Areal sound patterns: From perceptual magnets to stone soup

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1 Defining areal sound patterns

Linguistic areas are geographic regions where languages share characteristics as a result of language contact and not as a consequence of shared inheritance, general linguistic tendencies, linguistic universals, or chance.[1] Though there is controversy over the precise set of grammatical characteristics that can spread via language contact (see Campbell, this volume), recognition and study of linguistic areas in the modern era continues to reaffirm that sound patterns can and do spread in this way (Boas 1911, 1920, 1929; Trubetzkoy 1939; Emeneau 1956; Heath 1978; Aikhenvald 2002). Given this general outline, we can define areal sound patterns as in (1).

(1) Areal sound pattern: a definition

> An areal sound pattern is a sound pattern shared by two or more languages in a designated geographic region that: (i) does not result from shared inheritance for at least one pair of languages; (ii) is not a consequence of general linguistic tendencies alone for at least one language; and (iii) cannot be attributed to chance for at least one language. An areal sound pattern results from language contact when speakers of a language that lacks a particular sound pattern come to acquire a sound pattern in their speech from extensive contact with a distinct language that has that pattern.

The notion of sound pattern in (1) is a general one. It includes: overall properties of contrastive sound inventories such as vowel, consonant, and tone inventories; patterns determining the distribution of sounds or contrastive features of sounds, including the distribution of stress, tone, length, laryngeal features, and consonant clusters; and the variable realization of sounds in different contexts that constitute phonological alternations. We will look at cases of each of these types in the sections that follow.

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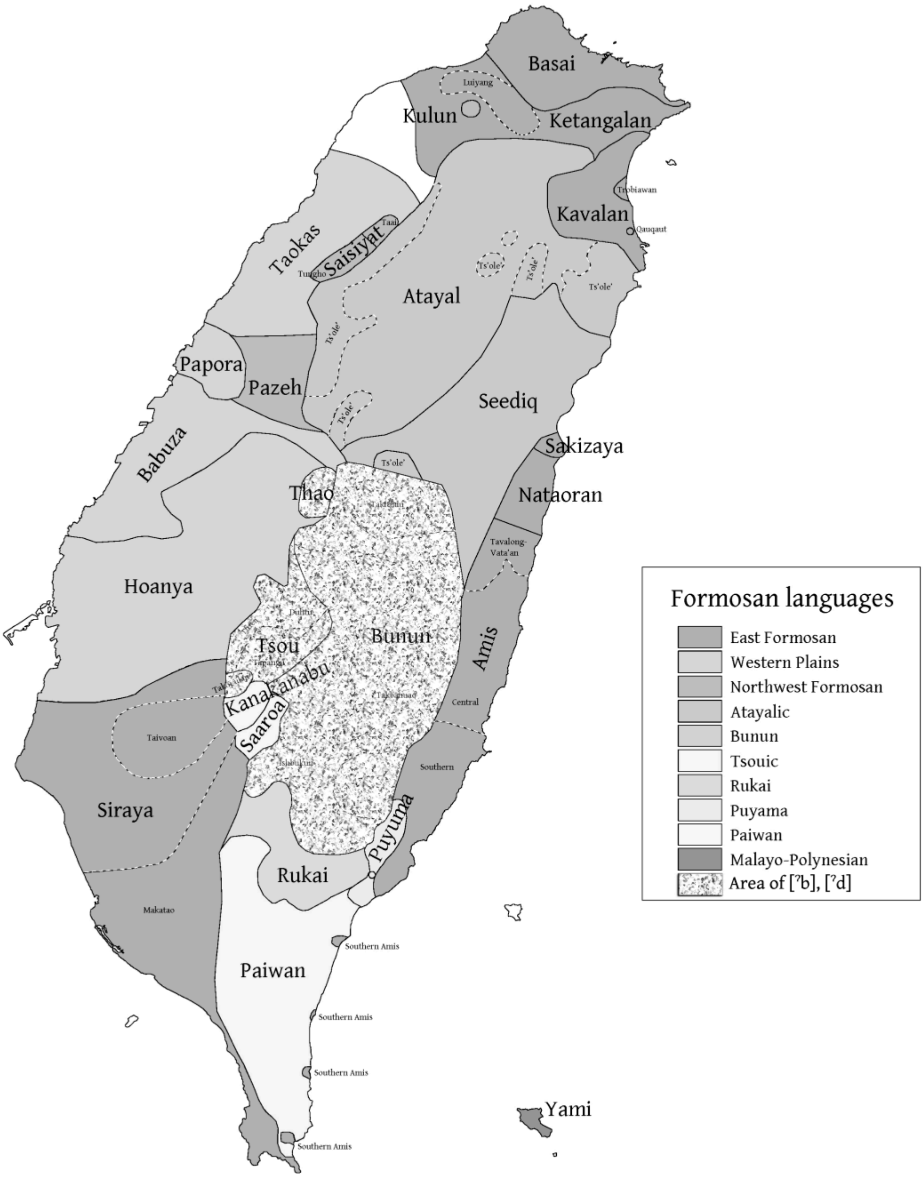
[1] Within some phonological frameworks, like Optimality Theory, linguistic universals are encoded as markedness constraints, while general linguistic tendencies are not (Prince and Smolensky 2004; Kiparsky 2006). In other frameworks, like Evolutionary Phonology, there is no clear categorical distinction between statistical tendencies and phonological universals, with apparent universals exhibiting extreme instances of statistical tendencies (Blevins 2004, 2006, 2009a, 2014). In the remainder of this chapter, I do not distinguish between general linguistic tendencies and linguistic universals, since, in both cases, what is relevant is a strong statistical tendency for a particular sound pattern to occur cross-linguistically, independent, for the most part, of inherited features. For cases where strong statistical tendencies do appear to correlate with other inherited sound patterns, see Blevins (2009b) and Blevins and Grawunder (2009).

The definition in (1) defines an areal sound pattern as a sound pattern shared minimally by two languages, having arguably diffused from one into the other. Though linguistic areas as large as the Australian continent have been proposed (Dixon 2002), looking only at sound patterns, we find many cases of areal sound patterns limited to small geographic areas, and to a small number of languages.[2]

Within the large and widely dispersed Austronesian language family, an areal sound pattern is found in a small region of central Taiwan as shown in Map 1.



Map 1: Pre-glottalization in a micro-area of central Taiwan

Three geographically contiguous Formosan languages, - Thao, Bunun, and Tsou -, show pre-glottalization of voiced stops /b/ and /d/ as [ˀb] and [ˀd] respectively

[2] Macro-areas and micro-areas for sound patterns may be more common than those for other levels of languages for the simple fact that the phonetics of one language is immediately accessible to speakers of another in a language contact zone, while aspects of morphology and syntax are not.

(Blust 2009:52, 165, 641-2). Blust (2009: 641) suggests that the innovation occurred in Bunun, and spread to both Tsou and Thao. Pre-glottalization is not a feature of Proto-Austronesian, - the only common ancestor from which these three languages descend.[3] Therefore, shared inheritance is ruled out.[4] Assessing whether pre-glottalization of /b/ and /d/ in three distinct Formosan subgroups could be attributed to phonetic naturalness or chance is more complex. If we look at the distribution of pre-glottalization and implosion of voiced stops throughout the Austronesian language family, we find it occurring in approximately 20/1000 or 2% of languages[5], while cross-linguistically, based on modern sampling of the WALS database, implosives occur in 77/567 or approximately 13.5 % of languages, but in less than 10% of languages that do not also have ejectives or glottalized sonorants (Maddieson 2013a). The chance, then, of three randomly chosen Austronesian languages having this property is .00008, while the chance of any three randomly chosen languages having this property is .001. Pre-glottalization/implosion is also clearly under-represented within the Austronesian family. The occurrence of this feature in 3/24 or 12.5 % of known indigenous languages of Taiwan at a shallow time-depth (see footnote 3), and in a contiguous area, then, does not appear to reflect the general tendencies for these sounds to develop within Austronesian languages, but, as Blust suggests, is best attributed to diffusion of pre-glottalization from Bunun to neighboring languages of central Taiwan.

Since areal sound patterns must be distinguished from sound patterns resulting from shared inheritance, general linguistic tendencies, or chance, the establishment of an areal feature cannot be based simply on the association of a geographically defined region with a linguistic feature that crosses language boundaries, no matter how vast the geographic region is, or how uncommon the linguistic feature is outside of this region. In this context, consider Dixon's (2002) proposal that the entire continent of pre-contact Australia is a linguistic area, including more than 200 indigenous Aboriginal languages. While this area might be defended on other grounds, proposed areal sound patterns do not meet the criteria set out in (1) because direct inheritance cannot be ruled out. The clearest example

