**AULA 4 TIPOLOGIA FONOLÓGICA 2023**

**CALENDÁRIO**

Até hoje 4 aulas

Novembro: 1, 8, ~~15~~, 22, 29

Dezembro: 6, 13, 20

Opções: 2 aulas em janeiro ou 20 minutos a mais por aula

Curso de pós: 15 aulas

20 minutos a mais por aula e 1 aula em janeiro: 13 aulas

**Dois livros principais: Maddieson e Gordon**

Gordon cap 3 (INVENTÁRIOS FONÊMICOS): vou intercalar com capítulos do Maddieson.

**RETOMANDO AULA ANTERIOR**

**PROPORÇÃO CONSOANTES/VOGAIS**

Português: 19C/7V = 2,714

Finlandês: 13C/8V = 1,625

Híndi: 38C/10V = 3,8 ou 38C/8V = 4,75

Japonês: 17C/5V = 3,4

Sueco: 18C/17V = 1,059 ou 18C/14V = 1,286

Vietnamita: norte 21 C/9V = 2,33 e sul 23C/9V = 2,55

Havaiano: 8C/5V = 1,6

YORÙBÁ: 18C/7V = 2,57

Tabela

Descrição gerada automaticamente

Tabela

Descrição gerada automaticamente

Capítulo 3 do WALS – 5 categorias:

- até 2,0: razão baixa

- acima de 2,0 e abaixo de 2,75: moderamente baixa

- de 2,75 até abaixo de 4,5: média

- acima de 4,5 e abaixo de 6,5: moderadamente alta

- de 6,5 ou mais: alta

Nuxalk: 29 C/3 V = 9,67

Abecásio (abkhaz): 58C/2V (=29) ou 60C/2V (=30) ou 67C/2V (=33,5).

Only 10 languages have ratios of 12 or higher.

Paradigmaticamente vs sintagmaticamente. Sueco e japonês.

**MADDIESON CAP 2**

**TIPOS DE PLOSIVAS**

**2 SÉRIES DE PLOSIVAS (162 línguas de 317 = 51%)**

- surda vs sonora: 117 das 162 línguas (72,2%).

- outras 27: (VOT) (Lisker and Abramson 1964)

surda (plain voiceless) vs aspirada

sonoro (plain voiced) vs aspirada

- juntos, esses grupos representam 88,9% das lgs com 2 séries.

**3 SÉRIES DE PLOSIVAS (76 línguas = 24%)**

- em geral, uma das séries é a surda simples (cerca de 90%), mas fora isso, há muita variação:

- **padrão mais comum: aspirada, surda, sonora**, mas são só 19 lgs (25.0%).

- **os mais comuns depois desse**:

- surda, sonora e **ejetiva** (13 lgs, 17.1%),

- surda, aspirada e **ejetiva** (12 lgs, 15.8%),

- surda, sonora e **implosiva** (12 lgs, 15.8%).

- Os três se encaixam no padrão: 2 séries com contraste de VOT + 1 série com elemento glotálico.

- No total, 50 lgs se encaixam nesse padrão: 31 com série glotálica surda, e 19 com com série glotálica sonora. Ou seja, quase 2/3 das lgs com 3 séries.

**4 SÉRIES DE PLOSIVAS (25 línguas)**

- Mais heterogêneas que as de 3 séries. Há 4 padrões igualmente comuns:

a) surda / sonora / **implosiva sonora / ejetiva surda** (6 lgs)

b) surda / aspirada / sonora / **ejetiva sonora** (5 lgs)

c) surda / sonora / pré-nasalizada sonora / **implosiva ou laringalizada sonora** (5 lgs)

d) surda / aspirada / sonora / **murmurada** (5 lgs)

- Two lgs, zulu e nambiquara do sul são semelhantes ao grupo a, mas têm surda / **aspirada** / implosiva sonora / ejetiva surda.

- **O padrão mais comum é de 2 contrastes de VOT e 2 glotálicos, mas só 1/3. Há padrões areais fortes:**

- Todas as línguas com o padrão (a) são da África;

- Só 1 língua com o padrão (b) não é da África (sedang: austroasiática);

- Todas as línguas com o padrão (c) são da América do Norte

- Todas as línguas com o padrão (d) são do subcontinente indiano.

- The (a) group includes both Nilo-Saharan and Afro-Asiatic languages from Africa

- The (b) group contains Niger-Kordofanian (Gbeya, 129), Nilo-Saharan (Yulu, 216, Sara, 217) and

Afro-Asiatic (Ngizim, 269) languages.

The (d) group includes Indo-European, Dravidian and Austro-Asiatic languages.

**RESUMO EM 2.3 [31]**

**CONTRASTES DE PONTO DE ARTICULAÇÃO NAS OCLUSIVAS**

Tabela

Descrição gerada automaticamente

Tabela

Descrição gerada automaticamente

**GORDON PLOSIVAS – Tabelas p. 45**

Tabela

Descrição gerada automaticamente

Imagem em preto e branco

Descrição gerada automaticamente com confiança média

**RETOMANDO GORDON**

**2.1 Tipos de explicação**

**2.1.1 Fatores fonéticos**

Liljencrants and Lindblom (1972): vogais maximamente distintas

Lindblom and Maddieson (1988) incorporate an articulatory component.

Within each zone of articulatory complexity, Lindblom and Maddiesion suggest that languages prefer sounds that are maximally distinct in the perceptual domain.

Pensar tb em termos tonais, por exemplo, o mandarim ou o iorubá.

**2.1.2 Processamento da fala e tipologia fonológica**

Frisch et al. and Frisch suggest that similar consonants are avoided in Arabic roots because they are more easily confused in both perception and production than dissimilar consonants Pozdniakov and Segerer has shown that the avoidance of shared place features in consonants is statistically observed in roots in most, if not all, languages even if there are no active alternations providing evidence for the restriction.

The widespread existence of similar place restrictions suggests that the processing factors appealed to by Frisch to account for the well-known Arabic facts play a fundamental role, perhaps universal, in shaping the phonological composition of lexicons.

Exs.: salsicha, problema: probrema > pobrema

**2.1.3 Frequência em fonologia**

Bybee (2001, 2007): elisão de *schwa* em inglês: *memory* vs *mammary*.

Fonologia baseada no uso e modelos de exemplares.

Mártir em asturiano: mártil e máltir

Caminhão.

**2.1.4 Vieses analíticos (ou cognitivos)**

As Hayes suggests, complexity may be viewed as a factor guiding the hypothesis space entertained by language learners: learners first test the phonetic efficacy of relatively simple and symmetrical characterizations of patterns before proceeding to formulate more complex phonological generalizations that might provide a closer fit to the phonetic map.

