24.961 Contrast and Perceptual Distinctiveness

[1] Flemming (1995, 2004, 2006)

- Auditory based features and constraints
- Grounded in perception
- Explicit reference to paradigmatic contrast
- Constraints evaluate the distance between contrasting pairs of sounds in perceptual space optimizing for distinctiveness of contrasts

[2] Markedness may depend on contrast (1995)

- For nonlow vowels, lip rounding aligns with backness (an enhancement relation): [i-u] is more distinct on F2 than [i-y] or [i-ɯ];
- Theories of markedness that don't invoke contrast posit *y,ɯ » *i,u (cf. Calabrese's 1995 Filters)
- Correctly states that a language will choose /i/ before /y/
- But Flemming claims that central vowels like [ɨ] are only marked when compared to [i] and [u]
- In a system that lacks [i] and [u] then [ɨ] may be the optimal vowel on articulatory grounds, since it involves more minimal tongue displacement between consonants
- Marshallese is parade example (Choi 1992)
- Vertical vowel system with front and back and round determined by consonants, which are palatalized and velarized
- Historical reanalysis of Autronesian five-vowel system: tʲeʌpᵚ < *tepo
- Calabrese might argue that Marshallese vowels are underspecified for front vs. back rather than being central
- What happens at word edges or when the vowel is long: do we see a central vowel quality steady state? Choi (1992) states that long vowels have an F2 target but does not say if it is a central vowel

[3] dispersion theory

- An inventory of sounds is a compromise between constraints maximizing the distance between the sounds along some auditory dimension (e.g. F1, F2; voicing duration in consonants) and constraints maximizing the number of sounds, with articulatory effort being a third factor
- Given a fixed auditory space, the more sounds there are, the smaller the distance between them: cf. persons in an elevator

- For vowels assume some grid with idealized space; F2 in barks; F1 doubles bark frequencies

F2

14	13	12	11	10	9	8	7		F1
i		y	ɨ	ɯ			u	5	2.5
								6	3
e̝		ø̝		ɤ			o̝	7	3.5
								8	4
	e		ø	ə			o	9	4.5
	ɛ					ɔ		10	5
		æ̝				ɒ		11	5.5
		æ			ɑ			12	6
				a				13	6.5

- *MinDist-F2: 1 » *MinDist-F2:2 » *MinDist-F2:3 » .... » *MinDist-F2:6: this markedness hierarchy optimizes the distance between sounds along some auditory dimension
- Maximize number of contrasts (vowels): more information can be stored and transmitted per unit of space or time, but at the cost of greater possible confusion
- Sound inventories arise from embedding Maximize Contrasts somewhere within the MinDist ranking
- Errata in table below: decrease each Mindist = F2 value by one
- First tableau for five-vowel Japanese, second for Korean

15. Dispersion on the F2 dimension – covariation of backness and rounding:

					MINDIST= F2:4	MAXIMIZE CONTRASTS	MINDIST= F2:5	MINDIST= F2:6
a.	☞	i		u		✓✓		
b.		i		ɯ		✓✓	*!	*
c.		y		u		✓✓		*!
d.		i	ɨ	u	*!	✓✓✓	**	**

					MAXIMIZE CONTRASTS	MINDIST= F2:4	MINDIST= F2:5	MINDIST= F2:6
a.	☞	i		u	✓✓!			
b.		i		ɯ	✓✓!		*!	*
c.		y		u	✓✓!			*!
d.		i	ɨ	u	✓✓✓	*!	**	**

- Candidate d is winner in second tableau; by moving Max Contrasts up (leftward) in the MinDist hierarchy, we derive more vowels but at the cost of closer spacing; by moving down (rightward) we derive fewer vowels but with larger spacing
- Korean has /i/ vs. /ɨ/ vs. /u/ while Japanese has /i/ vs. /u/ (though /u/ is phonetically quite front, at least in Tokyo dialect; if it really is /ɯ/ then we would have to appeal to articulatory effort to choose /ɯ/ over the auditorily more optimal /u/. One the other hand, phonologically Jap /u/ patterns with labials, causing /h/ to be realized as [ɸ]). Perhaps F3 is relevant; see discussion of Cantonese below.

Vowel height (F1)

- Standard Italian (i,u, e,o,ɛ,ɔ,a) arises from ranking MinDist F1:2 » Max Contr » MinDistF1:3

(8)

		MinDist = F1:1	MinDist = F1:2	MinDist = F1:3	MinDist = F1:4	MinDist = F1:5	Maximise contrasts
a.	i-a						✓✓
b.	i-e-a				**	**	✓✓✓
c.	i-e̞-ɛ-a			***	***	*****	✓✓✓✓
d.	i-ɪ-e̞-ɛ-a		**	*****	******	********	✓✓✓✓✓

- Spanish demotes Max Contrast for greater dispersion: MinDist F1:3 » Max Contr » MinDistF1:4

(9)