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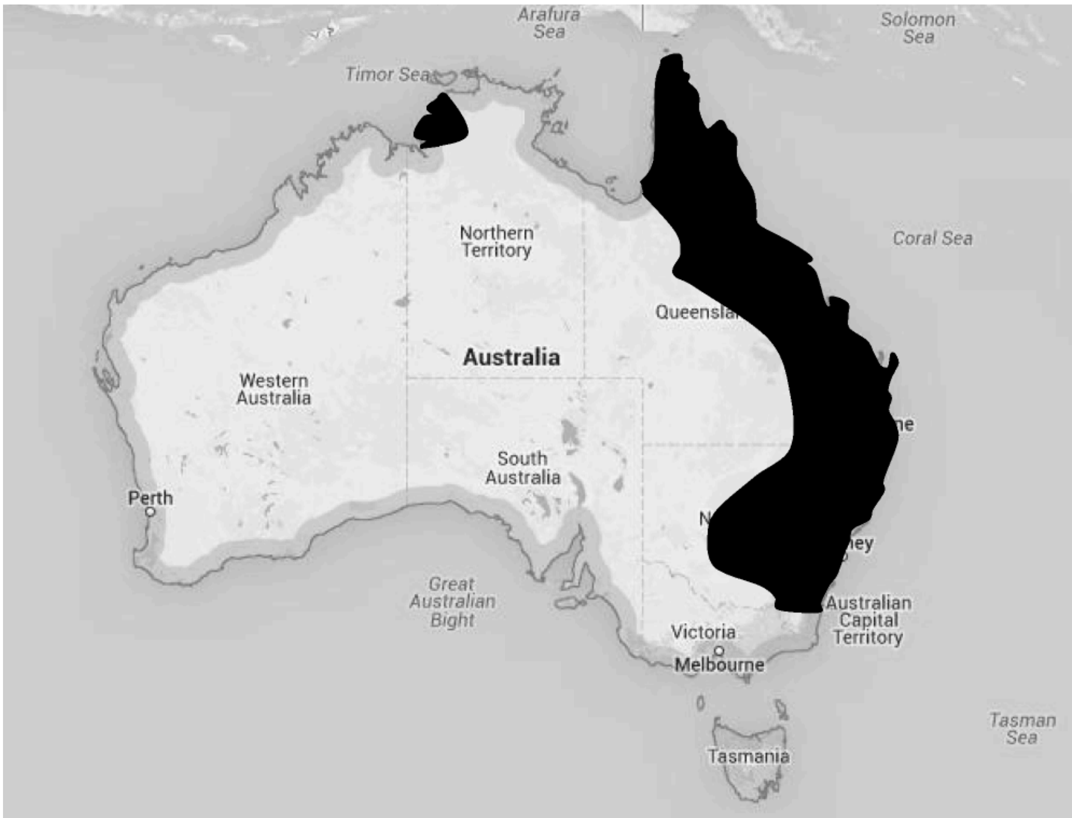
[3] I follow Blust's (2009, 2013) Proto-Austronesian (PAN) reconstructions here. However, the possibility that PAN did indeed have (phonetically) preglottalized [ˀb] and [ˀd] that were retained in at least one Formosan language, Bunun, might be considered: Proto-Mon-Khmer is reconstructed with preglottalized stops */ˀb/ and /ˀd / (Haudricourt 1965; Diffloth 1976) which were maintained in Mon, Palaungic, Katuic, and Bahnaric, but lost in Khmer, Pearic and Khmuic (Haudricourt 1965; Diffloth 1976).

[4] Under Blust's (1999, 2009) classification, Bunun is an immediate daughter of Proto-Austronesian, while Thao is a member of the Western Plains group, and Tsou a member of the Tsouic subgroup. Since no other Western Plains or Tsouic language has pre-glottalization, this feature appears to post-date the diversification of these subgroups.

[5] Implosives are found in Bintulu, Lowland Kenyah dialects, languages of the western Lesser Sundas and languages of southeast Sulawesi (Blust 2009: 176, 188). If these additional cases are not included, the figure may be under one percent. However, even in the language count, implosion is likely over-represented, since, as noted by Blust, implosion appears to be an areal feature in the western Lesser Sundas and southeast Sulawesi as well.

involves the contrast between retroflex and non-retroflex apical stops found in more than two-thirds of the indigenous languages.[6] Cross-linguistically, contrastive retroflexion for oral and nasal stops ranges from about 5-7% in the UPSID database sample of 451 languages (Maddieson 1984; Maddieson and Precoda 1989), so the much higher rates of this feature across Australia are suggestive. A further suggestion of areality is the band of Pama-Nyungan languages lacking retroflexes, stretching along the Eastern coast of the continent, from Cape York south, as shown in Map 2 (after Dixon 2002:566).



Map 2: Areas on the Australian continent lacking contrastive retroflexion

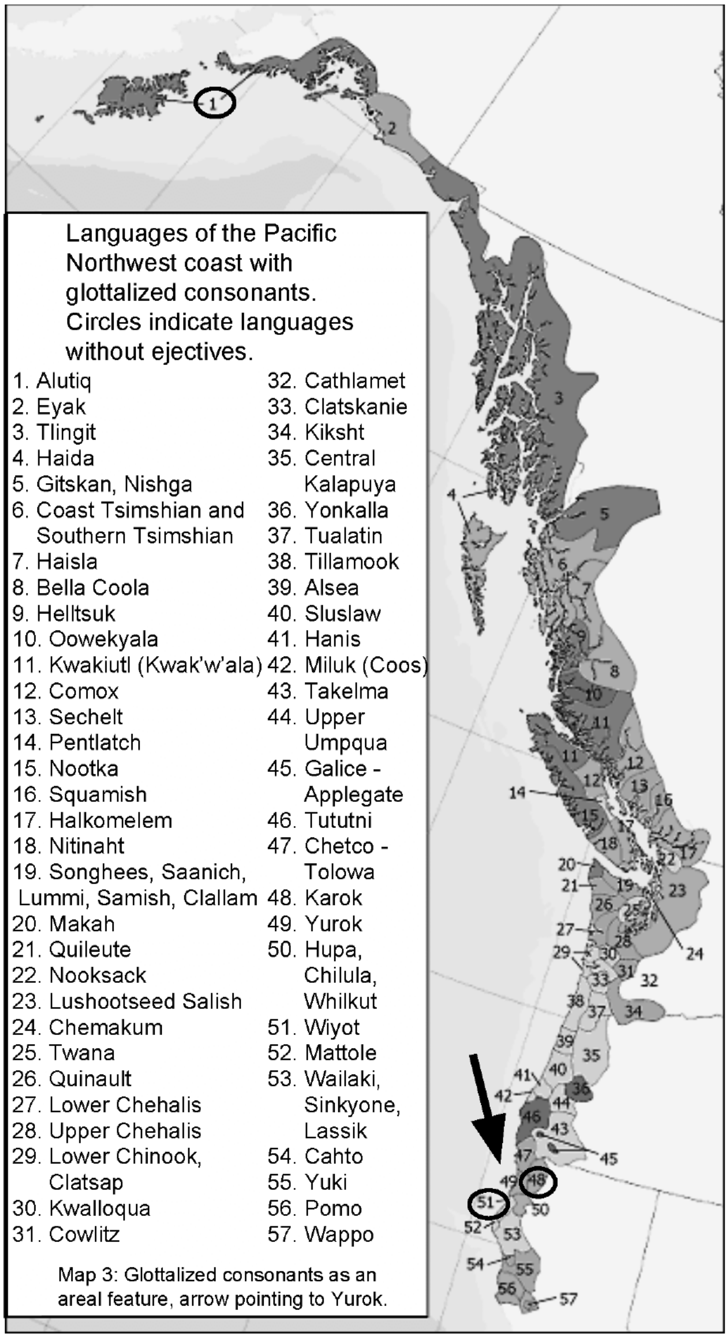
However, contrastive retroflexion is reconstructed for Proto-Pama-Nyungan (Bowern and Koch 2004), the mother language of approximately 75% of Aboriginal languages. The remaining Aboriginal languages fall into approximately 27 families/isolates. While detailed historical work on many of these is in the early stages, at least some non-Pama-Nyungan proto-languages, like Proto-Tangkic, are reconstructed with contrastive retroflexion as well (Evans 1995; Round to appear). Given these historical proposals, the high frequency of contrastive retroflexion in Australian Aboriginal languages seems due to inheritance or shared inheritance

[6] Australian languages with a retroflex contrast are often referred to as “double apical” languages in contrast to “single apical” languages that lack it. We return to consonant retroflexion as an areal feature in section 2.

within recognized language families.[7] If any areal feature needs to be explained, it is the band of Pama-Nyungan languages on the East coast that appear to have lost this contrast.

In regions where significant historical work has been done, shared inheritance is usually the easiest factor to rule out as a source of phonological convergence. For example, in assessing whether the occurrence of glottalized consonants in Yurok, an Algic language of Northwestern California, may constitute part of an areal sound pattern in Northwestern California (Haas 1976), or part of a larger identifiable areal pattern of high frequency glottalized consonants on the Northwest Coast of North America (Maddieson 2013a), we can rule out shared inheritance. This areal pattern is shown on Map 3, where only the northernmost language, Alutiq (1), and two southern fringe languages, Karok (48) and Wiyot (51), lack ejectives.

[7] In support of this, one can look at other apparent areal features of the Australian continent that are typologically unusual, like the occurrence of non-homorganic NC clusters. These are also arguably inherited, not diffused (Blevins 2004: 209-211).



Map 3: Glottalized consonants as an areal feature, arrow pointing to Yurok.

Glottalized consonants are found in Yurok (49), as well as in neighboring Hupa (50) and Tolowa (47), two Athabaskan languages, Chimariko, an isolate, in slightly more distant Shasta, another isolate, and in Wintu, a Wintuan language. Since Yurok is unrelated to all of these languages, the glottalized consonants in Yurok are not due to shared inheritance. Further, Yurok is unique among Algic languages in having ejectives /p’, t’, k’, tʃ’/.[8] The development of ejectives in Yurok is,

[8] The development of ejectives does not appear to be a natural one within the Algic family. No other languages have glottalized obstruents. Wiyot, a neighbor of Yurok, has some evidence of glottalized sonorants, but not obstruents. In Algonquian proper, aspiration and spread glottal gestures are more common accompaniments to the voiceless stop series.

apparently, unique within its language family.

However, ruling out general linguistic tendencies or chance may be more difficult in this case. Ejectives, or ejective-like consonants, are found in 92/566 or 16.3% of languages in WALS (Maddieson 2013a). Since Yurok is one of approximately 32 Algic languages, and the only one with ejectives, how can we rule this out as a chance event within Algic? If a particular sound change or sound pattern is common, or simply attested in some significant percentage of the world's languages, how can we determine whether its occurrence in what could be a linguistic area is independent, or due to contact?

To appreciate the problems involved, let us consider a more common sound pattern, like final obstruent devoicing. Final obstruent devoicing refers to sound patterns where an obstruent voicing contrast is neutralized to the voiceless series in word-final position.[9] Devoicing is widespread in the world's languages, and has a well-understood natural phonetic basis (Blevins 2006). An area with a high frequency of final devoicing sound patterns is Europe as illustrated in Map 4.