Oclusivas e vozeamento.

**CONTINUANDO GORDON**

**GORDON 2.2 TYPOLOGY IN PHONOLOGY: INCORPORATING EXPLANATION INTO THE THEORY**

[22-42]

The various explanations for cross-linguistic patterns described in section 2.1 have been integrated into many theoretical analyses in recent years. There are several unresolved issues, however, that surround the formal implementation of the phonetic and cognitive biases that underlie typological distributions. These topical areas of research include the interrelationships between different types of biases, their encoding as synchronic grammatical effects as opposed to reflexes of diachronic pressures, the formal architecture of the grammar as a rule-based vs. constraint-based system, and the capacity of the theory to model frequency effects both within and across languages.

**2.2.1 The relationship between analytic bias and other functional biases in typology: the case of laryngeal neutralization [pp. 22-25]**

In his account of postnasal voicing, Hayes appeals to one kind of analytic bias, a preference for symmetry, working in conjunction with articulatory considerations. Symmetry and other types of analytic bias can be made explicit through features and other phonological predicates. For example, in Hayes’s account, a bias against voicing distributions simultaneously referencing place features and surrounding context make it less likely that a language adopts overly complex voicing distributions in obstruents. An important and unresolved issue among phonologists is the extent to which phonological predicates themselves are sufficient to explain patterns without recourse to phonetic or other functional factors.

The predictions made by appealing to one as opposed to the other often overlap, which has led to situations in which both types of grounding are invoked to account for the same phenomenon.

NEUTRALIZAÇÃO LARINGAL (vozeamento)

Many languages, such as Greek and Lithuanian, only have voicing contrasts in obstruents occurring in certain positions. For example, voicing contrasts are licit before a sonorant in Lithuanian, including vowels and sonorant consonants,

e.g. áukle ‘governess’ vs. auglingas ‘fruitful’,

akmuó ‘stone’ vs. augmuó ‘growth’.

In other positions, including word-finally and before an obstruent, the voicing contrast is neutralized: to voiceless word-finally and to the voicing specification of a following obstruent word-medially, e.g.:

/daúg/ → daúk ‘much’

/atgal/ → adgal ‘back’

/dégti/ → dékti ‘burn-inf.’

An adequate theory of voicing neutralization must characterize the contexts in which neutralization occurs and those in which it fails to occur. The theory must also account for the fact that the output of neutralization in word-final contexts, where there is no possibility of voicing assimilation, is a voiceless obstruent.

Lombardi (1995) as a prohibition against the licensing of the feature [voice] in coda position. In pre-obstruent position, the [voice] feature that is shared with a following voiced obstruent is licensed by virtue of being linked to a consonant in the onset of a syllable.

An alternative approach to voicing neutralization pursued by Steriade (1999) is to appeal to **phonetic factors**. Steriade explores the hypothesis that neutralization is more likely in contexts where laryngeal features are difficult to implement in a perceptually salient manner.

Drawing on the results of studies on the perception of voicing (e.g. Raphael, Slis), Steriade suggests that the perceptual salience of laryngeal features in different environments depends on the acoustic properties associated with those environments (see Chapter for further discussion).

The accurate perception of an obstruent, in particular, a stop, relies heavily on **cues** realized on transitions from the obstruent to adjacent vowels.

For voicing, these contextual **cues** include the following:

- the burst, which is less intense for voiced obstruents than for voiceless ones,

- voice-onset-time, which is negative for voiced stops and either zero or positive for voiceless stops,

- as well as fundamental frequency and first formant values during adjacent vowels, both of which are lower in proximity to voiced relative to voiceless obstruents.

baːg vs back

baːd vs bat

Internal cues to **obstruents**, i.e. properties temporally aligned with the consonant constriction itself, are **less numerous** and **generally less salient perceptually**; these internal cues to laryngeal features include voicing, present for voiced obstruents but not for voiceless ones, and closure duration, typically shorter for voiced obstruents than for voiceless ones.

**Presonorant position**, where voicing contrasts are preserved in Lithuanian, is superior to pre-obstruent or final position (contexts where neutralization takes place in Lithuanian) for realizing a laryngeal contrast saliently, since several transitional cues are present: voice-onset-time (VOT), the burst, and fundamental frequency (F0) and first formant (F1) values at the offset of the consonant. The availability of internal and external cues to obstruents is illustrated for two CVC sequences in the spectrogram in Figure .. The spectrogram on the left depicts a vowel flanked by voiceless stops and the spectrogram on the right a vowel surrounded by voiced stops.

Although they have fundamentally different groundings, Lombardi’s and Steriade’s accounts make the similar prediction that neutralization will yield a voiceless consonant in final position. The two accounts diverge, however, in terms of the expected location(s) of neutralization. For Lombardi, all syllable-final consonants are predicted to undergo neutralization whether they are a wordfinal or a word-internal coda. Steriade’s approach, on the other hand, leaves open the possibility of a language asymmetrically preserving a voicing contrast in wordfinal coda position but neutralizing it in word-medial position, since obstruents are more likely to have an audible release in final position than when preceding another obstruent.

In fact, Steriade shows that the neutralization pattern observed in Hungarian fits the profile predicted by her account. In Hungarian, voicing contrasts occur in word-final obstruents but not in word-medial coda obstruents. Another argument for Steriade’s analysis over the Lombardi one comes from the Lithuanian data presented earlier showing that only a subset of coda consonants, those occurring before obstruents and word-finally, undergo neutralization. Crucially, presonorant obstruents maintain a voicing contrast even though they belong to the coda. It is thus descriptively inaccurate to state that codas undergo neutralization in Lithuanian.1 In summary, the syllable-based analysis of laryngeal neutralization does not adequately predict the range of typological variation in voicing contrasts (see Steriade for discussion of other patterns not covered by the syllablebased account).

1) Observemos primeiro dados do holandês. Comecemos com dados preliminares sobre o vozeamento em obstruintes.

