On allophonic relations: phonetic similarity or functional identity?

Daniel Silverman University of Illinois daniel@cogsci.uiuc.edu

1. Introduction

 Corsican voiceless stops (Dinnsen and Eckman 1977): <u>p</u>eðe 'foot' u <u>b</u>eðe 'the foot' <u>t</u>engu 'I have' u <u>d</u>engu 'I have it' Corsican voiced stops <u>b</u>ok:a 'mouth' a <u>β</u>ok:a 'the mouth

<u>b</u> ok:a	'mouth'	a <u>β</u> okıa	'the mouth'
<u>d</u> ente	'tooth'	u <u>ð</u> ente	'the tooth'
<u>q</u> ola	'throat'	di <u>y</u> ola	'of throat'

- When viewed in functional diachronic terms, strong dynamic and self-organizational properties of the sound system clearly emerge which are synchronically active in the form of alternations.
- It is the system's very complexity—its myriad patterns of allophony and allomorphy—that may provide a sufficiently richly articulated structure for learners to swiftly master the system, and to effortlessly predict new forms. Language learners, upon daily exposure to the system in all its enormous complexity, come to master its form and fill in any gaps with no effort whatever.
- Markedness is positionally determined.
- Marked values tend to stay marked, and unmarked values unmarked, regardless of position.
- Evolutionary forces—a combination of the diachroic consequences of phonetic naturalness and functional efficaciousness—may be responsible for observed patterns of allophony (cf. teleology).
- Neither phonetic similarity nor complementary distribution may be relevant for the determination of allophonic relations. Alternation is what matters.

2. The American English alveolar stop system

	lenis:			fortis:			
	form:	e	example:	form:	example:		
(a) word-initially:	t	'tak	dock	t ^h	't ^h ăp	top	
	ď	'dak					
(b) syllable- and word-finally:	t	'nat	nod	Ŭt⊓	'năt⁻	knot	
	å	'naḍ		$\breve{V}^{\breve{v}}t^{\urcorner}$	'năªt⁻		
				٧̈́?	'nă?		
(c) word-internal stressed-syllable- initially:	d	ə'dapt	adopt	t ^h	ə't ^h ăp	atop	
(d) word-internal unstressed	Vſ	'ar'i	odder	1	'ări	otter	
syllable-initially:	Vſ	'ări	(neutralized)				
(e) following s:	form: t example: stop [¬] ; stop (non-contrastive)					stive)	

2. American English alveolar stops:

3. Synchronic alternations

Lenis:	d - r	a <u>dd</u> iction	a <u>dd</u> ict		
	t/d - r	bu <u>d</u>	bu <u>dd</u> ing		
	t-d <u>d</u> o		re <u>d</u> o		
	t - r	<u>d</u> isperse	re <u>d</u> isperse		
Fortis:	Ŭ ^v t⁻ - Ŭſ	bu <u>tt</u>	bu <u>tt</u> ing		
	t ^h - Ր	a <u>t</u> omic	a <u>t</u> om		
	$\check{V^v}t^r$ - t^h	dicta <u>t</u> e	dicta <u>t</u> orial		

Westbury and Keating (1986):

- unmarked/common sound are more natural to produce where naturalness is defined positionally, not globally, and/or afford a reasonable trade-off between competing demands of perception and articulation.
- **Initially**: voicing is **aerodynamically unnatural**: open glottis (lowers subglottal pressure) and limited lung recoil (lowers subglottal pressure). Subglottal pressure may be sufficiently raised only after stop release.
- **Medially** (intervocalically): voicing is **aerodynamically natural** for the first portion of the closure; more voicing for fronter oral closures, less voicing for backer oral closures.
- **Finally**: transglottal flow may only persist for the first portion of the closure (about 35 msec after closure), until the supralaryngeal cavity is near-filled, thus equalizing sub- and supralaryngeal pressure—**voicing ceases**.