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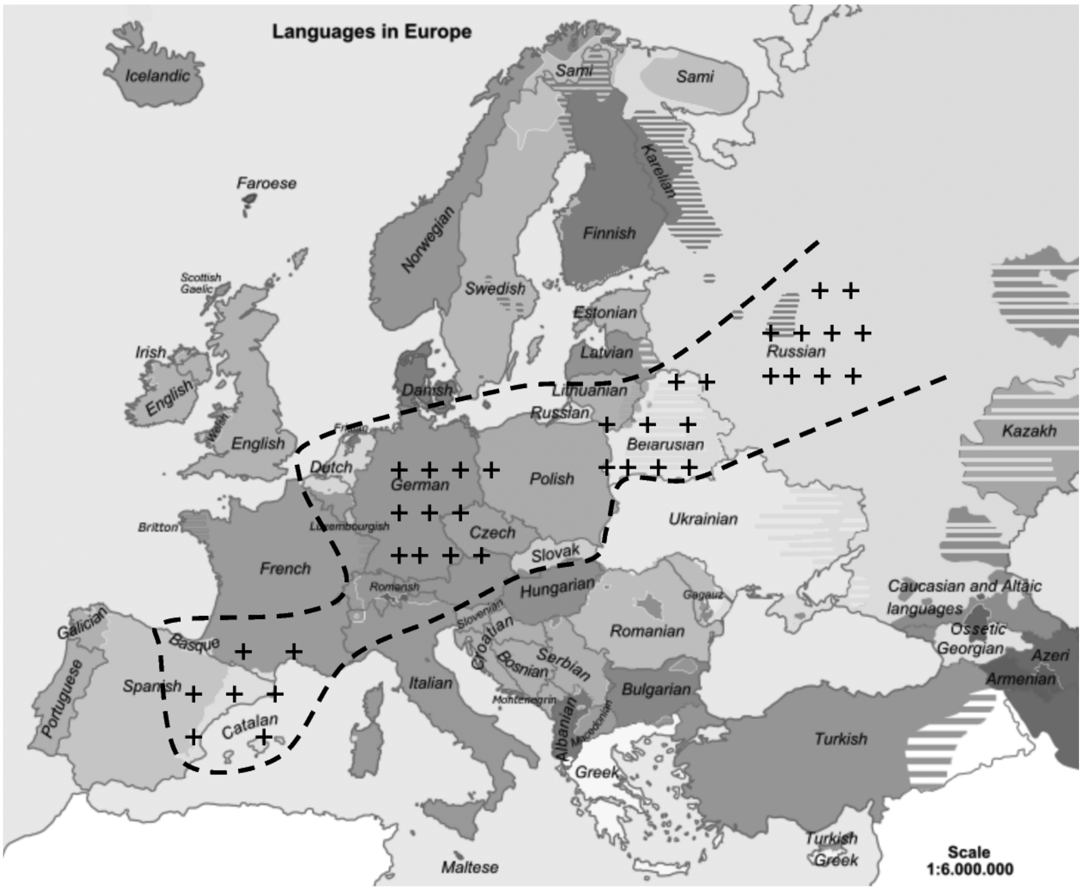
9 The term is used to refer to other kinds of laryngeal neutralization in final position as well. In German, for example, many varieties show a contrast between fortis aspirated and lenis unaspirated series, with neutralization to the aspirated series in final position (Iverson and Salmons, 2006). See Jansen (2004) for phonetically-based definitions of obstruent voicing vs. VOT contrasts in a range of European languages. This is perhaps the best place to point out that the classic Balkan Sprachbund (Joseph 1983, 1992), on which the notion of linguistic areas is based, is not securely associated with areal phonological features as defined in (1). Some features (like *n > r in Tosk Albanian and Romanian) are found in only a small subset of the languages involved. Others, like the existence of a central unrounded vowel, are common sound patterns, and could therefore result from natural parallel developments, or chance. See Vaux (2002) for further discussion.



Map 4: Final obstruent devoicing in Europe

This sound pattern stretches from East Slavic (Russian) to West Slavic (Polish), north and west into Germanic languages (German, Dutch), and farther west and south into Romance (Picard, Romansh, Camuno). Proto-Indo-European, as well as Proto-Slavic, Proto-Germanic, and Proto-Italic are all reconstructed with voicing contrasts in initial, medial and final position. As a consequence, final devoicing sound patterns are not due to shared inheritance. Independent developments must be posited within each subgroup, and could reflect parallel evolution of a phonetically-based sound change, or diffusions. In cases like this, a useful heuristic for diffusion is the occurrence of closely related dialects or languages, where one, arguably within the contact zone, shows the areal feature, and another, outside it, does not. Within the swathe of European devoicing, at least a few cases in the literature show this profile. In the central area, for example, we find that Standard Albanian maintains voicing contrasts finally, while Northern Tosk and transitional Southern Geg dialects exhibit final devoicing, shared with adjacent Montenegrin dialects. In this case, Friedman (2004) attributes Albanian devoicing to diffusion, due to historical contact with Macedonian (South Slavic) speakers. Many cases of final devoicing in Romance are also attributed to contact, usually with Germanic languages. For example, final devoicing in Old French is attributed to contact with Frankish (Posner 1995:219-220).[10]

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[10] Diffusion of apparent regular sound changes leads one to question their usefulness in subgrouping. In a recent study of Western Numic dialects, Babel et al. (2013) show that all

In the discussion that follows, we will use the range of criteria in (1) to define areal sound patterns so as to ensure that the sound pattern in question is not likely to have resulted from (shared) inheritance, general linguistic tendencies, or chance. Though some of these criteria may prove too restrictive, eliminating some cases of areal sound patterns, they will provide us with a working base of areal patterns from which we may be able to extract interesting generalizations. It should be kept in mind that databases on sound pattern frequency are limited, so that all references to general distributions noted in the typological literature should be taken as preliminary. For general statistical approaches to linguistic typology, and the problem of ruling out chance in the assessment of areal features see Bickel (in press). For the purposes of this chapter, we classify a sound pattern as uncommon if it occurs in less than 25% of the world's languages, and as rare if it occurs in less than 5% of the world's languages based on the UPSID (Maddieson 1984) and the WALS (Dryer and Haspelmath 2013) survey data. A sound pattern like final obstruent devoicing, then, is not rare, and the areal devoicing illustrated in Map 4 could well be a consequence of parallel evolution, diffusion, or some combination of the two.

2 The evolution of areal sound patterns: stone soup and the perceptual magnet effect

How do sound patterns spread from one language to another? How does a language without consonant implosion or retroflexion acquire these features by osmosis? How do new sound patterns materialize as speakers, exposed to these sound patterns in another language, continue to speak their own?

Though it was once commonly believed that areal sound patterns diffused primarily through lexical borrowing, as early as Emeneau (1956), it was clear that a process of "acculturation" occurred, whereby native sounds became more like sounds of contact-languages, without, or independent of, lexical borrowing. A case where this is particularly clear is the linguistic area of Northwestern California, mentioned earlier with respect to the areal distribution of glottalized consonants illustrated in Map 3. The Northwestern California culture area is home to at least four distinct language families/isolates: Karuk (isolate), Yurok and Wiyot (Algic); Hupa and Tolowa (Athabaskan), and Chimariko (isolate). As detailed in Conathan (2004), hundreds of years of multilingualism, intermarriage, and cross-cultural exchange have led to linguistic convergence in many areas of grammar. However, in this linguistic area, lexical borrowing is very rare (Conathan 2004:80-81). Not only are borrowings rare, but we are hard-pressed to find even one word that was borrowed into Yurok with /p'/ or /k'/; the most likely instances of borrowed words with ejectives involve /t'/ and /tʃ'/ (Blevins 2002).[11] Given that ejectives like /p'/

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of the six regular sound changes identified show evidence of diffusion. They conclude that, like parallel natural sound changes in distinct lines of descent, "phonological diffusion too can confound cladistic analysis (p. 482)."

[11] The most likely borrowings with ejectives are Yurok /tʃ'utʃ'iʃ/ 'bird', /tʃ'ek/ 'wren', /tʃ'iʃah/ 'dog' (Blevins 2002:11-12). Internal to Yurok, the primary source of glottal stop, and ejection, is Proto-Algic *t.

and /k’/ are thought to be areal features, and to have arisen in Yurok as a consequence of language contact, we cannot attribute the source of the sounds themselves to lexical borrowing.[12] For at least some ejectives, an internal historical source has been identified. A sequence of regular sound changes takes *Ct clusters to ejectives as shown in (3) (Blevins 2002).

(2) One source of glottalization in Pre-Yurok
 *Ct [Ct, Cˀt, Ctˀ] > Cʔ > C’

Yurok ejectives, then, appear to be triggered by areal contact with neighboring languages that have ejectives. Yet, they appear to evolve via natural phonetically motivated sound change. This observation is just one instantiation of what we might call the “Areal Sound Pattern Paradox”: areal sound patterns are paradoxical, in that their primary catalyst is external, and yet, they often take the form of regular internally motivated sound change. How can this be?

A useful comparison is to the making of stone soup in the well known European folktale, *Stone Soup*[13]:

> A poor peasant has been travelling for days through rugged land. He is hungry. When he arrives at the next village, he begs for food, first at one door, then at the next, and the next. But no one obliges. “Ah” he tells them, “then I will have to make a delicious stone soup like no other”, and he collects wood, makes a fire, fills his black pot with water from the stream, sets it on the flames, and, with the villagers all looking on, drops one large stone into the pot and begins to stir. “Go away” he says to them, - it will take some time to cook. I will tell you when it is ready. But the villagers are curious, and, one by one, they return. First a woman comes by. “What kind of soup is this, made from a stone?” the woman asks. “Ah” he tells her, taking a taste, “you will see, it is a delicious soup, like no other, and only needs a bit of carrot to be just right”. The woman gives a carrot from her basket, and the peasant drops it in. Soon the woman’s daughter comes by. “What kind of soup is this, made from a stone?” the girl asks. “Ah” he tells her, taking a taste, “you will see, it is a delicious soup, like no other, and only needs a bit of onion to be just right”. The girl takes an onion from her skirt pocket, and the peasant drops it in. Soon the suitor of the girl arrives and asks “What kind of soup is this, made from a stone?”. “Ah” he tells the boy, taking a taste, “you will see, it is a delicious soup, like no other, and only needs a bit of mushroom to be just right.” The boy gives what he has gathered, and the peasant drops it in. Soon the father of the boy comes around, a farmer. “What kind of soup is this, made from a stone?” the farmer asks. “Ah” he tells the farmer, taking a taste, “you will see, it is a delicious soup, like no other, and only needs a bit of barley to be just right.” The farmer digs in his bag for a pouch of barley, and the peasant drops it in. Soon the farmer’s wife arrives. “What kind of soup is this, made from a stone?” she asks. “Ah” he tells her, taking a taste, “you will

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12 Indeed, Yurok pronominal prefixes *'ne-* 1st person, *k'e-* 2nd person, *'we-* 3rd person, that are cognate with Wiyot, and more distant Algonquian languages, and that form the basis of the established genetic relationship of these languages, show glottalization, including the ejective /k’/ in the second person.