		MinDist = F1:2	MinDist = F1:3	Maximise contrasts	MinDist = F1:4	MinDist = F1:5
a.	i-a			✓✓!		
b.	☞ i-e-a			✓✓✓	**	**
c.	i-e̞-ɛ-a		*!**	✓✓✓✓	***	*****

- Arabic {i,u,a}

(10)

		MinDist = F1:2	MinDist = F1:3	MinDist = F1:4	Maximise contrasts	MinDist = F1:5
a.	☞ i-a				✓✓	
b.	i-e-a			*!*	✓✓✓	**
c.	i-e̞-ɛ-a		*!**	***	✓✓✓✓	*****

[4] neutralization of contrasts

- In unstressed syllables Standard Italian seven vowels reduce to five, with loss of the distinction between open and closed mid vowels

- EF sees this as a response to increased artic effort that would be required to realize vowels in shorter time span of unstressed syllables
- Chief evidence is that low vowel /a/ is raised to [ɐ]; this encroaches on the vowel space; if the *same* Min-Dist and Artic effort constraints that define the stressed vowel/lexical inventory are imposed, then the number of distinctions decreases since the grammar now chooses the five-vowel system

(19) Central Italian – vowels in primary stressed syllables

		*SHORT LOW V	MINDIST = F1:2	MAXIMISE CONTRASTS	MINDIST = F1:3
a.	í-á			✓✓!	
b.	í-é-á			✓✓✓!	
c.	☞ í-é-ɛ́-á			✓✓✓✓	***

(20) Central Italian – vowels in unstressed syllables

		*SHORT LOW V	MINDIST = F1:2	MAXIMISE CONTRASTS	MINDIST = F1:3
a.	i-e̝-ɛ-a	*!		✓✓✓✓	***
b.	i-e̝-ɛ-ɐ		*!	✓✓✓✓	***
c.	☞ i-e̝-ɐ			✓✓✓	**

[5] Dispersion and enhancement (Flemming 2006)

- If dispersion constraints can freely interact with faithfulness and markedness constraints then the model over-generates: the inventory of contrasting segments should vary with context and targeted enhancement repairs should be able to rescue contrasts that are challenged by context (e.g. adding a schwa to final voiced obstruents). Another problem is an infinite regress: "the wellformedness of a candidate word [pad] might depend on whether or not [pat] is a possible word. But to determine whether [pat] is a possible word, we have to determine whether or not is statisfies MinDist constraints, requiring it to be adequately distinct from its neighbors, and so on".
- EF's claim is that we don't in general find these effects and the only response to a nonoptimal contrast is neutralization: in unstressed syllables distinctions are lost and the set of vowels shrinks rather than shifts (e.g. by introducing length); the only response to final voiced obstruents is devoicing (loss of contrast towards articulatorily less effortful sound)
- Proposal is to restrict the role of dispersion constraints to defining the phonemic inventory that encodes the lexicon and as a final "quality check" on the output of the input-output mapping in the ESC (Evaluation of Surface Contrast) module; in particular, dispersion constraints cannot interact with (be ranked with) the markedness and faithfulness constraints that define the input-output mapping.

- In the ECS there are (apparently) just the MindDist constraints and a general *Merger constraint

[6] Example from Cantonese:

high vowels: i y u

UG space:

F2	5	4	3	2	1
	i	y	ɨ	ʉ	u
F3	4	3	2	1	
	i	ɨ	y,u	ɹ	

constraint ranking for inventory

(14)

		MINDIST= F2:2 or F3:2	MAXIMIZE CONTRASTS	MINDIST= F2:3 or F3:3	MINDIST= F2:4
a.	i ɨ u		✓✓✓	**!	**
b.	☞ i y u		✓✓✓	*	**
c.	i y ɨ u	*!	✓✓✓✓	***	*****
d.	i y ɯ u	*!	✓✓✓✓	***	*****
e.	i u		✓✓!		

- front rounded vowels found after dentals and velars but not labials: ti, tu, ty; ki, ku, ky but pi, pu, *py
- could be repaired by shift to a new phoneme (/py/ -> pɨ) but this is in general not found; only merger to [i]
- in input-output mapping there is coarticulation of /i/ with /p/ creating a vowel [$i^{β}$] that is too close to /y/ and the response is to neutralize the [$i^{β}$] - [y] contrast; the outcome is determined by lowering ranking dispersion constraint maximizing distance from [u] and choosing [i]

(17) Realization:

	/pin/	*LABIAL COARTICULATION	IDENT(F2)	IDENT(F3)
a.	pin	*!		
b.	☞ $pi^{β}n$			*
c.	$pɨ^{β}n$		**!	***

(18) ESC:

	/pyn_1, pin_2, pun_3/	MINDIST= F2:2 or F3:2	*MERGE	MINDIST= F2:3 or F3:3	MINDIST= F2:4
a.	/pyn_1, pin_2, pun_3/ pyn_1 $pi^{β}n_2$ pun_3	*!			
b.	☞ /$pin_{1,2}$, pun_3/ $pi^{β}n_{1,2}$ pun_3		*		
c.	/$pyn_{1,2}$, pun_3/ $pyn_{1,2}$ pun_3		*		*!

