are representative of this cross-linguistically common process (Payne 1981, McCarthy and Prince 1993, Kager 1999).

(1a)	(i)	/no-N-koma-i/	noŋkomati	'he will paddle'
	(ii)	/no-N-koma-aa-i/	noŋkomataati	'he will paddle again'
	(iii)	/no-N-koma-ako-i/	noŋkomatakoti	'he will paddle for'
	(iv)	/no-N-koma-ako-aa-i-ro/	noŋkomatakotaatiro	'he will paddle for it again'
(1b)	(i)	/no-N-č^{h}ik-i/	noɲč^{h}iki	'he will cut'
	(ii)	/no-N-č^{h}ik-aa-i/	noɲč^{h}ikaati	'he will cut again'
	(iii)	/no-N-č^{h}ik-ako-i/	noɲč^{h}ikakoti	'he will cut for'
	(iv)	/no-N-č^{h}ik-ako-aa-i-ro/	noɲč^{h}ikakotaatiro	'he will cut for it again'

A consonant is inserted to avoid a vowel hiatus and provide an onset. Insertion is minimal in that it applies exclusively to supply a missing onset (compare 1ai and 1bi). The syllabic approach to consonant epenthesis couched within Optimality Theory relies on the notion of markedness. Based on typology and articulatory and perceptual considerations, it has been found that syllables prefer to begin with a consonant rather than with a vowel. It follows that onsetless syllables are marked relative to syllables with an onset. The markedness constraint Onset captures this cross-linguistic preference (Prince and Smolensky 2004).

(2) Onset
Syllables must have onsets.

In a language like Axinica Campa, Onset is ranked above an anti-insertion faithfulness constraint (McCarthy and Prince 1995).

(3) Dep-IO
Output segments must have input correspondents.

In keeping with the main principles of Optimality Theory, a violation of a faithfulness constraint takes place under duress. For the candidate with epenthesis to be selected in (4), the markedness constraint must dominate the faithfulness constraint.

(4) Input: /no-N-koma-i/

		Onset	Dep-IO
	a. noŋkomai	*!	
☞	b. noŋkomati		*

Ranking Onset above Dep-IO is responsible for the reduction of markedness through the optimization of syllable structure. As for the quality of epenthetic consonants, the most frequent among them turn out to be coronals and laryngeals. This finds an explanation in the fact that they are considered the least marked (Selkirk 1981; Itô 1986). The well-studied process illustrated in (1) does not exhaust the typology of consonant epenthesis.

3. Emergent stops

The data below summarize the diversity of consonant epenthesis in English. We look both at modern and historical instances (Ohala 1983, 1995, 1997; Murray 1989; Warner and Weber 2001). The items are grouped according to the type of segments flanking the epenthetic consonant.

(5a) nasal + fricative

ns → nts	*prince*	prɪns	prɪnts (variant)
	dense	dɛns	dɛnts (variant)
mθ → mpθ	*warmth*	wɔɹmθ	wɔɹmpθ (variant)
	something	sʌmθɪŋ	sʌmpθɪŋ (variant)
ŋs → ŋks	*youngster*	jʌŋstɚ	jʌŋkstɚ (variant)
ms → mps	*Samson*	→ *Sampson*	
	Thomson	→ *Thompson*	
	gleam + se	→ *glimpse*	
	deem + ster	→ *dempster*	

(5b) nasal + stop

mt → mpt Old English *æmtig* → *empty*

(5c) lateral + fricative

ls →lts	*balsam*	bɔlsəm	bɔltsəm (variant)
	pulse	pʌls	pʌlts (variant)
	else	ɛls	ɛlts (variant)

(5d) nasal + lateral/rhotic

nl → ndl	Old English *enlefan*	*endleofan* (variant)	‘eleven’
	Old English *spinle*	→ Middle English *spindle*	‘spindle’
nr → ndr	Old English *ganra*	*gandra* (variant)	‘gander’

(5e) fricative + lateral/rhotic

sl → stl	Old Norse *hvisla*	→ Old English *hwistlian*	'whistle'
sr → str	English *stream*	(cf. Sanskrit srávati)	
sl → skl	Old English *slāt*	*sclāt* (variant)	'slit' pret. sg.[3]
	Old English *slēacnes*	*sclēacnes* (variant)	'slowness'
	Middle English *slēpen*	*sclēpen* (variant)	'sleep'

(5f) fricative + nasal

sn → stn	Middle English *glisnen*	*glistnen* (variant)	'glisten'
sn → skn	Old English *snīcendan*	*scnīcendan* (variant)	'sneak' pres. part.