13 This folktale has many different variants, including those where the hungry travelers making the soup are peasants, beggars, monks, or soldiers, and where the initial ingredient is a stone, a piece of wood, a nail, or some other non-food stuff. The version here is the one I heard most often as a child.

> see, it is a delicious soup, like no other, and only needs a bit of herbs to be just right." The farmer's wife gives what she has just picked, and the peasant drops it in. When the peasant declares the soup "just right", he shares it with the entire village, and all agree that it is a most delicious soup, like no other. All are well fed and rejoice.

While there are many ways of reading this tale, the features that most versions share are that of a hungry stranger coming into new country with nothing. From nothing, he makes a delicious soup. In essence, the soup is made from contributions of the surrounding villagers, but since each contribution is small, none of them notice that the soup is made from their own contributions, and not from the original stone. Clearly the stone is not the central ingredient, in fact, in the culinary sense, it is not an ingredient at all. It is a tool which mobilizes external ingredients, and these are what make the soup.

This, I suggest, is a useful metaphor for how areal sound patterns arise, The "stone" in the linguistic scenario of language contact is the contact sound pattern that ultimately spreads: it is the main ingredient of something new, different, and delicious, that people speaking their own language want to experience, but, in reality, it is completely inert. Areal sound patterns are not the result of phonetic borrowing or contamination. Under the view outlined below, the contact language serves as catalyst, but salient features of the new sound pattern come from the indigenous language, naturally, and unknowingly. In the same way that stone soup has the same active ingredients as other soups, areal sound patterns have similar language-internal phonetic trajectories as non-areal sound patterns. The external stimulus of a contact sound pattern shifts the odds of the same pattern evolving in a neighboring language, but it could have evolved in that language independently of contact, only with much lower probability.[14]

To make this comparison more concrete, I propose the *Areal Sound Pattern Hypothesis*:

> Areal sound patterns are due to perceptual magnet effects within one language, where the perceptual magnets themselves are sounds from another language. As a consequence, their evolution may mimic that of internal phonetically-based sound change.

The notion that language experience alters phonetic perception is central in the field of language acquisition, where it is often referred to as the "perceptual magnet effect" (e.g. Kuhl 1991; Kuhl and Iverson 1995; Kuhl 2000). The central finding in this research paradigm is that exposure to a specific language results in the warping of perceived distances or similarities between phonetic stimuli. In experiments with children and adults, listeners judge similar acoustic differences as being perceptually closer when the tokens include a proto-type or best instance of a particular phonological category. In the course of language acquisition, as proto-

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[14] Taking some of the frequencies introduced earlier, recall that ejectives, worldwide, occur in approximately 13.5 of languages. In contrast, in the Pacific Northwest culture zone depicted in Map 3, 94% of languages have ejectives (3/50 do not). Since these languages represent many distinct families, inheritance cannot explain the discrepancy between 13.5% and 94% . The hypothesis is that the odds of a language like Yurok developing consonant glottalization are skewed because of the external stimuli of ejectives in neighboring languages, as detailed below.

categories are established, they function as perceptual magnets, making stimuli in their vicinity seem more like them, and drawing tokens into the evolving category.

Areal sound patterns can be viewed as long-term consequences of a special case of the perceptual magnet effect. In the case of an areal sound pattern, an external phonetic proto-type is internalized by a speaker on the basis of data external to the language being acquired. In contact situations where bilingualism is the norm, the phonetic proto-type established for one language may have a magnet effect in another. In the mind of the speaker, the two languages are distinct, however, phonetic categories may move towards each other due to the perceptual magnet effect. While this process may have the greatest impact in the early years of language acquisition, there is growing evidence that, at least for fluent bilinguals, these effects may continue into adulthood (Simonet 2014).

This model of areal sound patterns does not require lexical borrowing for sound pattern spread. Further, with phonetic proto-types from one language acting as magnets in another, a prediction is that areal sound patterns will evolve incrementally via one or more seemingly natural phonetically based sound changes, since perceptual magnet effects are natural movements of categories in the perceptual/acoustic space.

Three additional concrete conditions can be identified from the empirical case studies summarized in this chapter as stated in (3).

(3) Sound pattern spread by the perceptual magnet effect: three variables

i. Establishment of a phonetic proto-type requires *phonetic saliency*: the more salient the phonetic pattern, the more likely it will spread areally.

ii. Establishment of a phonetic proto-type requires *significant exposure*: the more intense the language contact, the more likely it will result in diffusion of a sound pattern. The perceptual magnet effect works on phonetic proto-types, and may take several generations to yield sound patterns that are recognizable instances of sound change. For this reason, exposure must not only be intense, but span several generations of language learners.

iii. The perceptual magnet effect requires *phonetic proximity* between the proto-type and language-internal tokens, and draws phonetically similar tokens closer to the phonetic proto-type. If there are such tokens in the neighborhood, sound change will appear to be natural and phonetically motivated, and indistinguishable from internal developments. If the phonetic proto-type is far from similar tokens, there may be no effect, and no new category will evolve.

Within this model, perceptual saliency is critical to sound pattern diffusion (3i). Articulation plays little role in the spread of sound patterns. If the difference between an apical dental stop and an apical alveolar stop is not phonetically salient, this articulatory feature is unlikely to diffuse. Other features that may be less likely to diffuse under (3i) are within-category differences: for example, if two neighboring languages both have a plain voiceless vs. voiceless aspirated contrast that is cued by positive VOT, but one language has significantly longer VOT than the other, the difference in positive VOT is less likely to diffuse than an unshared phonetic feature, because perception of VOT will already itself be active in warping the perceptual space.

At the same time, perceptual saliency is not enough for a sound pattern to diffuse, even if exposure is significant. If the phonetic proto-type is too far from native sounds, magnet effects will not result in new categories. One perceptually salient sound pattern that may resist diffusion for this reason is the occurrence of clicks. Clicks, or consonant sounds made with the ingressive velaric airstream mechanism, are rare sounds occurring in less than 1% of the world's languages, and in 1.8% of the WALS sample of 567 (Maddieson 2013b). They are primarily restricted to the Khoisan languages (including Sandawe) where they are believed to be directly inherited, but also found in Hadza of Tanzania, and clearly borrowed into some unrelated Bantu languages like Xhosa and Zulu. Areally, however, it is clear that clicks did not spread widely outside of the Khoisan zone. The few languages like Zulu that show borrowed clicks have them through two processes: lexical borrowing, and *hlonipha* vocabulary, - a process of taboo word-formation where clicks can be replaced by non-clicks and vice versa (Faye 1923-25). In short, there is no evidence of perceptual magnet effects yielding diffusion of clicks. Within this model, the failure of clicks to establish themselves as an areal feature is not due to lack of phonetic saliency (3i) or to insignificant contact (3ii); on the contrary, both of these conditions are strongly met. It is the actual mechanism of sound change (3iii) that renders clicks ineffective as perceptual magnets in Bantu. Most Bantu languages reflect the simple Proto-Bantu consonant system with /p t c k b d j g m n ɲ/ combining into CV or NCV syllables. The problem seems to be that from this Bantu language type, no phonetic categories are particularly close to clicks. As perceptually robust as clicks are, there is nothing to draw into their sphere. They can be borrowed in specific lexical items, and they can replace sounds in taboo word-formation, but they remain inert within the phonological system due to their phonetic distance from other consonants.[16]

In contrast, the ejective consonants of many North American languages seem to be close enough to distinct sound patterns to serve as perceptual magnets. Recall that Yurok is unique among Algic languages in having ejective or glottalized consonants /p', t', k', tʃ'/.[17] The evolution of ejectives via the sound changes in (2)

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[16] Another segment type that rarely, if ever, takes part in areal sound patterns is pharyngeals. Pharyngeals and pharyngealized sounds are perceptually salient. However, significant contact between languages with pharyngeals and those lacking them is not enough to induce areal pharyngealization, since it is rare that a language will have a phonetic pattern that approaches the characteristic F2 lowering of adjacent vowels triggered by pharyngeals. For example, languages in contact with varieties of Arabic rarely show sound changes shifting other sounds to pharyngeals. One possible case of pharyngealization as an areal feature is nomadic Northern Songhay Tasawaq, that might have acquired pharyngealization via contact with Tuareg (Kossmann 2012).

[17] The development of ejectives does not appear to be a natural one within the Algic family. No other languages have glottalized obstruents. Wiyot, a neighbor of Yurok, has some evidence of glottalized sonorants, but not obstruents. In Algonquian proper,

appears to be due to contact. Glottalized consonants are an areal feature of Northwestern America, and Northwest California, the region where Yurok is spoken is a genetically diverse micro-area within this greater macro-area. How did Yurok acquire ejectives? What triggered the sound changes in (2)? Adhering to the model in (3), we suggest that ejectives, as pronounced in the American Northwest, are perceptually salient sounds (3i). Further, these ejectives were established as phonetic proto-types in Pre-Yurok due to sustained contact and multilingualism with languages having these sounds (3ii). Finally, given certain contexts where consonants were produced with glottalization, perceptual space between these sounds and ejectives was compressed, giving rise to the sequence of changes in (2) where a glottal stop and an adjacent oral stop are produced as a single glottalized consonant (3iii).

One striking aspect of the evolution of areal sound patterns within this model is that the sound changes involved, like those in (2) above, are, for the most part, indistinguishable from phonetically-based sound changes elsewhere in the world that appear to be internally motivated. For example, the association of glottalization with /t/, and a sound change of *t [t, ˀt, tˀ] > ʔ has occurred in many varieties of English (Wells 1982), especially in the syllable coda, with no apparent external conditioning, while similar neutralization of glottalized codas to glottal stop is found in the transition from Middle Chinese to Fuzhou (Blevins 2004:120-21). At the same time, the regular pre-Yurok fusional development Cʔ > C' is the diachronic source of ejectives in widespread unrelated languages, including Caddo of the American central plains, and Yapese, an Austronesian language with a long independent history (Fallon 2002: 303).