Gallagher (2010)

- two types of cross-linguistic root co-occurrence constraints on laryngeally marked consonants such as ejectives
- dissimilatory: C'VCV, CVC'V, CVCV, *C'VC'V (cf. Lyman's Law in Japanese)
- assimilatory (less common): *C'VCV, CVC'V, CVCV, *C'VC'V (Chaha)
- Repair of dissimilation eliminates second ejective; repair of assimilation eliminates C'VC by distributing ejection through the root

(1) a. *dissimilation* *T'-K' T'-K T-K
*T'-T' T'-T T-T
b. *assimilation* T'-K' *T'-K T-K
T'-T' *T'-T T-T

a. Shuswap: kw'alt 'to stagger' qet' 'to hoist' kwup 'to push' qmut 'hat

b. Chaha: jɨ-t'ək'ɨr 'he hides' jɨ-kəft 'he opens *C'VC or CVC'

- Not a simple markedness hierarchy since what is ruled out in one type is preferred in the other
- Gallagher treats this as arising from a paradigmatic dispersion constraint over the permitted lexical root types with respect to ejection
- Analysis is supported by a speech perception task ("same" or "different") that finds it is more difficult to judge a C' vs. C contrast in the presence of another ejective than when the accompanying consonant is plain: i.e. more errors on C'VC' vs. C'VC than on CVC' vs. CVC or C'VC vs CVC
- (15) [k'ap'i-kapi] > [k'api-kapi] > [k'ap'i-k'api]
  Δ([T'-K']:[T-K]) Δ([T'-K]:[T-K]) Δ([T'-K']:[T'-K])
- LarDist(2v1)-[F]
  If two contrasting roots each have an [F] segment, then they do not minimally differ in [F].
- LarDist(1v0)-[F]
  If two contrasting roots each have two segments that may be specified for [F], then they do not minimally differ in [F].
-

the first constraint is intended to penalize just {k'ap', k'api} but allows {k'api, kapi}, which does not satisfy the "if" clause

the second constraint is more stringent and it intended to exclude {k'api, kapi} and {k'api, kap'i} as well as {k'ap'i, k'api} and allows just {kapi, k'ap'i}

(27) *Shuswap: dissimilation in ejection (homorganic)*

	{/k'ak'i, k'aki, kak'i, kaki/}	LarDist (2v1)-[ej]	Ident [ej]	LarDist (1v0)-[ej]	H-LarDist (1v0)-[ej]
	a. {k'ak'i, k'aki, kak'i, kaki}	**!		*****	*****
☞	b. {k'aki, k'aki, kaki}		*	***	***
	c. {k'ak'i, kaki}		**!		

- typo: b is {k'aki, kak'i, kaki}
- if a pair of roots each have an ejective then they cannot contrast minimally by virtue of the presence or absence of ejection: excludes C'VC'V vs. C'VCV

(33) *Chaha: assimilation in ejection (homorganic)*

	{/k'ak'i, k'aki, kak'i, kaki/}	LarDist (1v0)-[ej]	Ident [ej]	LarDist (2v1)-[ej]	H-LarDist (1v0)-[ej]
	a. {k'ak'i, k'aki, kak'i, kaki}	*!****		**	*****
	b. {k'aki, kak'i, kaki}	*!**	*		***
☞	c. {k'ak'i, kaki}		**		

- if a pair of roots differ in ejection then they must differ in ejection maximally, i.e. at each C

A major question these appeals to systemic contrast constraints must face is what is the candidate set over which the constraints are operating? This remains an outstanding research question.

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Appendix on [voice]

Various phonologists (Iverson, Ringen, Jessen, Vaux, and others) argue that the Germanic languages differ in the feature that contrasts /p,t,k/ vs. /b,d,g/: English, German [spread gl], Dutch [voice]. This position is critiqued by Kingston and Lahiri (K&L).

- proponents of [spread gl] point to the fact that in many contexts there is no phonetically observed voicing and therefore this is prima facie evidence that [spread gl] is distinctive
- K&L term this an "essentialist" view of a feature: this is a core set of phonetic correlates that should appear in every realization [±F] of the feature (cf. structuralists invariance condition on phonemes). They deny this, at least for [voice], claiming that a voicing contrast can be implemented by a variety of phonetic gestures whose distribution and magnitude vary according to context and no one gesture has privileged status. What unites them is a perceptual integration.
- voicing in sonorants, stops, and fricatives is phonetically diverse but yet they pattern as a natural class for the past tense and plural allomorphs in English (assumes z and d are not the defaults).
- passive voicing is really actively and purposely produced
- perceptual integration to give an "intermediate perceptual property" IPP. Performed by the auditory system and can occur even when sound in not heard as speech: low frequency of F0 (and F1) with vocal fold vibration and duration of consonant with preceding vowel duration.
- permits a more abstract view of a distinctive feature; so apparently VOT will integrate with high F0 to define the voiceless value signaling the open glottis gesture in the adjacent vowel.

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