Keating, Linker, Huffman (1983)

• If phonetically voiced stops are found in initial position, it is almost always in contrast with some other category

- Languages typically do not neutralize intervocalically: single series languages might voice stops intervocalically, double series language might voice and spirantize intervocalically
- Final stops often must be voiceless: Basque, Bulgarian, Cantonese, Choctaw, Dutch, Efik, Ewondo, Finnish, Gaelic, German, Polish, Russian, Zoque, Korean, Nama, Thai, Tikar, Vietnamese

Some examples of what we rarely (if ever) find:

- initial voiced stops devoice medially
- initial spirants occlusivize medially
- spirants but not stops are present medially





13. American English alveolar stop alternation:

Context: ⇒	(a) word-initially:		(b) syllable- and word-finally:		(c) word-internal stressed syllable		(d) word-internal unstressed syllable		(e) preceding s:
					initially:		initially:		
Lenis/	₫/t	\Leftrightarrow	t/d	\Leftrightarrow	d	Ŷ			t
Unmarked:	(more natural)		(more natural)		(more natural)				(more natural)
	¢		¢		¢		(Ŭ)r (more natural)	Ŷ	
Fortis/	t ^h	ŧ	Vt/ Vvrt/ V?	ŧ	t ^h	∇			
Marked:	(less natural)		(less natural)		(less natural)				

3. On the evolution of change



14. Early pattern in Western Romance (intervocalic):

- In English, the present-day lenis stop may have been truly voiced in coda position, inducing a moderate preceding vowel length distinction between it and its fortis counterpart. Upon diachronic de-voicing, the length distinction may have been functionally harnessed to serve a primary contrastive role. This scenario might also explain the vowel length contrast in flapping environments.
- We might further conjecture that the aspiration contrast in utterance-initial position actually derives from an earlier voicing contrast. The tendency toward devoicing in this context may have resulted in increasingly aspirated "voiceless" forms being communicated more effectively, culminating in an overall shift to aspiration here.

15. Conjecturur Duri	.j puttori	i (iiiititai).							
	less natural:			more natural:					
	d			t					
prevalence	d		d	t		t			
	d		d	ģ		t			
VOT	-90	-60	30	0	30	60			
Present-day pattern:									
	le	ss natural	•	more natural:			less natural:		
				d 🔪				∠ t ^h	
prevalence			d	t			t ^h		t ^h
			d		t		t ^h		t ^h
VOT	-90	-60	-30	0	30	60	90	120	150

15. Conjectural Early pattern (initial):

4. Learning, and Gestalten

• The natural tendency toward phonetic variation is typically delimited by phonetic naturalness (for unmarked values), and the functional force of contrast maintenance (for marked values). The existence of delimited variation itself possesses functional

significance, as a given value may move toward those phonetic states which better maintain contrastive status with its neighbors both syntagmatic and paradigmatic.

- A diachronic consequence of these delimited drifts is that allophones tend to possess a marked degree of phonetic similarity.
- The tendency toward phonetic similarity among allophones ought not have a principled standing in synchronic analyses: allophones tend to be phonetically similar not due to a first principle of linguistic theory, but instead due to the evolutionary forces that push toward phonetic naturalness and the maintenance of contrasts across differing phonotactic environments.
- Jusczyk (1997:76) suggests that "...[A]ny...early capacities that infants possess should allow them to begin to make sense of sound patterns in the input and help them to detect any inherent regularities that are present,."
- While phonetic similarity may initially serve to bootstrap categorization procedures in the manner alluded to by Jusczyk, the historical forces that have shaped the pattern in this way may nonetheless be of only limited relevance to learners. It is ultimately the functional relevance (meaning-changing, meaning-preserving, or meaning-obliterating) of sound substitutions which learners might exploit in forming their linguistic sound categories.
- Sometimes phonetically dissimilar phones belong to the same phonological category.
 - # # 24 ⇔ 22 Û Û 22 \Leftrightarrow 21 Û Û ⇔ 21 ▲ 53 Û ĵ 53 44 ĵ ĵ

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16. Southern Min tone sandhi (Chen 1987):

• A theory of category formation which relies exclusively on similarity is clearly unable to account for such patterns as Corsican stop allophony, or Southern Min tone sandhi. Instead, the functional identity of certain phonetic distinctions clearly overrides their phonetic dissimilarity, and, conversely, functional non-identity may override phonetic similarity.