If ejectives can propagate in the Pacific Northwest through the process described, then, given significant contact in other parts of the world, ejectives are expected to show areal distributions in these regions as well. A survey of the high-density pockets of languages with glottalized consonants in the world shows that this is indeed the case. For example, as illustrated in Map 5, in the Caucasas region, ejectives are found in four different language families: in Nakh-Daghestani languages (e.g. Archi, Lak); in Northwest Caucasian languages (e.g. Kabardian); in South Caucasian languages (e.g. Georgian, Laz); and in two distinct subgroups of Indo-European, - Armenian (Eastern Armenian) and Iranian (Ossetic).

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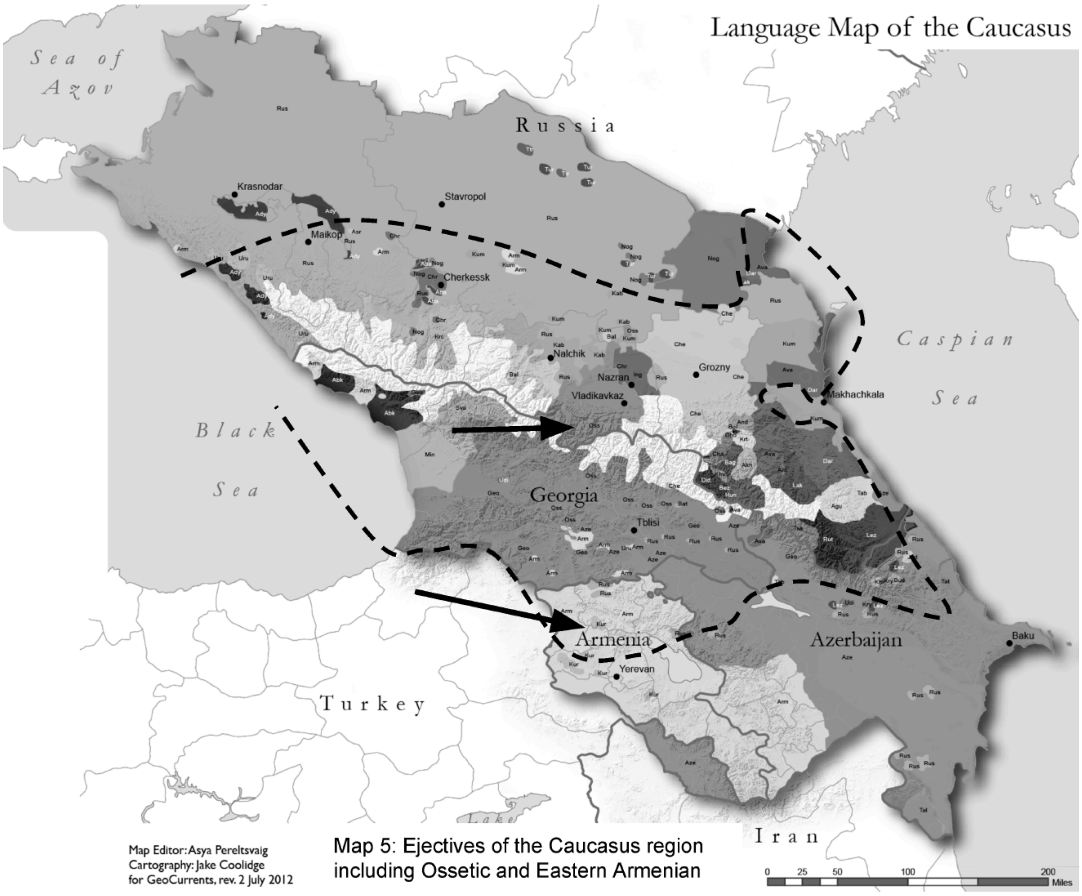
aspiration and spread glottal gestures are more common accompaniments to the voiceless stop series.



Map 5: Ejectives of the Caucasus region including Ossetic and Eastern Armenian

While ejectives may be inherited in Caucasian languages, their occurrence in Armenian and Ossetic stands out in the same way Yurok glottalized consonants do: within the Indo-European language family, ejectives are only found in these two languages. In Ossetic, unlike Yurok, loanwords are the primary source of ejectives (Thordarson 2009). These include Caucasian loans, where ejection is preserved, and Russian loans, where voiceless stops can be replaced with ejectives.[18] However, there is at least one environment in Ossetic where ejectives have arisen in native words: in final –sC clusters, e.g. *xuisk', xusk'* 'dry' (< Old Iranian *huʃka-). Again, it appears that perceptual magnet effects may be at work, drawing a final [k] with heavy release and surrounding noise into the /k'/ category.

The phonetic naturalness and regularity of internal sound changes giving rise to areal sound patterns (3iii) is central to Hamp's (1996) account of the origins of the retroflex contrast in Sanskrit. As first detailed by Emeneau (1956) in his influential paper "India as a linguistic area", the contrast between retroflex and non-retroflex apical stops is a striking feature of India and surrounding areas that cannot be attributed to direct inheritance and defies chance. Within the area, illustrated in Map 6, the contrast is found in languages of the four major language families represented: Dravidian, Indo-Aryan, Austro-Asiatic (Munda) and Sino-Tibetan (e.g. Ladakhi).

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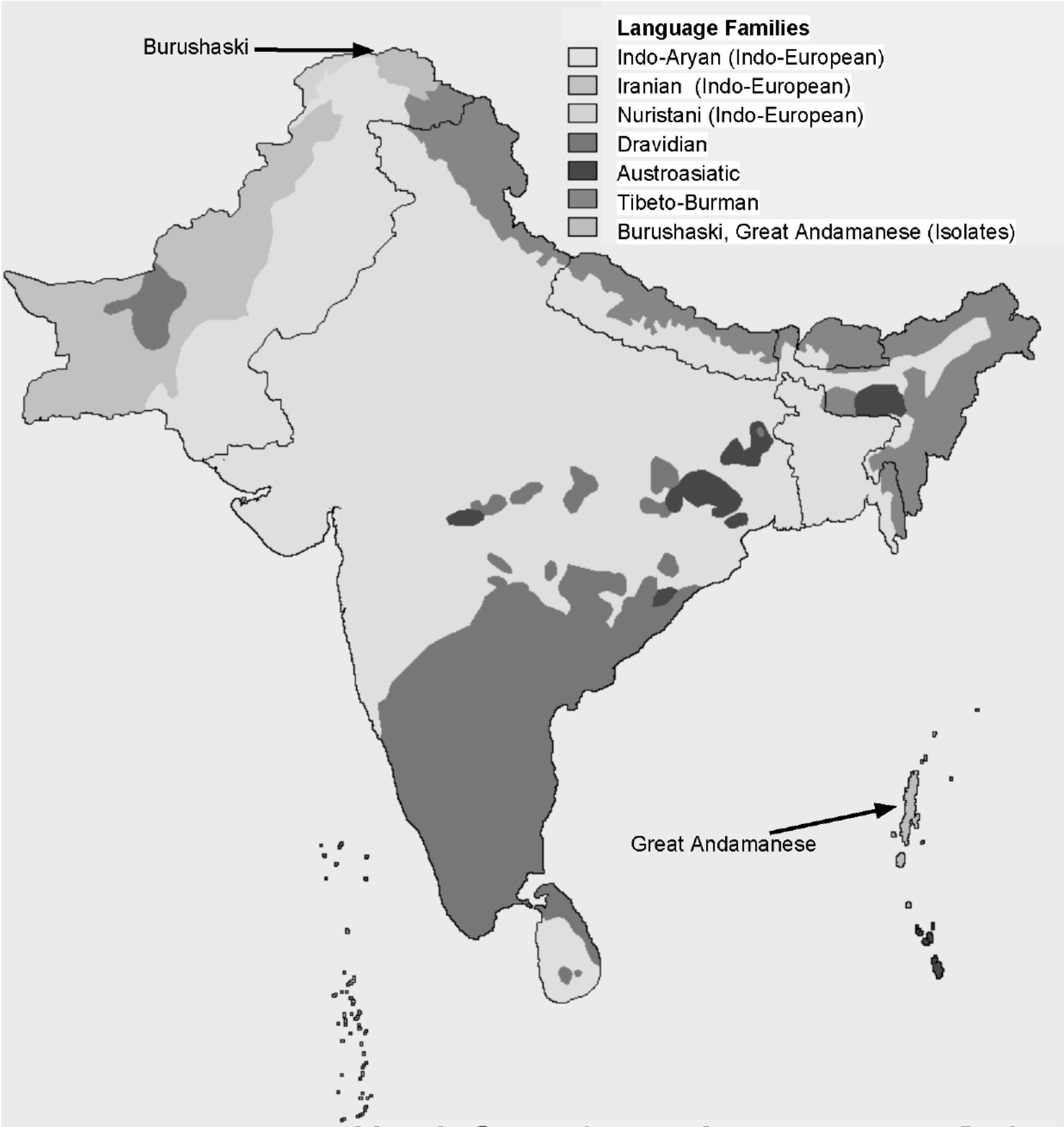
[18] In the case of Russian loans, ejection may be used to mark words as foreign, and could be unrelated to perceptual magnet effects.