[ˈbɑt] ‘banho’ [ˈpɑt] ‘trilha’

[ˈblɑŋk] ‘branco, pálido’ [ˈplɑŋk] ‘tábua’

[ˈlaːtə] ‘deixar’ [ˈlaːdə] ‘carregar’

Qual a alternância encontrada nesses dados e em que contexto?

infinitivo 1ª sg. presente

[ˈhɛbə] [ˈhɛp] ‘ter’

[bəˈlowvə] [bəˈlowf] ‘prometer’

[ˈʋejtə] [ˈʋejt] ‘saber’

[ˈvɪndə] [ˈvɪnt] ‘encontrar’

[ˈlowpə] [ˈlowp] ‘andar’

[ˈʀɛjzə] [ˈʀɛjs] ‘viajar’

[ˈlɑxə] [ˈlɑx] ‘rir’

singular plural

[ˈhɔnt] [ˈhɔndə] ‘cachorro’

[ˈkɔp] [ˈkɔpə] ‘cabeça’

[ˈpɛrzik] [ˈpɛrzikə] ‘pêssego’

[ˈdiːf] [ˈdiːvə] ‘ladrão’

[ˈhœɥs] [ˈhœɥzə] ‘casa’

[ˈkɑws] [ˈkɑwsə] ‘meia’

1. Examinemos agora dados do alemão. As alternâncias vocálicas, por exemplo, entre [a] e [ɛ], ou entre os ditongos [aw] e [ɔɥ], não têm relevância para o exercício. Obs: a transcrição do ditongo grafado <eu> ou <äu> varia, sendo o segundo vocoide transcrito como arredondado ou não. Utilizei a semivogal [ɥ] na transcrição.

Comecemos com dados preliminares sobre o vozeamento em obstruintes.

[ˈglajt] ‘deslize!’ [ˈklajt] ‘vestido’

[ˈpaːɐ̯] ‘par’ [ˈbaːɐ̯] ‘em dinheiro vivo’

[ˈzajdə] ‘seda’ [ˈzajtə] ‘lado, página’

Agora vejamos os dados que contêm alternâncias:

[ˈlawp] ‘folha’ [ˈlaw.bn̩.ɡaŋ] ‘pérgola’ [ˈlawp.bawm] ‘árvore caducifólia’

[ˈlawt] ‘som’ [ˈlaw.tə] ‘sons’ [ˈlawt.lɪç] ‘fonético’

[ˈbɛɐk] ‘montanha’ [ˈbɛɐ.gə] ‘montanha’ [ˈbɛʁk.baw] ‘mineração’

[gəˈpɛk] ‘bagagem’ [gəˈpɛkə] ‘bagagens’ [gəˈpɛk.bant] ‘esteira de bagagem’

[ˈʃtʁaws] ‘buquê’ [ˈʃtʁɔɥ.sə] ‘buquês’ [ˈʃtʁɔɥs.lajn] ‘buquezinho (poético)’

[ˈhʊnt] ‘cachorro’ [ˈhʊn.də] ‘cachorros’ [ˈhʏnt.lajn] ‘cachorrinho (poético)’

[bəˈvajs] ‘prova’ [bəˈvaj.zən] ‘demonstrar’ [bəˈvajs.baʁ] ‘demonstrável’

[ˈʁajf] ‘maduro’ [ˈʁaj.fn̩] ‘amadurecer’ [ˈʁajf.lɪç] ‘maduro (figurado)’

O que exemplos como [ˈlawp.bawm] e [bəˈvajs.baʁ] nos mostram com relação a esse proesso? Ele é assimilatório? Qual seu domínio?

1. Analise os dados a seguir e verifique diante de quais classes de sons existe contraste de vozeamento em croata. Apenas os dois segmentos iniciais da palavra devem ser analisados. A ausência de determinado tipo de dado indica que ele não ocorre. Os dados estão na ortografia croata. Obs: <h> = [x]

tmina ‘escuridão’ zlato ‘ouro’

smisao ‘sentido’ znak ‘sinal’

tlak ‘pressão’ tumač ‘intérprete’

zdravlje ‘saúde’ snijeg ‘neve’

shodno ‘adequadamente’ dućan ‘loja’

zadati ‘passar (lição)’ trava ‘grama’

sredina ‘meio’ staklo ‘vidro’

slovo ‘letra’ dlan ‘palma da mão’

dnevni ‘diário’ zmija ‘cobra’

dražba ‘leilão’ zrak ‘ar’

sad ‘agora’

**2.2.2 Typological over- and under-prediction in phonetically driven phonology [pp. 25-27]**

Although the phonetically based analysis of voicing neutralization would appear to have **a descriptive advantage** over the syllable-based account, there are other cases where an appeal to **phonetic biases** in explaining typological patterns is less convincing. A phonetically driven theory may in some cases overpredict the existence of non-occurring patterns or, in other cases, incorrectly exclude patterns that are attested.

Moreton compiles phonetic data from a series of studies indicating that consonant voicing and the height of a vowel in an adjacent syllable exert an effect of roughly similar magnitude on first formant values for vowels. Strikingly, though, cases in which the influence of consonant voicing on vowel height has been phonologized are far less common than cases of phonological vowel-to-vowel height harmony (see Chapter  on vowel harmony), suggesting that phonetic factors alone do not offer a complete story for the typology of harmony involving vowel height (see section .. for further discussion of Moreton’s findings).

A phonetically driven model of phonology also does not readily predict the existence of certain attested patterns. Consider the case of voicing neutralization described by Yu for the Nakh-Daghestanian language, **Lezgian**.

Vejamos alguns dados. Em primeiro lugar, como Yu (2004) escreve, há contraste laringal entre quatro tipos de obstruintes em lesguiano: ejetivas, surdas aspiradas, surdas não aspiradas, e sonoras. A consoante relevante em cada exemplo é a do ataque da sílaba tônica, o contexto em que se tem pleno contraste.

(1) ejetivas:

[wa'k’a] ‘porco’ [i'c’i] ‘cru’ [a'q’altun] ‘subir, aparecer’

(2) surdas aspiradas:

[xaˈtʰur] ‘respeito’ [gaˈpʰur] ‘adaga’ [eˈkʰnaqʰ] ‘de manhã’

(3) surdas não aspiradas:

[aˈqatʰun] ‘sair’ [qʷeˈter] ‘perdizes’ [taˈkʷar] ‘nabos’

(4) sonoras:

[ruˈgud] ‘sete’ [diˈde] ‘mãe’ [ˈbade] ‘avó’

Já em final de palavra e antes de consoante, o contraste quádruplo não se mantém. Surpreendentemente, entre a surda e a sonora, é a sonora que se realiza em final de palavra. Vejamos exemplos de Yu:

(5) ejetivas:

[jak’ʷ] ‘machado’ [kits’] ‘cachorro’ [k’wat’] ‘bola’

(6) surdas aspiradas:

[kʰatʃʰ] ‘cadela’ [nekʰ] ‘leite’ [peqʰ] ‘corvo’

(7) sonoras:

[k’yd] ‘nove’ [p'uz] ‘lábio’ [tʃ'iʒ] ‘abelha’