A cursory look at the data in (5) reveals that both the quality and the site of epenthesis differ from the cases studied in (1). Apart from coronal stops, /t/ and /d/, one can find the labial stop, /p/, and the velar stop, /k/. As for the site, insertion occurs between consonants. In the next section we consider a syllable-based account.

3.1. Syllable-based analysis

Obviously, the motivation for the processes in (5) has nothing to do with providing missing onsets. Looked from the perspective of syllable structure, the processes in (5) seem to make it more complex, let alone improve it. To take an example, there seems to be nothing wrong with the syllabification of the word *Samson* [sæm.sən], as codas are not only permitted but very common in English. As a result of epenthesis, *Samson* surfaces with a complex coda [sæmp.sən].[4] Insofar as complex margins are linguistically less preferred than simple margins, epenthesis results in an *increase* in markedness in (5). In an Optimality Theoretic evaluation of [sæmpsən], markedness constraints *Coda and *ComplexCoda interplay with a faithfulness constraint, Dep-IO (Prince and Smolensky 2004).

(6a) *Coda
Syllables may not have a coda.

(6b) *ComplexCoda
Syllables must not have more than one coda segment.

[3] The Old English spelling *sc*- was ambiguous; it could stand for /sk/ or /ʃ/. In the cited examples, the occasional *sc*- spelling in *scl* and *scn* clusters corresponds to /sk/.

[4] The word cannot be syllabified [sæm.psən] because English does not allow syllable-initial **ps*-, e.g. *psychology* [saɪkɑləʤi] and *psalm* [sɑm].

*ComplexCoda is universally ranked above *Coda as complex codas are more marked than simple codas. This is reflected in typological asymmetry. There is a considerable number of languages which allow simple codas and ban complex codas, while the reverse is not attested (Blevins 1995; Zec 2007).

(7) Input: /sæmsən/

		*ComplexCoda	*Coda	Dep-IO
☞	a. sæm.sən		**	
	b. sæmp.sən	*!	**	*

It is evident from (7) that the candidate [sæmp.sən] is harmonically bound by [sæm.sən] and its selection as optimal is impossible. A different mechanism must be responsible for the epenthesis in (5). Insertion as a repair strategy to provide missing onsets is completely inapplicable and a solution must be sought elsewhere if a syllabic analysis is to be maintained.

Clements (1987) and Picard (1987) attempted to account for consonantal epenthesis of the kind exemplified in (5) in syllabic terms. Murray (1989) raised a number of objections in connection to these syllable-based approaches. What follows is a summary of Clements' (1987) account with several points of criticism in essence due to Murray (1989).

In accounting for the epenthesis in (5), Clements resorts to syllable contact and preferable margins. Syllable Contact (SC) favors a sonority fall across syllable boundaries (Hooper 1976; Vennemann 1988; Gouskova 2004). The scale in (8) evaluates syllable contacts (O – obstruent, N – nasal, L – liquid) and is drawn from Zec (2007).

(8)

SC +2			*OL*
SC +1		*ON, NL*	
SC 0	OO, NN, LL		
SC −1		LN, NO	
SC −2			LO

SC0 is assigned to sonority plateaus, positive values of SC characterize sequences of rising sonority, and clusters showing a sonority fall are assigned negative values. Syllable contacts with positive values (italicized) are cross-linguistically avoided.

Syllable Contact is argued to drive epenthesis in *ganra* in (5d), as repeated below.

(9) gan.ra → gan.dra
NL: SC +1 NO: SC −1

The insertion of an obstruent results in an improvement of the syllable contact: a nasal + liquid contact with a positive value (SC +1) becomes a nasal + obstruent contact with a negative value (SC −1). Cases compatible with this syllable-based explanation can be found in the historical developments of other languages, including French and Spanish (Murray 1989: 298–299; Ohala 1983: 209).