Map 6: General area of consonant retroflexion

As one moves east and north through Pakistan, retroflexion can be found in Burushaski, an isolate, and in Iranian languages (e.g. Wakhi). Retroflexion is not reconstructed for Proto-Indo-European, Proto-Austro-Asiatic, or Proto-Sino-Tibetan, but it is a contrastive feature of Proto-Dravidian. For this reason, Emeneau (1956) and others attribute the feature in Indo-Aryan languages to early contact with Dravidian languages, which clearly had a wider distribution than they do at present.[19]

In trying to pin down the precise source of retroflexion, Emeneau (1956) suggests that bilingualism allowed "allophones to be redistributed as retroflex phonemes". Hamp (1996) attempts to be more precise about the mechanisms giving rise to Sanskrit retroflexion, justifying the level of detail in terms of providing a

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19 Brahui, a Dravidian language, is spoken in the modern Balochistan region of eastern Iran and Pakistan, almost one thousand miles from the closest Dravidian speaking regions of southern India. Kurukh, another Northern Dravidian language, is spoken hundreds of miles to the east, in Odisha, and Malto, another, is spoken mostly in East India.

clear explanation of "the development and spread of an important trait of the South Asian *Sprachbund*…[and] one of the clearest, most fully documented, and most internally complex cases known to us of what appears as areally induced phonological diffusion." Hamp's focus is on the internal evolution of retroflexion by natural means (3iii). The evolution of retroflex consonants within Indic begins with the birth of Indo-Iranian *ʃ, which had several sources, including the "Ruki Rule", whereby *s > ʃ / {r,u,k,i}__.[20] A rule of voice assimilation in clusters results in a further split, so that Proto-Indo-Iranian has both *ʃ and *ʒ. In Indic, these sounds shift to retroflex articulations. In terms of the model in (3), exposure to Dravidian retroflexion, seems to draw the "closest" Indic sounds towards the retroflex category, giving rise to an internal context-free *ʃ, *ʒ > ʂ, ʐ sound change.[21]. After the evolution of [ʂ], [ʐ] in Indic, local and long-distance assimilations between /t,d,n,l/ and these retroflex sibilants give rise to retroflex oral stops, nasals and laterals. Since these assimilations, are, by their very nature, natural and phonetically motivated, the key step in the infiltration of retroflexion into the Indic system appears to be the initial *ʃ, *ʒ > ʂ, ʐ sound change, itself a clear example of the perceptual magnet effect.[22]

Other languages with distinct sound patterns within this greater India area have alternative means of fabricating retroflex obstruents from scratch. For example, in Ladahki, a Tibetan language of Ladakh, India, retroflex oral stops have developed from fusion of earlier *tr and *dr clusters, as in truk > ʈuk 'six', dre > ɖe 'devil', etc. (Sharma 2004:30).

An interesting question one can pose in this context is how common or rare a sound pattern is outside of cases where it appears to arise through contact.

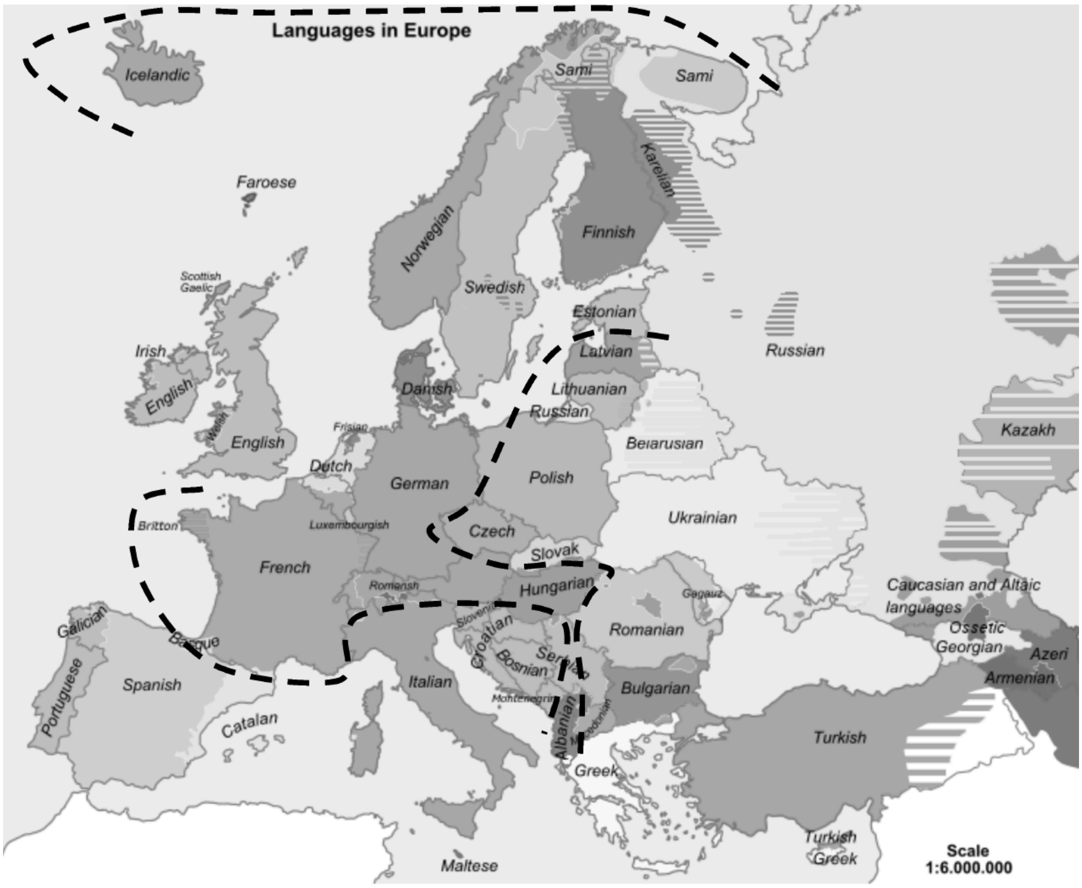
[20] Though the phonetic basis of the Ruki Rule has been debated in the phonological literature, Longerich (1998) presents experimental acoustic data supporting phonetic conditioning of the Ruki Rule in Indo-European. In her study, the sounds [r], [u], [k], and [i] all had the effect of lowering the noise frequency of a following /s/, resulting in a sound that was closer, in terms of its spectral properties, to [ʃ]. Her phonetic study is important, not only in providing acoustic support for the sound change, but in highlighting a natural shift to [ʃ], which then, in Indic, underwent subsequent contact-induced change to retroflex [ʂ].

[21] Assuming bilingualism at the time of contact, this change may also be influenced by the fact that in early Dravidian, the only sibilant contrast is /s/ vs. /ʂ/. Hence, native speakers of Dravidian will be likely to map their own sibilant contrast onto the Indic /s/ vs. /ʃ/ contrast. This is a distinct source of retroflexes from the cases discussed by Hamp that I attribute to the perceptual magnet effect. In this case, Dravidians would impose their phonological contrasts on Indic, using retroflex pronunciation for broad-grooved sibilants.

[22] Typological evidence for context free *ʃ, *ʒ > ʂ, ʐ as an areally induced perceptual magnet effect would come from statistical evaluation of the probability of this change occurring without an "external" perceptual magnet. How common is it for this context-free sound change to occur in the isolated development of a language? These kinds of questions are difficult to evaluate at present, since a comprehensive inventory of context-free sound changes has not been compiled. Other areally induced examples of this change appear in Eastern Iranian languages like Pashto (Henderson, no date).

Consider, for example the case of front rounded vowels. Maddieson (2013c) finds that 37/562 languages or only 6.6 % of languages in the WALS survey have front round vowels. This suggests that front rounded vowels are relatively rare features in the world's languages. However, when one looks at the distribution of the vowels in the sample, one finds that the majority of languages with front rounded vowels (29/37 or 78%) are spoken in the north-central area of the Eurasian continent, and further, that outside of this region very few languages with front rounded vowels are found, and they are widely scattered. (Maddieson 2013c).

Within Eurasia front rounded vowels appear to be directly inherited within Uralic and Turkic, but elsewhere, the result of widespread diffusion. Map 7 illustrates some of the languages of Europe with front rounded vowels, and shows that they constitute a near-continuous stretch, from Hungarian in the east, north to Finnish, Norwegian and Swedish, south to Albanian and Greek, and west and south to Gallo-Romance, including Camuno, a Gallo-Italic language of northern Italy (Cresci 2013).



Map 7: Front rounded vowels in Central and Western Europe, including "edge" languages Breton (NW), Souletin Basque (SW), Albanian (SE), Finnish (NE)

From Gallo-Romance, front rounded vowels have diffused even farther west, from French to Breton, and farther south, from French to eastern varieties of Basque, including Souletin, where they are attested in the earliest written documents (Egurtzegi 2013, 2014).[23] Of Proto-Indo-European, Proto-Uralic, and Proto-

23 See Trudgill (2011:120-21) for related discussion.

Basque, only Proto-Uralic is reconstructed with front rounded vowels. Within Indo-European, front rounded vowels arose in: Germanic (excluding Gothic) via umlaut; in Albanian; in South Slavic (Vermeer 1979); and in Gallo-Romance.[24] We suspect, that many of these cases were also contact-induced, given the rarity of front-rounded vowels outside this zone. If we eliminate front rounded vowels that are clear areal features of Western Europe from the WALS database, the sound pattern falls from 6.6% to 5.6%, and if inherited cases are eliminated in Uralic and Turkic, the figure falls to below 5%. By our gross measures above, front rounded vowels would be rare features.