Haspelmath (1993) já havia apontado que as surdas não aspiradas se tornam sonoras (!) em final de palavra em alguns substantivos monossilábicos. Isso vai na direção contrária ao que vimos na seção ‎8.2. Não há exemplos desse tipo em outras classes de palavras nem em substantivos com mais de uma sílaba. Vejamos exemplos de Yu, com os substantivos na forma sem sufixo, monossilábicos, e com sufixo, tendo duas ou mais sílabas:

(8) a. [pab] [papa] ‘esposa’

[rab] [rapuni] ‘agulha’

b. [gad] [gatu] ‘verão’

[pad] [patar] ‘lado’

c. [rug] [rukʷadi] ‘poeira’

[pagʷ] [pakʷar] ‘costela’

d. [juʁ] [juqar] ‘dia’

[myʁ] [myqy] ‘ponte’

e. [mez] [metsi] ‘língua’

[tsaz] [tsatsuni] ‘espinho’

Nos pares d e e há também alteração do modo da consoante, que aparece como contínua em final de palavra (fricativa) e como não contínua em posição medial (oclusiva em d, e africada em e). Yu fez um estudo acústico que comprovou que essas obstruintes finais são realmente sonoras, apresentando vozeamento em mais de três quartos de sua duração.

Quanto à origem histórica que explicaria esse processo inesperado, Yu propõe que ele é o resultado de mais de uma mudança. Para justificar sua explicação, Yu apresenta conjuntos de cognatos das línguas samúrias, família à qual o lesguiano pertence. Ilustro aqui com um exemplo em que é reconstruído \*b e outro em que é reconstruído \*d para o proto-samúrio, estágio hipotético dessa família linguística.

(9) lesguiano [rib] [riˈpar] ‘furador, sovela’

agul [reb] [reˈbar]

tabassarano [rib] [riˈbar]

buduk [reb] [rebri]

kryz [reb] [rebri]

tsakhur [rab] [rabbɨ]

rutul [rab] [rabɨr]

Proto-samúrio \*b

(10) lesguiano [jad] [jaˈtar] ‘água’

agul [xed] [xiˈttar]

tabassarano [ʃid] [ʃttar]

buduk [xəd] [xədri]

kryz [xæd] [xædri]

tsakhur [xʲan] ------

rutul [xed] [xedbɨr]

Proto-samúrio \*d

A análise de Yu reúne elementos propostos por outros autores, como a hipótese de que no ataque da sílaba tônica, as oclusivas sonoras se geminaram. As oclusivas geminadas majoritariamente são surdas, inclusive como resultado de um processo de ensurdecimento. Isso se deve à dificuldade de manutenção do vozeamento em oclusivas, que é maior ainda nas geminadas, em consequência da sua maior duração. Posteriormente, houve a simplificação das consoantes geminadas, um processo muito comum nas línguas em geral, tendo ocorrido com as geminadas latinas na passagem para o português, por ex., bucca > boca. Essa simplificação produziu como resultado a alternância entre surdas e sonoras do lesguiano atual. Cabe mencionar que há ainda complicações relacionadas ao acento e à morfologia do lesguiano.

[rib] [riˈbar]

[rib] [riˈbbar]

[rib] [riˈppar]

[rib] [riˈpar]

Há ainda um outro tipo de alternância relacionada a traços laringais que envolve o vozeamento no lesguiano. É uma alternância entre obstruintes vozeadas e ejetivas (desvozeadas). Novamente, há presença da consoante desvozeada em final de palavra. Mais uma vez, a análise de Yu para esse processo pouco comum envolve o exame de conjuntos de cognatos da família samúria, à qual o lesguiano pertence.

(11) lesguiano [tʃ’ib] [tʃp’er] ‘unidade de medida (distância entre o polegar estendido e o indicador)’

agul [tʃ’eʕb] [tʃ’eʕ’bar]

tabassarano [tʃ’ib] [tʃ’ibar]

buduk [ts’ip’] [ts’ip’ri]

kryz ------ ------

tsakhur [tʃ’um] [tʃ’ummɨ]

rutul [tʃ’ub] [tʃ’ubɨr]

Proto-samúrio \*b

(12) lesguiano [q’yd] [qʰt’ar] ‘inverno’

agul [q’ʕurd] [q’ʕur’der]

tabassarano [q’ʕurd] [q’ʕur’dar]

buduk [q’adʒredʒ] [q’adʒredʒer]

kryz [q’ud] [q’udni]

tsakhur [q’ʕɨdɨm] [q’ʕɨdɨmmɨ]

rutul ------ ------

Proto-samúrio \*d

As obstruintes finais dessas raízes ocorrem só como sonoras, a não ser no lesguiano, que apresenta a alternância sonora-ejetiva. Yu conclui que, também nesse caso, houve um desvozeamento em contexto intervocálico. Como evidência para corroborar essa hipótese, Yu aponta que as ejetivas que não alternam em lesguiano eram ejetivas na protolíngua.

(13) lesguiano [rik’] [rik’ar] ‘coração‘

agul [irk’ʷ] [irk’ʷar]

tabassarano [juk’] [juk’ar]

buduk [jɨk’] [jɨk’ri]

kryz [jik’] [jik’ri]

tsakhur [jik’ʲ] [jik’ʲbɨ]

rutul [jik’ʲ] [jik’ʲbɨr]

Proto-samúrio \*k’

(14) lesguiano [t'ʷat'] [t'ʷaˈt'ar] ‘mosca’

agul [t'ut'] [t'uˈt'ar]

tabassarano ------ ------

buduk [t'ut'] [t'ut'ri]

kryz [t'ɨt'] [t'ɨt'ni]

tsakhur [t'ot'] [t'ot'aːr]

rutul [dɨd] [dɨdar]

Proto-samúrio \*d

Falta responder como uma oclusiva sonora se tornou ejetiva. Segundo Yu, todas as palavras que apresentam essa alternância começam com ejetiva. A hipótese de Yu é que a consoante surda produzida pelos processos já vistos assimilou a glotalização da consoante inicial. Embora ainda não se tenha uma explicação satisfatória, essa assimilação (ou talvez cópia) da glotalização é um processo atestado em várias línguas de continentes diferentes: aimara (Bolívia), haussá (Nigéria), tz’utujil (Guatemala), maia yucateco (México) e chaha (Etiópia).

Em suma, processos inesperados, antinaturais foneticamente, recebem explicações diacrônicas plausíveis ao se comparar a língua que os apresenta com outras línguas da família. Simplesmente eliminar por princípio a possibilidade de qualquer explicação diacrônica pode acabar levando à postulação de explicações pouco fundamentadas.