(10)	Latin	French
mr → mbr	*căm(ĕ)ra*	→ *chambre* 'room'
ml → mbl	*sĭm(ĭ)lāre*	→ *sembler* 'appear'
nr → ndr	*gĕn(ĕ)rum*	→ *gendre* 'son-in-law'
lr → ldr	*mŏl(ĕ)re*	→ *moudre* 'grind'
sr → str	**ĕss(ĕ)re*	→ *être* 'be'
zr → zdr	*lăz(ă)rum*	→ Old French *ladre* 'leper' (cf. French *ladrerie* 'leprosy')
	Latin	Spanish
nr → ndr	*ven(i)re*	→ *vendre* 'sell'
ml → mbl	*tem(u)lar*	→ *temblar* 'tremble'
	Arabic	Spanish
mr → mbr	*al hamra*	→ *Alhambra* 'the red (house)'

Clements rightly points out that an account along these lines cannot be extended to the data in (5a–c). In the disyllabic forms in (5a), insertion of a stop does not improve Syllable Contact. The SC −1 of [sæm.sən] rises to SC0 in [sæmp.sən]. In an attempt to salvage the analysis, Clements (1987: 40) claims that the epenthesis in (5a–c) does not result in "true" segments but in fact turns the existing segments into "contour (internally complex) segments". Such contour segments fall outside the scope of the syllabic analysis. He bases this argument on two types of evidence: native speaker intuitions and experimental evidence. He argues that native speakers do not have problems distinguishing cases with epenthetic stops from cases with underlying stops in (5a–c), such as *dense* vs. *dents*. By contrast, making such distinctions between epenthetic and underlying stops is claimed to be impossible for the epenthesis in (5d–f). Second, experiments measuring the duration of epenthetic vs. underlying stops in (5a) showed that the former tended to be shorter than the latter. On a similar note, Ohala (1983) found that the duration of the preceding VN sequence is different for cases of underlying vs. epenthetic stops (*clampster* vs. *clam[p]ster*). A similar difference in the duration of stops was not evident in (5d–f). Murray (1989) discounts these arguments by pointing out that the differences find a better explanation in the influence of orthography on speaker intuition. The experiment cited by Clements involved reading aloud a set of items, thus orthography was also likely involved.

(11) Consequently, the fact cannot be ignored that in the "underlying" [(5a–c)] clusters (as well as in [(5d–f)] clusters generally), the plosive is typically represented in English orthography whereas in the "intrusive" [(5a–c)] clusters it is not (e.g. "underlying" *t* in *dents* and "intrusive" *t* in *densed*. The possibility that the speakers' "phonological intuitions" are directly related to this orthographic distinction cannot be ignored.

(Murray 1989: 296)

Clements' classification into "contour", on the one hand, and "true" epenthetic segments, on the other, is essentially based on native speaker intuition. We follow Murray in concluding that this distinction is disputable and in need of more convincing evidence. The decision to exclude the data in (5a–c) from a syllabic analysis seems arbitrary.

This is not the only problem that the syllabic approach has with the data in (5). Even the "true" epenthetic segments in (5d–f) are not fully accountable under this approach. Apart from cases like *gandra*, discussed above, there are those where epenthesis is not amenable to a syllable-based analysis. The representative data are repeated from (5d–f).

(12a)	Old English: *en.le.fan*	*end.leo.fan* (variant)	'eleven'
	NL: SC +1	OL: SC +2	
(12b)	Old Norse *hvis.la*	→ Old English *hwist.lian*	'whistle'
	OL: SC +2	OL: SC +2	
(12c)	Middle English *glis.nen*	*glist.nen* (variant)	glisten'
	ON: SC +1	ON: SC +1	

The syllable divisions in (12a–b) get support from Lutz's (1986) study of word divisions. In Old English manuscripts the division invariably falls in the middle of *-tl-* and *-dl-* sequences. Modern English provides additional evidence for the syllable divisions in (12). The sequences *dl-*, *tl-*, and *tn-* never appear word- and syllable-initially (collocational constraints; see Jespersen 1904; Clements and Keyser 1983).

The data in (12) undermine the syllabic approach to epenthesis. Not only do the syllable contacts fail to be improved (12b–c); they become more marked (12a). Let us turn to word-initial clusters. Illustrative examples in (13a) are repeated from (5e–f). Additional data from Romanian, Latin, Greek, and Italian serve to demonstrate the heterogeneity of the clusters involved (Murray 1989: 307, Ohala 1997: 5).

(13a) English

sr → str	English *stream*	(cf. Sanskrit *srávati*)		
sl → skl	Old English	*slāt*	*sclāt* (variant)	'slit' pret. sg.
sn → skn	Old English	*snīcendan*	*scnīcendan* (variant)	'sneak' pres. part.