As with Indic retroflexion, details of the evolution of front rounded vowels support a model incorporating the perceptual magnet effect. Front rounded vowels are perceptually salient, and can result in phonetic proto-types when a speaker of a language without them has sustained and significant contact with a language making use of them. As perceptual magnets, front rounded vowels draw phonetically similar tokens closer to the proto-type. And, if there are such tokens in the neighborhood, sound change will appear to be natural and phonetically motivated (3).[25] In Germanic and Albanian, front rounded vowels are a consequence of anticipatory coarticulation in _C_0i sequences, while in Gallo-Romance and Souletin Basque, we see context-free changes of u: > y, and u > y respectively; in Souletin and Camuno, subsequent vowel to vowel harmonic sound changes take more vowels to /y/. While all of these are natural, phonetically motivated changes, they appear to be extremely rare without pre-existing front rounded vowels as perceptual magnets.[26]

However, at least one areal sound pattern leads one to question whether perceptual saliency is central to all cases of phonetic diffusion. The feature of interest is pre-aspiration, an areal feature of medial tense voiceless stops in Northern Europe, especially Scandinavia and areas where Old Norse was once spoken (Hansson 1999; Helgason 2002). Pre-aspiration is a rare phonetic feature cross-linguistically, occurring in only 4/451 languages of UPSID, and is typically an allophonic variant of post-aspiration in voiceless stops.[27] It is even rarer as a

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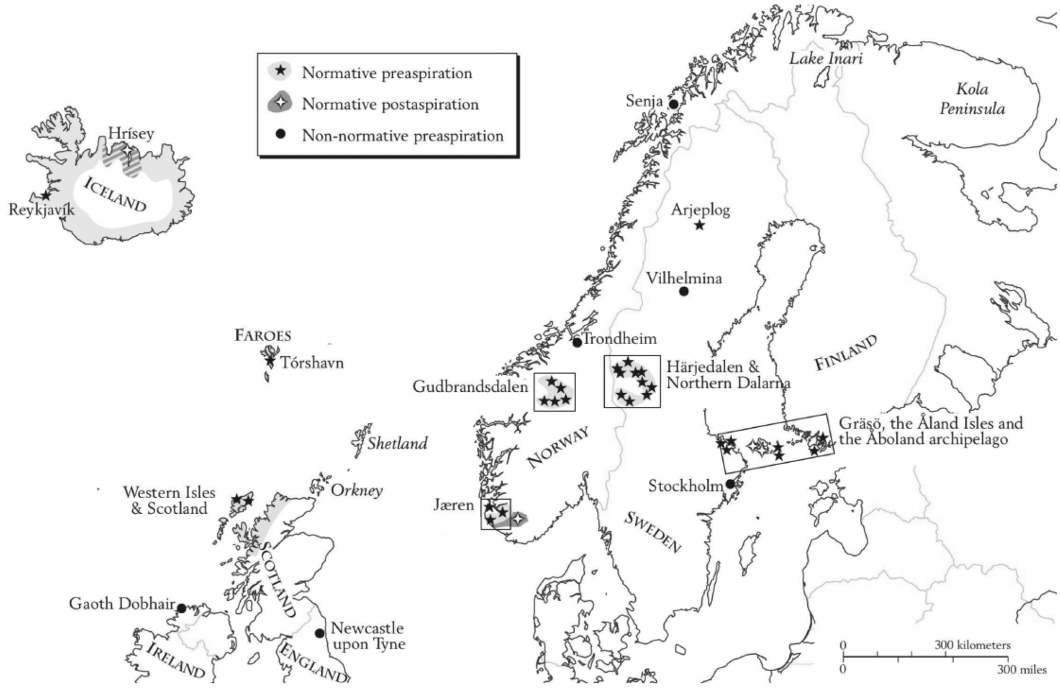
24 In South Slavic, front rounded vowels are still found in some Kajkavian dialects (Vermeer 1979). Greek is also thought to have had front rounded *y (Allen 1987). Under this view, it would be typologically highly unusual in lacking a back rounded counterpart.

25 Slavic speakers consistently unround rounded vowels when speaking German (Raymond Hickey, p.c.). Recall that contact must be sustained for the perceptual magnet effects hypothesized here to take effect.

26 Maddieson's (2013c) remarks are in line with this hypothesis. With respect to the distribution of front rounded vowels, he remarks "…it is quite striking that their occurrence is so relatively concentrated in a particular geographical area. It seems likely that the *hearing of sounds of this sort in some languages of the area may have given further support to phonetically natural processes in other languages* [my emphasis:JB], with the end result being the addition of front rounded vowels to the inventory of more of the languages."

27 Tarascan (aka P'urhépecha), an isolate of Michoacan, Mexico, is classified by UPSID as a language with (post-)aspirated stops, though these are pre-aspirated in predictable environments (Friedrich 1971, 1975; Lluvia Camacho, 2013, personal communication).

contrastive feature of oral stops, with Ojibwe being the only UPSID language with this property. Bladon (1986) has suggested that the rarity of pre-aspiration is due to its low perceptual saliency. If this is the case, then, pre-aspiration should be less likely to diffuse by (3i) than other more salient phonetic properties. Helgason's (2002) detailed study of pre-aspiration in Nordic languages, shown in Map 8, provides confirmation of the model in (3) in two ways.



Map 8: Principal locations of pre-and post-aspiration in Scandinavia and the North-Atlantic (Helgason 2002:3)

First, it demonstrates that the strongest instances of pre-aspiration, cases where it is a language-specific phonetic feature, or "normative" in his terms, are those directly inherited from Old Norse.[28] In these cases, direct inheritance accounts for the common feature of pre-aspiration and its distribution. In cases where pre-aspiration has diffused into other language families, it is either highly variable and non-contrastive, or strengthened to be more perceptually salient. In the first case, exemplified by Saami varieties and Tyneside English, the weak perceptual saliency of pre-aspiration results in spotty diffusion, with variability across speakers, and

Counting Tarascan as a pre-aspirating language would make the figure 5/451 languages in UPSID.

28 Helgason's definitions of normative vs. non-normative phonetic traits are as follows: "If the absence (or presence) of a particular phonetic trait leads to a pronunciation that is considered deviant by the speakers of a given dialect, that trait can be classified as normative (or normatively absent) in that dialect. Conversely, a trait whose absence or presence does not lead to deviant pronunciation can be classified as non-normative in that dialect" (Helgason 2002: 21). There may be some circularity in these terms, and I have taken the liberty of paraphrasing them in the text.

what Helgason refers to as “non-normative” phonetics.[29] In contrast, a stronger percept is associated with Helgason’s category of “normative” phonetics. The spread of pre-aspiration from Northern Germanic languages into Celtic has given rise to many Scots-Gaelic dialects where Common Gaelic /p, t, k/ are realized as pre-aspirated stops. In areas where pronunciation appears to be the most “normative”, preaspirates are strengthened to velar fricatives, resulting in pronunciations like [xp], [xt], and [xk]. It appears then that where pre-aspiration diffuses and becomes a regular allophonic pattern, it is more perceptually salient than elsewhere.[30]

3 Radical areal spread, and tone as an areal feature

To this point, the areal sound patterns under discussion have involved single features or segment types: pre-glottalization of voiced consonants; ejectives; retroflexion; click sounds; front-rounded vowels; and pre-aspiration. Recall that part of the reason for focusing on less common phonological features was to rule out chance, or parallel evolution (i.e. natural internal developments) of more common sound patterns. However, another way of ruling out chance or parallel evolution is to show that a group of features is shared between neighboring languages, and that this group of features cannot be the consequence of shared inheritance. In cases where multiple aspects of sound patterns spread, radical changes to the typological profile of a language are possible.

One of the most striking instances of this kind of radical areal spread is found in South-East Asia. Matisoff (2006) catalogues numerous instances of this kind of profound structural and prosodic influence, including: Chinese phonotactic and prosodic influence on Vietnamese, Tai, and Hmong-Mien; Mon phonational influence on Burmese with subsequent Burmese tonal influence on Karenic; and the influence of Mon-Khmer and Sinitic on the evolution of tone and register in Chamic, a subgroup of Austronesian. This last case is, perhaps, the best documented of all instances of radical phonological areal diffusion, being the subject of Thurgood’s (1999) monograph, *From Ancient Cham to Modern Dialects: Two Thousand Years of Language Contact and Change*. The level of detail in terms of social and linguistic history is remarkable, and the stages and range of areal phonological features are audible to this day in the Chamic languages still spoken.

Chamic, and its sister Malayic, are subgroups of Western Malayo-

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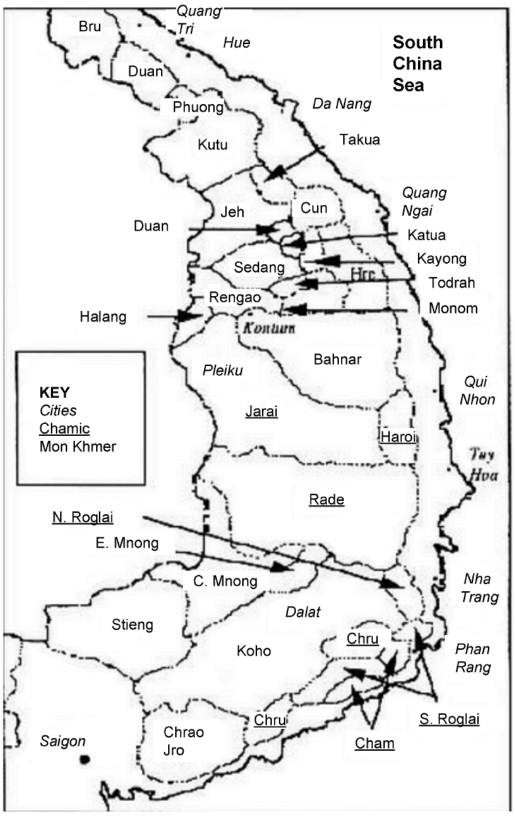
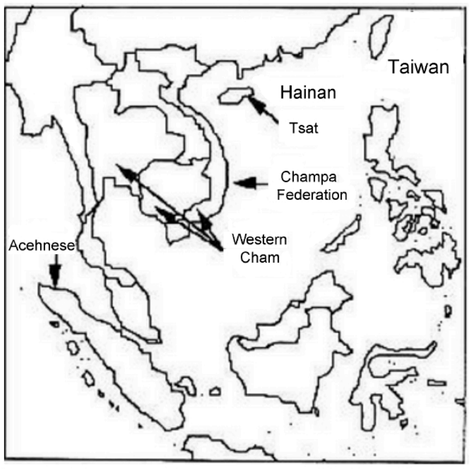
[29] The phrase-final distribution of pre-aspiration in Tyneside English is consistent with perceptual magnet effects: in this variety, which lacks a geminate/singleton or tense/lax obstruent contrast, pre-aspirates, as perceptual magnates, might be expected to draw in phrase-final obstruents due to the effects of phrase-final spread-glottal gestures (Blevins 2006).

[30] A final aspect of pre-aspiration that should be kept in mind in assessing its perceptual saliency is what it contrasts with. In typical cases, the phonetic contrast is between long voiceless stop closure preceded by modal voicing versus shorter voiceless stop closure preceded by a period of glottal friction, e.g. Vt:V vs. VhtV. The relevant question that must be asked then is how perceptually salient this contrast is for speakers of different language types.