Para concluir esta seção, só menciono que ainda há mais uma alternância envolvendo traços laringais em lesguiano, envolvendo a aspiração e a glotalização, da qual não tratarei aqui, mas que pode ser lida no trabalho de Yu.

There is no straightforward way in a purely synchronic analysis to admit the pattern of final voicing in Lezgian while also capturing its status as a cross-linguistic outlier. The difficulties encountered by both approaches in accounting for the Lezgian data instantiate the more general difficulty in modeling cross-linguistic frequency effects.

As a final note on Lezgian, Yu’s work demonstrates that it is important to verify phonological descriptions through phonetic data. He presents results of an acoustic study confirming that the word-final counterparts to the intervocalic voiceless stops are phonetically voiced in Lezgian. However, he also finds that the alternating voiced stops have slightly longer voiced phases and overall duration than underlying voiced stops in final position. Lezgian voicing thus falls into the class of near-neutralizing phenomena (see Chapter  for more on neutralization).

In any case, Yu’s phonetic study indicates that there is a phonetic asymmetry that must be accounted for between the two obstruent series that he assigns to the phonologically voiced category.

Sistemas complexos dinâmicos ou adaptativos.

Chagas de Souza (2021). Lacunas entre os ataques complexos no português: um olhar diacrônico e algumas considerações relacionadas à percepção

Chagas de Souza (2023). Imobilidade do acento em não verbos em português: umaabordagem diacrônica baseada no uso

**2.2.3 Typology as a reflex of diachronic change [pp. 27-29]**

A more coherent understanding of frequency often emerges when one considers a phenomenon from a diachronic perspective, as in the Evolutionary Phonology framework developed by Juliette Blevins. Under Blevins’s approach, which builds on work by John Ohala on the phonetic basis for sound change, phonologies evolve through a series of misapprehensions and phonological restructurings on the part of the listener. In this account, vowel harmony arises when normal low-level phonetic vowel-to-vowel coarticulatory effects are mistakenly assumed by the listener to be phonological targets intended by the speaker (Ohala).

In the Evolutionary Phonology model, patterns that are typologically infrequent, such as final voicing in Lezgian, are rare because they are phonetically unnatural, but they are not impossible since a series of historical events, each of which might in isolation be phonetically natural, could conspire to produce a synchronic distribution that is phonetically anomalous. Yu , in fact, shows that the Lezgian pattern of final voicing is likely the result of a confluence of diachronic changes that are all phonetically natural.

Ver espectrogramas Öhman (1966: 152, 153). Coarticulation in VCV Utterances: Spectrographic Measurements

Um tipo de trabalho que ilustra bem o quanto a fonologia de laboratório pode contribuir para nossa compreensão dos fenômenos fônicos são trabalhos como Fails (2011), que compara a nasalidade em vogais do português e do espanhol. As vogais normalmente denominadas nasais Fails prefere denominar oronasais, porque nelas o ar circula e ressoa tanto pela cavidade oral quanto pela nasal. Ele inicia o artigo citando o estudo, que qualifica de excelente, de Moraes (2003) sobre a nasalização. Nele, Moraes comenta o carater físico da nasalização, dizendo que ela é bastante nítida perceptualmente, mas “parece resistir bravamente à descrição acústica”. Segundo Moraes, os motivos dessa dificuldade são: a grande variedade individual na anatomia da cavidade nasal e do trato oral, que afetam muito o resultado acústico da vogal oronasal; a sutileza nas diferenças no espectro entre as vogais orais e oronasais, que não correspondem a uma única indicação no sonograma; e o fato de que as caracteristicas acústicas da nasalização parecem variar de acordo com o timbre da vogal, ou seja, as pistas acústicas da nasalização dependem do ponto e modo de articulação.

Moraes (1997) já havia distinguido três tipos de nasalização, as quais denomina: fonemática, como em cama; alofônica, como em canta; e coarticulatória, como em camada. Nesse trabalho, Moraes mediu o grau de abertura velofaríngea na produção desses três tipos de vogais. Ele constatou que, nesse aspecto, a nasalização fonemática e alofônica são semelhantes, com valores relativos de 72,9% e 69,9% de abertura velofaríngea respectivamente, enquanto esse valor fica em 49,6% para a nasalização coarticulatória e em 3,3% para vogais orais. O que quero destacar aqui é o foco do trabalho de Fails: o fato de que uma das caracteristicas da nasalização é que seu grau muda no decorrer da vogal, uma distinção que não foi feita no trabalho de Moraes, já que a cada realização de uma vogal é atribuído em seu trabalho um único valor de nasalização.

Fails utilizou o Nasometer em sua pesquisa, um aparelho que consiste em um capacete que fixa uma placa acima do lábio superior do sujeito, separando a onda sonora que provém do nariz da que provém da boca. Há dois microfones: um no lado superior e outro no lado inferior da placa, e cada um registra a energia acústica de um componente: do nasal e do oral.

O cálculo do índice de nasalidade feito pelo Nasometer se baseia na proporção de energia acústica vinda da cavidade nasal e da cavidade oral. Se o índice for de 100% de nasalidade, isso representaria um som totalmente nasal e 0%, um som totalmente oral. Na prática, nenhuma dessas possibilidades ocorre por mais de um fator. O principal é que, como a energia acústica se propaga pelos tecidos da face, os dois microfones sempre registram alguma energia. Então mesmo uma vogal considerada totalmente oral, como a vogal [a], pode ter um valor de 23% de nasalidade devido à reverberação do som, que faz com que vibrem os tecidos da cavidade nasal mesmo sem que saia ar pelo nariz. Por outro lado, um som considerado totalmente nasal, como a consoante [m], pode ter um valor de 95% de nasalidade devido à reverberação do som, que faz com que vibrem os tecidos da cavidade oral, mesmo sem que saia ar por ela.

Como foi dito, Fails (2011) compara a nasalidade em vogais do português e do espanhol. As diferenças na pronúncia da palavra escrita cama em ambas as línguas podem ser vistas no gráfico a seguir.

Gráfico

Descrição gerada automaticamente

Gráfico 1. A nasalidade na palavra cama em português e em espanhol.

Fonte: Fails (2011).