(13b) other languages

Romanian
ml → *mbl → bl   *mlaştină → *mblaştină → blaştină*   ‘marsh’
mr → *mbr → br   *mreajă → *mbreajă → breajă*   ‘filets’

Latin
mr → *mbr → br   Latin *brĕvis*   (cf. Avestan mərəzu-)   ‘short’

Greek
mr → *mbr → br   Greek *βροτός*   (cf. Sanskrit mṛtas, Latin *mortuus* ‘dead’)

Italian
sl → stl → skl   slavo ‘slave’ → stlavo → sklavo → … → *ciao* [tʃao] ‘hello’

The insertion of a consonant turns a CC-onset into a CCC-onset. Thus, it seems as if a marked structure becomes more marked. Under the syllabic analysis, a change *reducing* markedness would be expected. For example, avoidance of complex onsets is held responsible for vowel insertion in CCCVC sequences, yielding CVC.CVC (see Zec 2007 for a review). Yet another strategy that can in principle be used to account for the epenthesis in (12) invokes Minimal Sonority Distance (Venneman 1972; Hooper 1976; Zec 2007).

(14) Sonority Distance

O	N	L
3	2	1

The sonority scale in (14) states that obstruents are separated from nasals by one interval and from liquids by two intervals. Complex onsets with segments that have a greater sonority distance are unmarked relative to those with a low sonority distance or a sonority plateau. That is, higher values of Minimal Sonority Distance (MSD) are universally preferred.

(15) Minimal Sonority Distance

MSD0	OO, NN, LL
MSD1	ON, NL
MSD2	OL

To take an example, the *pl-* cluster makes a more preferable onset than the *pt-* cluster as the MSD of the former is 2 and of the latter is 0. Complex onsets with a low sonority distance are predicted to be cross-linguistically avoided. Crucially, Minimal Sonority

Distance has been used for bi-consonantal complex onsets. It is far from clear how the sonority distance should be calculated in onsets of more than two consonants, as in (13). For example, the MSD of *sr-* is 2 (OL), while the MSD of *str-* is 0 (OO) and 2 (OL). The least that can be said about the change in *sr → str* is that it does not result in a less marked structure. To sum up, syllable structure does not provide a plausible explanation for epenthesis in CC clusters found word-medially (*endleofan*) and in complex onsets (*stream*). The resulting CCC clusters fail to improve on markedness. In fact, under the syllabic analysis one would expect processes that perform exactly the opposite operation, for instance the reduction of a CCC cluster to a CC cluster through consonant deletion or vowel epenthesis, C<u>V</u>CC. Additionally, as argued above, the distinction between "contour" and "true" epenthetic segments is not based on sound evidence and must be abandoned, leaving more cases which the syllabic analysis is unable to handle (*prince, empty, balsam*).

The next step is to determine whether this process is typologically rare or not. If it is, it might be brushed aside as exceptional and quirky. The data in (16) are drawn from Standard Polish (SP) and the North Mazovian dialect of Polish (NMP) (Zduńska 1965: 118; Czaplicki 2009).

		SP	NMP	gloss
(16a)	nasal + rhotic (alveolar trill)			
	Henryk	hɛnrɨk	hɛndrɨk	'first name'
	Konrad	kɔnrat	kɔndrat	'first name'
(16b)	nasal + stop			
	czeremcha	t͡ʂɛrɛmxa	t͡ʂɛrɛmpka	'bird cherry'[5]
(16c)	fricative + stop			
	Ruskie	ruscɛ	rustcɛ	'Russians' (derogatory)
(16d)	rhotic (alveolar trill) + glide (lateral; see below)			
	Barłoga	barwɔga	bardwɔga	last name

The items in (16a) and (16b) show epenthesis in nasal + liquid clusters and in nasal + stop clusters respectively and are parallel to the English data in (5). The items in (16c) and (16d) show epenthesis in fricative + stop and liquid + glide sequences and do not have straightforward counterparts in (5). The Polish data in (16) provide cases parallel to (5) and indicate that that this type of metathesis is cross-linguistically common enough to require a uniform explanation. In the next section we propose that retiming of articulatory gestures lies at the root of this perceptual epenthesis.

[5] Additionally, in this item the fricative /x/ underwent occlusivization in the North Mazovian dialect.