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• Shepard, Holland, and Jenkins (1961), pace French (1953): similarity and reinforcement may be independent variables affecting category learning; these researchers tested subjects' ability to group visual stimuli into sets that possess either similar or dissimilar members.

17.



• Six logical breakdowns of the eight forms, each consisting of two groups with four members each:

18.



- Group I: groups with members that are maximally similar (here, on the color dimension).
- Group II: groups with qualitatively less similar members (requiring two dimensions to be considered for classificatory purposes).
- Groups III-V: groups with maximally dissimilar members (requiring all three dimensions to be considered).
- Group VI: requires learning the qualities on all three dimensions for each individual member:
- Subjects went through a number of sets of stimuli, with each set conforming to one of the six group types. Ss were trained to associate a prescribed verbal response to each of eight stimuli within the given set. Four of the stimuli were associated with one verbal response; the other four, another. Ss were provided with immediate feedback as to the correct response to the stimulus flashed, and were then presented with the next stimulus, and so on. After exposure

to one set, stimulus presentation moved on the next set, until 32 consecutive correct responses were produced.

19.



- Ss were successful at learning all six sorts of groupings, but showed a clear facility with learning groups consisting of more similar members (I, II). Learning the group with the least similar members (VI), while slowest, nonetheless improved most over time, and ultimately patterned similarly to all other groups in terms of learnability upon feedback.
- Learners might experience an initial difficulty, but an ultimate success, in discovering which phonetically disparate allophones should be grouped together. That is, in such cases as the Corsican [t-d]/[d-ð] type alternation, and in those somewhat unusual historical circumstances when allophones have strayed far from each other in terms of their phonetic quality, the functional relevance of the phonetically disparate elements is yet learnable (that is, that the substitution is meaning-preserving).
- Despite the initial boost that similar stimuli apparently receive in terms of category grouping, this boost may ultimately be overridden by functional cues to category membership: initial semantic feedback regarding category membership may fall on deaf ears, as infants are unaware of the sameness or distinctness in meaning that accompanies sound substitution. But just as experimental subjects who, when provided with feedback are, over time, ultimately able to group unlike elements together, so too may language learners, over time, exploit the lexical semantic feedback provided them regarding meaning changes or non-changes, in order to replicate the functional categories employed in the adult system, regardless of the phonetic values of these elements.
- Murphy and Medin (1985:310): "...[C]hildren form their first concepts through perceptual similarity; then, as they learn more about the world, they incorporate knowledge into their concepts, where it has increasing importance. On this view, the similarity-based views of

coherence are correct for early concepts, at least, to the extent that we can ascertain built-in constraints on the perception of similarity."

• Werker and Lalonde(1988:682): "If we accept that the definition of a phoneme as a phonetic unit that is used to contrast meaning, then the beginning—just the beginning—of the emergence of a phonemic system around 1 year of age should come as no surprise. Certainly by this time, the infant has begun to construct a receptive vocabulary. Although it is far from clear how fully specified initial oppositions might be, logically the development of a receptive vocabulary and the initial emergence of a system of phonological contrasts should co-occur."