No Gráfico 1, vemos uma semelhança entre as duas línguas: tanto no português quanto no espanhol a nasalidade da consoante nasal em sua fase estável beira os 100%. No entanto, as vogais vizinhas à consoante nasal são bem diferentes nas duas línguas. Em português, a vogal que precede a consoante nasal começa com 20% de nasalidade e atinge um patamar de 64% antes da transição rápida até a consoante nasal, sendo portanto uma vogal oronasal. Já no espanhol, essa vogal apresenta apenas 5% de nasalidade no início, chegando a um máximo de 25% de nasalidade antes de iniciar a transição até a consoante; a vogal é classsificada, então, como oral. Esses dados são muito interessantes e nos permitem entender de forma mais precisa a nasalização em línguas em que ela aparentemente ocorre e em línguas em que ela aparentemente não ocorre. A diferença é de grau entre as duas línguas, e não entre haver nasalização e não haver. Além disso, podemos identificar claramente o fator temporal na nasalização.

Por fim, Fails considera surpreendente o que se verifica com a vogal átona final. Em português, na transição da consoante nasal para a vogal, a nasalidade cai de 94% apenas para 66%, subindo ligeiramente antes da pausa. Já no espanhol, a nasalização cai de 95% para 45%, subindo um pouco antes da pausa. Apesar desse índice alto de nasalização, nós falantes do português não percebemos essa vogal como nasal.

**2.2.4 Typology and learning biases: experimental approaches [pp. 29-32]**

The last decade has witnessed considerable expansion of the psycholinguistic research program that supplements traditional typological inquiry as a basis for theory development with the investigation of phonetic and analytic biases in phonological acquisition. I summarize here some work belonging to this line of research, which, though still in its relative infancy, has already produced some important results that potentially offer explanations for why certain patterns are more common than others across and within languages.

Pycha et al. presented native English listeners with one of three artificially constructed vowel distributions two of which involved vowel harmony and disharmony.

i, ɪ, æ (> anterior) ʊ, u, a (> posterior)

i, ɪ, æ (> posterior) ʊ, u, a (> anterior)

i, æ, ʊ (> anterior) i, u, a (> posterior)

In one condition, the presented forms illustrated a phonetically natural rule of palatal harmony of the type found in many natural languages (see Chapter ) in which suffixes have two allomorphs varying in backness depending on the backness of the root vowel.

In another condition, listeners were given forms instantiating a phonetically less natural and correspondingly rare (see Chapter ) process of palatal disharmony in which the suffixal vowel had the opposite backness values of the root vowel.

Finally, the third pattern involved an arbitrary interaction in which a mix of front and back vowels (i, æ, ʊ) triggered a front vowel suffix, while a different mix (i, u, a) triggered a back vowel suffix. Both the phonetically natural harmony and the phonetically unnatural disharmony processes are formally simple in terms of manipulating a single phonological predicate, the backness feature for vowels. The arbitrary distribution, on the other hand, is formally more complex since it requires reference simultaneously to height and backness of the vowels conditioning harmony.

After a training session in which examples of harmony were presented aurally, listeners were asked for their grammaticality judgments on a series of novel forms differing in their well-formedness according to the learned harmony rule. Results suggested difficulty in acquiring the formally complex and arbitrary rule of vowel harmony relative to the other two types of systems. Pycha et al. also found that the percentage of correct responses for listeners exposed to the phonetically natural harmony system was slightly greater, but not reliably so, than for speakers presented with the phonetically less natural but formally simple disharmony pattern. Crucially, because English does not have vowel harmony, results of their study are unlikely to be attributed to interference from preexisting knowledge of a harmony system.

Using a somewhat different type of experiment employing an Artificial Grammar paradigm, Wilson also attempted to address the role of naturalness in the acquisition process. Listeners in his first experiment were presented with one of two different nasal harmony processes. In one condition, listeners heard tokens containing a suffix that had two allomorphs, [-na] and [-la], where the occurrence of each was conditioned by the nasality of the final consonant of the stem according to a widely attested and natural type of nasal harmony system (see Chapter ) found in languages: a nasal consonant triggered the [-na] variant whereas an oral consonant triggered the [-la] variant, e.g. gomena vs. gobela.The other group of listeners was given forms in which the [-na] allomorph was triggered by a final dorsal consonant and the [-la] allomorph was conditioned by a non-dorsal consonant, e.g. dogena vs. dobela a less natural and unattested type of harmony system. After a training session in which the relevant grammar was illustrated, listeners were presented with novel forms either conforming to ordeviating from the patterns of the training session, and asked whether they had heard these forms previously or not. Wilson found that listeners were far more accurate in recognizing forms conforming to the phonetically natural rule of nasal harmony than the unnatural alternation conditioned by the dorsality of the final consonant. In a follow-up experiment, listeners were presented with forms illustrating a process of nasal disharmony in which a nasal consonant in the root triggered the [-la] allomorph. Nasal disharmony is attested in several languages (Alderete , Suzuki ; see Chapter ). In keeping with the results of Pycha et al. , listeners were better able to recognize grammatical forms displaying disharmony than listeners exposed to an unnatural rule in which the [-la] allomorph was conditioned by a dorsal consonant in the root. Wilson does not make a direct comparison of results for the nasal harmony and disharmony conditions.

Simon Kirby: The Language Organism: Evolution, Culture, and What it Means to be Human

https://www.youtube.com/watch?v=f3-R3Ii35nY

[30:00] início

[30:30] 6 “gerações” depois

**2.2.5 Typological variation modeled: constraints or rules [pp.32-41]**

**Steriade (1999) on laryngeal neutralization in Optimality Theory**

Steriade couches her analysis of laryngeal neutralization within an Optimalitytheoretic paradigm (Prince and Smolensky), in which the loss of laryngeal contrasts is driven by constraints on phonological well-formedness that ban laryngeal contrasts in contexts where they are perceptually less optimal (see Gordon for an overview of typology in Optimality Theory). She posits an implicational scale of constraints prohibiting laryngeal contrasts in different contexts varying in their capacity to realize those laryngeal contrasts in a perceptually salient manner.

Steriade (1997/1999: 35-36)

**Factorial typology in phonology: the case of syllable-contacts**

To explore this prediction further let us build on the discussion of sonority from Chapter  and consider consonant clusters at syllable boundaries, drawing on Gouskova’s work on the typology of heterosyllabic clusters. As will be discussed further in Chapter , there is a cross-linguistic preference for heterosyllabic consonant clusters to display a falling sonority profile where the first consonant has greater sonority than the second one according to the sonority scale presented in Chapter . Languages differ both in the strictness of this preference, termed the Syllable Contact Law (Hooper, Murray and Vennemann, Vennemann), and in their strategies for ameliorating violations of it. In the discussion that follows we will abstract away from cross-linguistic variation in the sonority thresholds that trigger changes in heterosyllabic clusters and instead focus on the varied responses to potential violations of the Syllable Contact Law.