3.2. Evolutionary account

The present account is based on Ohala (1974, 1995, 1997), Browman and Goldstein (1989), and Warner and Weber (2001). Ohala argues that the terms "epenthetic" and "intrusive" commonly used in connection with the stops in (5) are misleading and might have contributed to the confusion surrounding them in many phonological accounts. He proposes the terms "emergent" and "excrescent" as more fitting and reflecting the epiphenomenal nature of these stops. "Emergent" is used here as in evolutionary biology to mean "a novel structure that develops out of the rearrangement of pre-existing elements" (Ohala 1997: 1). All the phonetic elements that give rise to the emergent stops are present, nothing is inserted. Henceforth, the term "epenthetic" is restricted to consonants inserted to resolve a vowel hiatus, as in (1). The stops in (5), on the other hand, will be called "emergent". Having cleared up the confusion surrounding the terminology, we are in a position to explain how emergent stops arise in perception.

Ohala argues that emergent stops that break up nasal + fricative or nasal + stop sequences (*Sampson*, *empty*) are best explained in terms of articulatory gestures and aerodynamics. The production of a nasal requires a closure in the mouth and lowering of the velum, allowing air to escape through the nasal cavity. The second element in the sequence, an oral fricative or a stop, is produced with the velum raised, blocking the nasal passage. In the transition between the two segments, the release of the oral closure for the nasal needs to precede the gesture of raising the velum for the oral segment. However, this is not always the case. In the event that the velum is raised *before* the oral closure for the nasal is released, the oral cavity is completely sealed. The subsequent release of the oral closure produces an audible voiceless burst, perceived as a voiceless stop. This mechanism giving rise to emergent stops results from a mis-timing of the velic closure and can be viewed as anticipatory denasalization (Ohala 1997).

More generally, Ohala speaks of two exit valves for air space, A and B. Four configurations are possible: (i) valve A is open and valve B is closed, (ii) valve B is open and valve A is closed, (iii) both valves are open, and (iv) both valves are closed. In the case at hand, valve A is the nasal cavity and valve B is the oral cavity. During the production of a nasal, valve A is open and valve B is closed. The reverse is true for an oral obstruent. An emergent stop is produced when in the transitional stage both valves are closed for a moment due to the mis-timing of articulatory gestures. Air has nowhere to escape and its pressure rises. When valve B finally opens, an unintended voiceless stop is released. There is an aerodynamic requirement that raises the probability of emergent stops: "the oral obstruent requires a closed velopharyngeal valve in order to maintain the air pressure differential across the oral constriction; without the closed nasal valve the pressure would be vented through the nose and the oral obstruent would lack acoustic-auditory cues from frication or bursts" (Ohala 1995: 163). As this account refers to the denasalization of the initial nasal, it follows that the place of articulation of the emergent stop must correspond to the place of articulation of the nasal. This is indeed the case, as repeated in (17).

(17)	ms → mps	*Samson*	→ *Sampson*	
	ns → nts	*prince*	prɪns	prɪnts (variant)
	mθ → mpθ	*warmth*	wɔɻmθ	wɔɻmpθ (variant)
	ŋs → ŋks	*youngster*	jʌŋstɚ	jʌŋkstɚ (variant)
	mt → mpt	*œmtig*	→ *empty*	

An explanation along these lines is available for all the emergent stops in (5). The fricative + nasal clusters in (5f) are parallel except that the sequence of the opening and closing of the oral and the nasal valve needs to be reversed. The configurations with a lateral and a fricative in (5c) and (5e) employ a valve formed by the tongue side(s) and a valve formed by the tongue midline. Finally, the case of nasal + lateral/rhotic (5d) requires reference to the nasal valve and a valve formed by the tongue side(s). This last case has an acoustic explanation. The emergent stop serves to prevent the preservatory nasalization of the lateral /l/, the tap /ɾ/, the trill /r/, and certain other sonorants, which otherwise might be confused with a nasal (Ohala 1995: 163, 1997: 3). Clusters /sl/ and /sn/ in (5e–f) do not seem to comply with the generalization that the emergent stops always exhibit the place of articulation of C_1. Apart from the expected coronal stops in /stl/ and /stn/, the data in (5e–f) show realizations where the emergent stops are neither homorganic with C_1 nor with C_2 but emerge as velar: /skl/ and /skn/. The development of /stl/ to /skl/ (and vice versa) has a convincing phonetic explanation. It has been established that /tl/ and /kl/ clusters are acoustically and auditorily very similar and contrasts between them are cross-linguistically unstable (Halle et al. 2003; Flemming 2007; Blevins 2009). A plausible explanation for the evolution of /skl/ from /stl/ in (5e) involves misparsing the weakly cued place features of the stop before a lateral.[6]