- Given the possibility that history will take its toll on the phonetic order of a phonological system, why are not all phonological systems in a state of phonetically transmogrified disarray? A conceivable answer emerges when considering the learning curve involved in forming categories out of dissimilar elements.
- Categories with dissimilar members will take more time to master. Such categories may initially be mistakenly filled with similar members, which would be in keeping with the majority of the more readily learnable categories.
- Over time, such incorrectly formed categories may be "corrected" with sufficient feedback (sufficient exposure to allophonic alternations—which do not change meaning), but some incorrect regularities may take hold, and consequently change the system towards a more regular state.
- Which categories with dissimilar members should be most susceptible to a change toward regularity, and which categories should most likely maintain their dissimilar members?
- If there is a great deal of feedback in the form of exposure to frequently employed items, categories with dissimilar members should ultimately be successfully learned.
- If there is little-to-no exposure to a given irregular pattern at early stages in the learning procedure, these irregularities too will probably be learned correctly later on, as feedback begins after the mature system is well in place.
- Irregular categories with only a modicum of feedback—again, in the form of moderate exposure to less frequently employed items—will likely be the most susceptible to regularization, as moderate amounts of feedback may be insufficient for the proper generalizations to emerge for the learner. The result is that the learner will fill the category with likely candidates—those that conform to the regularization may undergo lexical diffusion, perhaps ultimately pervading the lexicon. But also, lexical diffusion may be blocked to the extent that the "unnatural" alternation takes on morphological significance, as in Southern Min tone sandhi, or, say, morphophonologically conditioned umlaut system

evolving into a purely morphological ablaut system. In this scenario, linguistic sound systems may be seen as being under a continual force of regularization, concomitant with the possibility that phonological and morphological change might result in the emergence of certain irregularities.

- Köhler (1929) "In countless cases organization is a sensory reality without there being a corresponding physical unit."
- "continuous sensory wholes may occur in the absence of a homologous physical unit" (p.171). In this sense, "a dynamical distribution will be rightly regarded as a functional whole...No part of this distribution will be self-sufficient; local processes depend throughout upon the totality of the distribution" (p.148).
- "Since 'real form' presupposes a segregated whole, the existence of 'form' depends upon factors of stimulation similar to those upon which the segregation and organization of wholes depends...As for the existence of segregated wholes, i.e., organization, **certain** *special* **relations**...are important and others **indifferent**; which are the important ones can only be discovered by the observation of real forms appearing under a given set of conditions... 'form,' wherever it exists, is a *supra*local property of that part of the field; so the **property of the underlying process must be a supralocal phase of it**" (pp.202-204; italics in original).

alternations/ sound substitutions physical similarity, complementary distribution allophony as a consequence of phonetic naturalness and contrast maintenance

- "Everywhere in nature dynamical events depend upon the properties of those processes and materials which exert influence upon one another" (p.120).
- Surely, given their highly complex and dynamically orchestrated functional interdependencies—the functional relevance of certain of their dynamic properties and the functional irrelevance of others—our capacity to learn linguistic sound systems naturally lends itself to a Gestalt-theoretic analysis.



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• In contrast to the richly articulated data array which provides learners with sufficient dynamic information to learn allophonic relations within the stop system, consider finally the English ŋ-h opposition.





• Neither the phonetic dissimilarity of the velar nasal and the laryngeal, nor their complementary distribution, likely plays any significant role in establishing their functionally distinctive status for English learners. Their behavior betrays no evidence that any sort of allophonic relationship exists between the two values: there is no immediate dynamic component to their relationship, as substitution of one with the other is never present in the sensory field; mere complementary distribution may offer no evidence of functional identity, whether the sounds are phonetically similar or not. Alternation is what matters.

5. Conclusion

- Markedness is positionally determined.
- Marked values tend to stay marked, and unmarked values unmarked, regardless of position.
- Evolutionary (not teleological) forces—a combination of phonetic naturalness and functional efficaciousness—may be responsible for observed patterns of allophony.
- Neither phonetic similarity nor complementary distribution may be relevant for the determination of allophonic relations. Alternation is what matters.

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Daniel Silverman Department of Linguistics, UIUC 4088 FLB 707 S. Mathews Urbana, IL 61801 daniel@cogsci.uiuc.edu