Gouskova discusses one pair of strategies for circumventing syllable contact violations in the Cushitic language Sidamo. Rising sonority clusters (those in which the second member has greater sonority than the first) undergo metathesis (and place assimilation), which produces a falling sonority cluster: /duknanni/ ! duŋ.kanni ‘they carry’, /huʧ-nanni/ ! hun.ʧanni ‘they pray/beg/ request’, /has-nemmo/ ! han.semmo ‘we look for’, /hab-nemmo/ ! ham.bemmo (Gouskova).

Flat sonority clusters and falling sonority clusters in which the fall is insufficiently large, i.e. when the consonants in the cluster are adjacent on the sonority scale, display a different resolution, gemination:/af-tinonni/ ! affinonni ‘you (pl) have seen’, /lelliʃ-toti/ ! lelliʃʃoti ‘Don’t show!’, /ful-nemmo/ ! fullemmo ‘we go out’, /um-nommo/ ! ummommo ‘we have dug’ (p. ). Gouskova assumes that geminates are a single sound and thus not subject to constraints on clusters.

Another strategy for dealing with ill-formed heterosyllabic clusters is found in the Turkic language Kirghiz, in which suffix-initial sonorants strengthen to stops when they follow any coda consonant, a shift that has the effect of improving the sonority profile of the coda-onset cluster. For example, the objective suffix -nu and the plural suffix -lar surface unchanged intervocalically but the first sound in each changes to a lower sonority plosive (/t/ or /d/ depending on voicing of the rootfinal consonant) when suffixed to a consonant final root, e.g. toː-nu, toː-lar ‘mountain’ vs. kar-dɯ, kar-dar ‘snow’, antan-dɯ, antan-dar ‘gelded camel’, taʃ-tɯ, taʃ-tar ‘stone’, konok-tu, konok-tar ‘guest’ (Gouskova). Note that Kirghiz suffixal vowels alternate due to vowel harmony (see Chapter ).

Yet another response to a sub-optimal syllable contact is to delete one of the consonants participating in the offending transition. In Diola Fogny (Rice), syllable contacts involving a sonority plateau or a rise are resolved through deletion of the first consonant.For example,thefirst stopdeletes inthe stop–stop cluster in/let-ku-jaw/‘they won’t go’, yielding lekujaw (p. ); the nasal is lost in the nasal–lateral cluster in /na-laɲ-laɲ/ ‘he returned’, giving nalalaɲ ‘he returned’ (p. ). A nasal does not delete if it precedes a lower sonority plosive (though it assimilates in place), e.g. /na-ti:ŋ-ti:ŋ/ !nati:nti:ŋ ‘he cut (it) through’ (p. ).

Finally, epenthesis may also be employed to avoid heterosyllabic clusters with illicit sonority profiles (see Chapter  for an alternative perceptually driven account of epenthesis in rising sonority clusters). In Kabardian (Colarusso), an epenthetic vowel is inserted in clusters of a consonant + sonorant consonant: /fəz-mɐ/ ! fəzəmɐ ‘if a woman’, /məl-mɐ/ ! mələmɐ ‘if ice’. Sonorants in onset position word-initially or following a vowel do not trigger epenthesis: nɐ ‘eye’, wənɐ -mɐ ‘if a house’.

In summary, Sidamo, Kirghiz, Diola Fogny, and Kabardian together instantiate five different strategies for avoiding heterosyllabic clusters with impermissible sonority profiles: metathesis and gemination (Sidamo), fortition (Kirghiz), deletion (Diola Fogny), and epenthesis (Kabardian). The employment of varied mechanisms for dealing with the same ill-formed configuration fall out in straightforward fashion from a theory like Optimality Theory that formally separates the prohibition against a marked structure from the varied strategies for coping with that structure (see Kager, McCarthy).

Instances in which multiple strategies are employed to cope with the same marked configuration are often referred to as “conspiracies” (Kisseberth).The syllable contact cases discussed by Gouskova constitute a type of conspiracy operating across languages. Another arguably more compelling type of conspiracy is observed within languages (see Casali ,  on languageinternal conspiracies involving vowel hiatus).

Um deles é o termo conspiração (conspiracy), proposto em Kisseberth (1970), o qual se refere à situação em que vários processos convergem num mesmo “objetivo”. No português do Brasil, por exemplo, há os seguintes processos, que são sujeitos a variação:

Apagamento de tepe em ataques complexos: outro > oto; cabra > caba

Epêntese vocálica final: chip > chipe;

Epêntese vocálica em sequências de consoantes: gnomo > g[i]nomo

Elisão de consoante final: falar > falá

Although the existence of conspiracies would appear to give a decided advantage to the constraint-based OT framework over its derivational counterpart, the natural ability of OT to model conspiracies is not without its pitfalls. In fact, it turns out for many phenomena that only a subset of the logically possible responses to avoiding a marked structure is attested cross-linguistically.

Modeling frequency in a constraint-based grammar In its original conception (Prince and Smolenksy), Optimality Theory assumed a universal set of constraints that are discretely ranked on a language-specific basis.Free variation in this model is captured through optional re-ranking of constraints at the time of speaking. For example, in the case of syllable contact violations, hypothetical free variation between deletion and epenthesis as repair strategies within a language could be modeled as variability in the relative ranking of DEP (NO INSERT) and MAX (NO DELETE). On one occasion, a speaker might rank the former constraint over the latter and employ deletion, whereas on the next occasion, a speaker might employ the opposite ranking and opt for epenthesis.A drawback of this model is its limited capacity to model frequency distributions: there is thus no way of capturing the fact that epenthesis might be more commonly employed than deletion in a given language as a strategy for avoiding poor syllable contacts. Similarly, there is no possibility of modeling the relative typological rarity of one response to a well-formedness constraint compared to another response to the same constraint.

More recent incarnations of Optimality Theory employ probabilistic constraint ranking algorithms that are capable of modeling frequency distributions.

One probabilistic constraint-based model of phonology is Boersma’s (, ) stochastic version of OT in which constraint rankings are treated as probability distributions along a continuous linear scale rather than possessing a single ranking value relative to other constraints as in the traditional OT model. In the process of evaluating potential candidates to produce in speech, the actual ranking of each constraint, the selection point, is a function of its probability distribution with a random perturbation component that creates a unique ranking for each utterance. The odds of a particular selection point occurring decreases as the selection point moves away from the center of a constraint’s ranking range.This conception of constraint ranking allows for the possibility of ranking “reversals” in which a constraint whose ranking range is higher than but overlaps with that of another constraint may be ranked either above or below that constraint when a selection point is set.