The evolutionary explanation proposed by Ohala for the phonologization of the emergent stops in (5) makes reference to the variability of speech and a structural reinterpretation of the acoustic signal. Sound change most commonly occurs during the transmission of the phonetic signal from the speaker to the hearer. Speech is variable and an individual is exposed to a number of phonetic realizations of a single form. For example, before the emergent stop found its way into the phonological representation of *Samson*, the word had a number of variants including the intended one, [sæmsən], and one with an emergent stop resulting from a mis-timed velic closure, [sæmpsən]. This variability of speech rooted in coarticulation is commonplace and language users are aware of its effects. Thus, hearing [sæmpsən] with an emergent stop does not necessarily result in an immediate phonological reanalysis. The hearer may infer that the emergent stop is coarticulatory and unintended. The phonological representation remains intact. However, in the event that the hearer interprets the emergent stop as intended by the speaker, structural reanalysis takes place and the stop enters the phonological representation. Such a sound change may be then represented in orthography, e.g. *Sampson*.

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[6] The change of /tl/ to /kl/ is also documented in the development of Italian *ciao* in (13b). It is an empirical question whether an explanation along these lines is available for the emergent dorsal stop in the /skn/ cluster.

It follows from this discussion that one cannot fully predict whether a given sound change takes place or not. Three trajectories can be envisaged for phonetically emergent stops: (i) they enter the phonological and the orthographic representation (e.g. *Sampson*), (ii) they are phonologized but not represented in orthography, or (iii) they are absent from the phonological representation and from orthography. An illustrative example for the last two cases is *warm[p]th*. Whether a phonetically emergent stop that is not represented in orthography has entered the phonological representation can only be established experimentally.

The Polish data in (16a) and (16b) show nasal + rhotic and nasal + stop sequences and are fully compatible with the phonetic explanations provided above. Note also that, unlike in English, in Polish the /r/ is a trill. This fact is likely to facilitate the emergence of stops (Ohala 1997: 3).[7] The items in (16c) and (16d), *Ruskie* [ruscɛ] and *Barłoga* [barwɔga], show fricative + stop and rhotic + glide sequences, and have not been explicitly dealt with in Ohala's work. Whether a parallel mechanism involving the retiming of articulatory gestures played a role remains to be determined.[8] In addition, it is worth noting that the glide in *Barłoga* (and elsewhere) historically derives from the velarized lateral /ɫ/, and consequently the phonologization of the emergent stop actually might have occurred in a rhotic + lateral cluster. As evidenced in (5), the lateral is likely to spawn emergent stops in certain contexts.

4. Conclusion

The insertion of stops appears to be driven by two distinct mechanisms. First, we have seen that intervocalic consonant insertion is phonologically motivated and serves to provide missing onsets. Its function seems to be the reduction of markedness. Optimality Theory has provided adequate tools to model this type of insertion. A syllable-based analysis has not been equally successful in accounting for the insertion of stops in consonant clusters (e.g. in *Sampson*). We have looked at analyses involving reference to (i) syllable structure, (ii) syllable contact, and (iii) sonority distance. None of these accounts hold up to scrutiny. The syllable does not seem to be responsible for the insertion in consonant clusters.

In an attempt to find an alternative explanation, we have discussed an evolutionary account that makes reference to articulatory gestures and aerodynamics. The stops are no longer seen as inserted. Rather, they are emergent and epiphenomenal as all the elements that give rise to them are already present. A mis-timing of articulatory gestures

[7] In fact, Ohala mentions a tap. A trill is a series of taps.

[8] The priming effects of pre-existing linguistic structures may also play a role in the phonologization of emergent stops in specific contexts. The categorization of an ambiguous signal tends to be "structure-preserving" and results in structures that are common in the language (Structural Analogy; Blevins 2004: 154).

modifies the acoustic signal and leads to the perception of emergent stops. The fact that many instances of the emergent stops are represented in orthography indicates that a phonological reanalysis has taken place. A study of a considerable number of instances drawn from modern and historical English, as well as from dialectal Polish and from other languages has given support to this phonetic analysis. This natural sound change is likely to have independently occurred in many languages.

More generally, this paper has demonstrated that synchronic generative accounts which rely on markedness are not always the best place to look for explanations of typologically common sound patterns. Phonetically-based evolutionary accounts which appeal to the structural reinterpretation of the acoustic signal may provide more insight into the underlying mechanisms of particular sound changes. Finally, despite the general applicability of the proposed phonetic explanation to the discussed data, we have found several cases which indicate that the specifics of this approach need to be refined in future research.

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