Polynesian, within the expansive Austronesian language family. The history of Chamic-speaking people over the last 2,000 years involves movement from insular Asia to the Southeast Asian mainland as early as 500 B.C., and involves initial and sustained contact with speakers of Mon-Khmer languages, with the exception of Achenese speakers, who returned to Northern Sumatra [Map 9a].





Map 9a: The Modern Distribution of Chamic languages (Thurgood 1999)

Map 9b The Modern Distribution of Cham and Mon-Khmer (Thurgood 1999)

Subsequent movements of distinct groups of Chamic-speaking peoples resulted in later intense contact with Vietnamese, and with Min speakers on the island of Hainan [Maps 9a, 9b] Thurgood's (1999:6) summary of the general tendencies in sound change under the influence of these languages are listed in (4).

(4) Radical areal sound patterns in Chamic

i. Templatic modification: disyllabic > sesquisyllabic > monosyllabic
ii. Restructuring of segment inventories
    a. New consonant series
    b. Proliferation of vowel contrasts
iii. Syllabic modification
    a. merger and loss of final consonants
    b. neutralization of voicing and vowel-quality in pre-syllable
iv. Prosodic innovation: neutral > register complex > tone

Table 1 illustrates the shift from disyllabic to sesquisyllabic to monosyllabic/tonal with Austronesian cognate sets. The shift to sesquisyllabic or iambic words was due to contact with Mon-Khmer languages that are sequisyllabic; the further reduction to monosyllables in Phan Rang Cham was due to contact with Vietnamese, a monosyllabic language, while for Tsat, monosyllabism resulted from contact with the monosyllabic Sinitic languages of Hainan.

MOSTLY DISYLLABIC		MOSTLY SESQUISYLLABIC	MOSTLY MONOSYLLABIC	
no tone no register	no tone no register	no tone no register	tone	
PMP	**Malay**	**Rade**	**Tsat**	gloss
*mamaq	mamah	məmah	ma^{55}	'chew'
*qumah	Huma	həmah	ma^{33}	'dry field'
*taŋan	Taŋan	kəŋan	ŋa:ŋ^{33}	'hand; arm'
*panaq	Panah	mənah	na^{55}	'shoot (bow)'
*baseq	Basah	məsah	sa^{55}	'wet; damp'
*m-uda	Muda	məda	tha^{11}	'young, tender
*daRaq	Darah	ərah	sia^{55}	'blood'
*bulan	Bulan	mlan	-phian^{11}	'moon'
*qabu	Abu	hbao	phə^{11}	'ashes' (p.183)

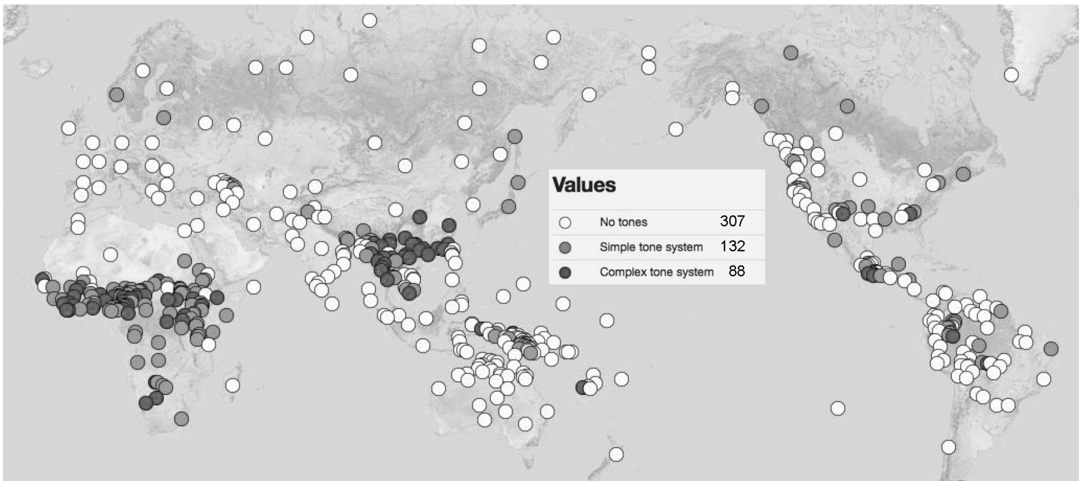
Table 1. Radical phonological change in two Chamic languages: Rade of South Vietnam, and Tsat of Hainan Island (based on Thurgood 1999)

As with other cases of areal sound patterns discussed above, Thurgood demonstrates that the contact-induced sound patterns that arise in Chamic do so through natural, phonetically-based regular sound change. While substantial loans undoubtedly played a role in seeding sequisyllabic structure, register, and tone in these languages, the internal developments support the model in (3), where a perceptual magnet effect gives rise to new categories from old cloth. In the shift from disyllables to sesquisyllables, the iambic prosody of Mon-Khmer languages draws similar disyllables toward it, resulting in wholesale reduction of initial vowels as seen in Rade (Table 1). In Western Cham, contact with neighboring Mon-Khmer register languages, has additional effects. Proto-Chamic *b-, *d-, *g- and *j- and their transitions into following vowels are perceptually close to the breathy voiced register of contact languages, and it is this register which is found in syllables with these initials. In the Tsat case, Min tones act as perceptual magnets drawing F0 perturbations, originally due to laryngeal aspects of consonants, in to be reinterpreted as tones.

Thurgood's (1999) case study of the areal diffusion of multiple sound patterns, including tone and register, has serious implications for general typological work on tone. It is widely recognized that about half of the world's languages are tone languages.[31] Most of these tone languages are centered in three

[31] Maddieson's (2013d) WALS figure is 58.2 non-tonal vs. 41.8 tonal, however, in the text he suggests that if Niger-Congo languages were not under-represented, the figure would be closer to 50/50.

large zones: South-East Asia, New Guinea, and equatorial Africa, as illustrated in Map 10, where "simple tone systems" are those with a H vs. L contrast, and "complex tone systems" are all others (Maddieson 2013d).



Map 10: Tone as an areal feature of sub-Saharan Africa, South-East Asia, and New Guinea (Maddieson 2013d)

Within Africa, most of the tonal languages are found within the Niger-Congo family, and tone is assumed to be an inherited feature there. However, the situation in South-East Asia is very different. Though tone and register are pervasive, the largest language families in the area, Proto-Austro-Asiatic and Proto-Sino-Tibetan, are reconstructed as non-tonal languages. It could well be that tone has evolved through contact more than any other phonological feature, both within South-East Asia, and within the New Guinea area.

Potential support for the rarity of non-contact induced tonogenesis can be found in the wider history of the Austronesian family, a family of approximately 1,000 languages. Proto-Austronesian was thought to be spoken approximately 6,000 years ago in what is now Taiwan. Proto-Austronesian had no register or tone contrasts and fairly simply CVC(C)V(C) stem structure. Over the course of thousands of years, as populations moved and split and moved and split, thousands of sound changes occurred. However, nearly all cases of tonogenesis within the Austronesian family can be attributed to contact-induced change: tonogenesis in Tsat occurred under Min influence as outlined above; tone in a dialect of Moken, and in Pattani Malay are due to heavy contact with southern Thai (Blust 2009: 181); and there are scattered cases of tonogenesis in the New Guinea area, including the Raja Empat languages of western Papua (Remijsen 2003), Jabem and Bukawa of the coastal Huon Gulf area (Ross 1993), and Kara of New Ireland (Hajek and Stevens, 2004), which occur in Papuan contact zones. The one apparent exception to contact-induced change is tonogenesis in New Caledonia, resulting in 5 (of 28) tone languages (Rivierre 1993). Assuming that the islands of this chain were uninhabited when settled by Austronesian speakers, tonogenesis in New Caledonia is the sole instance of an internal development leading to contrastive tone over thousands of years of development, and thousands of languages.

Implications of tone as a common areal sound pattern, however, go beyond linguistic typology. It has been hypothesized by Dediu and Ladd (2007) that the global distribution of tone languages is related to a negative correlation between the linguistic feature of tone and population frequency of the derived haplogroups of two brain size genes in human populations, ASPM and Microcephalin. Evidence that tone can and does spread areally, and that the tone languages of South-East Asia represent a linguistic area, seems incompatible with a hypothesis that the distribution of tone (or absence of tone) in the world's languages is related to an inherited genetic feature of human brains.[32]

4 Concluding remarks

Areal sound patterns are easy to define but not always easy to identify. This is because they appear to mimic internal developments. The perceptual magnet model of sound pattern diffusion makes use of the same mechanisms needed in first language acquisition, and therefore, predicts the similarity between regular sound changes with internal perceptual magnets, and those whose perceptual magnets are external. Sound patterns that diffuse must be perceptually salient, but how salient? It was suggested that category-internal divisions are unlikely to propagate, but a more positive proposal is possible. Phonetic features that are not central to signaling contrast in a language are more likely to be co-opted into new category formation than others, and, the great majority of areal sound patterns are additive, as opposed to neutralizing. Because areal sound patterns require extensive periods of significant language contact, they could, in theory, be used to reconstruct ancient population movements and pre-historic contact zones. In this area, countless mysteries present themselves. Consider, for example, the geographic distribution of rare word-final pre-stopped (pre-ploded) nasals, found in some Austronesian languages of Borneo, Chamic languages, and some Mon-Khmer languages of the Malaysian peninsula (Blust 1991:149). Does this distribution reflect pre-historic contact between Austronesian and Mon-Khmer speakers in Borneo? Another mysterious but well studied sound pattern is the Proto-Aztecan sound change of *t > tɬ /_a (Campbell and Langacker 1978). Since the evolution of lateral affricates from /t/ before low vowels appears to be unknown outside of this case, could areal influence from languages with lateral fricatives or affricates have played a role? Could this unusual sound change provide evidence for early contact between Proto-Aztecan speakers and speakers of Proto-Totonaco-Tepehua? The Areal Sound Pattern Hypothesis together with other tools of analysis offered in this volume should bring us closer to answering these questions, and many more.

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[32] A serious problem is raised by Wong et al. (2012), an fMRI study of brain function, where a positive relationship between ASPM and lexical tone perception is found, in contrast to the opposite pattern predicted by Dediu and Ladd (2007).

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