Random perturbation is also a key component in the Noisy Harmonic Grammar model (Pater, Boersma and Pater to appear). Like Optimality Theory, the Harmonic Grammar (HG) framework (Legendre et al., Smolensky and Legendre, Pater) assumes a series of constraints against which candidates corresponding to an input form are evaluated. However, unlike in the original OT model, HG assumes that each constraint is associated with a numerical weighting reflecting how much a candidate is penalized for each violation of that constraint. The “harmony” of a candidate is determined by multiplying each constraint violation by the penalty associated with violating that constraint and then summing the totals over all the constraints. This calculation of harmony is illustrated in () for a subset of the Hungarian final devoicing data considered earlier. In the example, the voicing in both the pre-obstruent and the final stop is varied in the candidates and the penalty associated with each constraint is given as an integer above the constraint name.

A salient feature of the Harmonic Grammar model is its ability to model so-called “ganging” effects where multiple violations of a lower weighted constraint can gang up to eliminate a candidate that honors a higher weighted constraint. This differs from the traditional OT model in which satisfaction of lower ranked constraints cannot resuscitate a candidate that has been eliminated by virtue of violating a higher ranked constraint. The ganging effect can be illustrated using an example from the syllable contact data from Goukova considered earlier (though it cannot handle all the facts addressed by Gouskova). To exemplify the ganging effect, we consider the least relational of the data discussed by Gouskova.Recall that in Kirghiz suffix-initial sonorants change to stops when following a consonant-final root, e.g. toː-nu ‘mountain-objective’ vs. kar-dɯ ‘snow-objective’ (Gouskova), where the vowel alternation reflects an orthogonal vowel harmony process. The strengthening of postconsonantal sonorants can be analyzed as an effect of two constraints: one banning sonorant onsets, \*SONONSET,and one prohibiting codas, \*CODA. Each of these constraints is ranked below the constraint banning changes in the underlying form, IDENT, as evidenced by the failure of onset sonorants not in post-consonantal position to strengthen to stops and the tolerance of codas in the language at large. However, if both \*SONONSET and \*CODA are violated, the candidate displaying fortition to a stop wins, a result that can be modeled as a ganging effect that eliminates the faithful candidate lacking fortition, a scenario that is depicted in ().

An important metric for evaluating a theory is its ability to provide a framework in which a plausible model of the phonological acquisition process can be couched. Although phonological learning algorithms antedate the advent of constraint-based phonological paradigms, e.g. Dresher and Kaye’s model for setting metrical stress parameters, attempts to formally model the acquisition process have burgeoned within constraint-driven frameworks aided by parallel advances in computational resources.

One such learning model is the Gradual Learning Algorithm (Boersma), which has been tested within both stochastic Optimality Theory (Boersma and Hayes) and Harmonic Grammar (Boersma and Pater to appear) frameworks. In the Gradual Learning Algorithm (GLA), the constraint “strength” (ranking in Stochastic OT and weighting in HG) is adjusted in response to each learning datum, where more frequently occurring data points exert greater influence. Boersma and Hayes run various simulations within an OT framework, drawing on frequency data of different types. In their most rigorous simulation, they feed the frequency distributions of various allomorphs of the genitive plural in Finnish based on Anttila’s data and employing constraints proposed by Anttila in his work. The GLA succeeds in constructing a constraint ranking that closely predicts the frequency patterns in Anttila’s corpus, including word types that show no variation, e.g. kala ‘fish’ vs. kalojen ‘fish (gen. pl.)’, ajattelija ‘thinker’ vs. ajattelijoiden ‘thinkers (gen. pl.)’, as well asthose with differing degrees of optionality, e.g. naapuri ‘neighbor’ vs. naapurien (.%) or naapureiden (.%) ‘neighbors (gen. pl.)’, korjaamo ‘repair shop’ vs. korjaamojen (.%) or korjaamoiden (.%) ‘repair shops (gen. pl.)’.

An ambitious research program employs frequency data to model not only the acquisition of constraint rankings but also the learning of the constraints themselves. One promising probabilistic constraint learning and ranking algorithm proposed by Hayes and Wilson employs a Maximum Entropy grammar that uses weighted constraints to assign probabilities to output forms. In their model, the probability of a given candidate form is a function of its score, i.e. the weighted sum of its constraint violations, which determines the candidate’s maxent value. A candidate with a larger share of the sum of maxent values of all competing candidates has a greater probability of surfacing than a candidate with a lower share of the total maxent values. A feature of Hayes and Wilson’s model shared with Harmonic Grammar is its aggregate evaluation of candidates against all constraints, which allows for the possibility of constraints collectively ganging up to penalize a form.

In a number of learning simulations, Hayes and Wilson show that their model is able not only to establish a relative weighting of a set of constraints from input data distributions fed to the learning algorithm, but also to acquire the constraints given appropriate heuristics for limiting the search space for discovering constraints. In keeping with an important issue faced by language learners, their implementation of the constraint learning algorithm is sensitive to a tradeoff between increasing the specificity of constraints in order to improve their accuracy in predicting attested forms while simultaneously maximizing the generality of individual constraints in order to offer broader empirical coverage.

Hayes and Wilson test their algorithm against various types of phonotactic patterns including onset consonant clusters in English, Shona vowel harmony, the typology of weight-insensitive stress systems, and a cross-section of phonotactic data from the Australian language Wargamay (Dixon). For example, in the test of their model against English word-initial onset cluster frequency data, Hayes and Wilson feed their learning algorithm frequency distributions for English onset clusters from the online CMU Pronouncing dictionary (<http://www.speech.cs.cmu.edu/cgi-bin/cmudict>).

Their learning algorithm successfully constructs a grammar consisting of  constraints, whose weightings yielded scores for various potential clusters that correspond to the distinction between unattested and attested onset clusters. Clusters whose scores are relatively high are attested, whereas those with lower scores are generally either rare or unattested. Hayes and Wilson also test their learning algorithm against well-formedness intuitions for different clusters obtained by Scholes () from a group of seventh-grade students. They find a strong correlation between the well-formedness probabilities obtained in the experimental setting with the probabilities obtained from the maxent grammar.

Not all current implementations of phonological learning algorithms take place within a constraint-based framework. Heinz adopts a learning algorithm for stress systems that focuses on modeling the inference procedure guiding the learner’s hypothesis construction. Representing stress systems in terms of finitestate acceptors, Heinz runs a series of simulations in which the learner is fed stress data for words ranging from one to nine syllables long. Ultimately his Forward Backward Neighborhood Learner acquires  of the  targeted stress systems including both those with weight-insensitive and those with weight-sensitive stress (see Heinz and Riggle for more on learnability in phonology).