Environmental shielding is contrast preservation

Juliet Stanton, MIT – *juliets@mit.edu*

Overview. The term "environmental shielding" refers to a class of processes where the phonetic realization of a nasal depends on its vocalic context. In Kaiwá (Tupí, Bridgeman 1961), for example, nasals are prenasalized before oral (/ma/ → [mba]) but not nasal (/mã/ → [mã]) vowels. Herbert (1986:199) claims that shielding occurs to protect a contrast in vocalic nasality: if Kaiwá /ma/ were realized as [ma], the [a] would likely carry some degree of nasal coarticulation, and be less distinct from nasal /ã/ as a result. This paper provides new arguments for Herbert's position. I show that a contrast-based analysis of shielding correctly predicts several typological generalizations, and argue that any successful analysis of shielding must make reference to contrast.

The argument for contrast. Herbert's claim that shielding protects contrasts makes a basic prediction: if the purpose of shielding is to preserve a V–$\tilde{\text{V}}$ contrast, shielding should only occur in languages that have a V–$\tilde{\text{V}}$ contrast. In other words, shielding is only necessary when there is a contrast to protect. To test this prediction, I conducted a survey composed of 188 languages from SAPhon (Michael et al. 2012). With the sole exception of Ese Ejja (Tacanan, Vuillermet 2012), the prediction holds: *all languages that allow shielding also exhibit a V–$\tilde{V}$ contrast* (1).

(1) Shielding survey results

	✓*Shielding*	**Shielding*
✓*V–$\tilde{V}$*	55	44
**V–$\tilde{V}$*	1	88

The contrast-based approach also makes language-specific predictions. If a language limits V–$\tilde{\text{V}}$ to certain contexts, it should also limit shielding to those same contexts. The logic behind this is the same: shielding is only necessary in contexts where there is a contrast to protect. Evidence that this prediction is correct comes from Wari' (Chapakuran, Everett & Kern 1997), where both the V–$\tilde{\text{V}}$ contrast and shielding phenomena are restricted to stressed syllables.

The picture, then, is clear. If a language allows shielding to occur in some context *x*, this asymmetrically implies that the language licenses a V–$\tilde{\text{V}}$ contrast in *x*. I propose a contrast-based analysis referencing auditory factors (following Flemming 2008) that derives this generalization.

Asymmetries in the typology. Further asymmetries in the typology of shielding mirror cross-linguistic asymmetries in the direction and extent of nasal coarticulation. I focus on two well-supported generalizations: (i) vowels preceding coda nasals (V/_N]$_\sigma$) are more nasalized than vowels preceding onset nasals (V/_]$_\sigma$N) (e.g. Schourup 1972), and (ii) vowels following nasals (V/N_) are more nasalized than vowels preceding onset nasals (V/_]$_\sigma$N) (e.g. Jeong 2012). Whether there is more nasalization in V/N_ or V/_N]$_\sigma$ is language-dependent: Greek nasalizes more in V/N_, while English nasalizes more in V/_N]$_\sigma$ (see Jeong 2012:450). Assuming that the greater the extent of nasal coarticulation in an oral V, the less distinct the contrast wrt a nasal V, we expect to find two types of systems. In *Type 1* systems (2a), the V–$\tilde{\text{V}}$ contrast should be more distinct in V/_]$_\sigma$N than V/N_, and more distinct in V/N_ than V/_N]$_\sigma$. In *Type 2* systems (2b), the V–$\tilde{\text{V}}$ contrast should be more distinct in V/_]$_\sigma$N than V/_N]$_\sigma$, and more distinct in V/_N]$_\sigma$ than V/N_.

(2) Two possible types of system (△ = perceptible difference between *x–y*)

a.	*Type 1*	△V/_]$_\sigma$N–$\tilde{\text{V}}$/_]$_\sigma$N	> △V/N_–$\tilde{\text{V}}$/N_	> △V/_N]$_\sigma$–$\tilde{\text{V}}$/_N]$_\sigma$
b.	*Type 2*	△V/_]$_\sigma$N–$\tilde{\text{V}}$/_]$_\sigma$N	> △V/_N]$_\sigma$–$\tilde{\text{V}}$/_N]$_\sigma$	> △V/N_–$\tilde{\text{V}}$/N_

If shielding is a strategy to protect V–$\tilde{\text{V}}$ contrasts, then the phonetic asymmetry in (2) should lead to a typological one. If a language requires shielding in a context where V–$\tilde{\text{V}}$ is more distinct, this should asymmetrically imply shielding in all contexts where V–$\tilde{\text{V}}$ is less distinct. So while we

expect to find languages that shield in V/N_ only *(Type 2)*, or V/_N]$_\sigma$ only *(Type 1)*, or V/N_ and V/_N]$_\sigma$, or all contexts, what we don't expect to find are languages that shield in V/_]$_\sigma$N but not all other contexts: in V/_]$_\sigma$N, V–Ṽ is most distinct. As shown in (3), this prediction is correct.

Similar considerations allow us to explain more subtle, language-specific contextual asymmetries. In Krenak (Macro-Ge, Pessoa 2012), for example, V–Ṽ is licensed in all contexts, but shielding occurs more frequently adjacent to stressless (short) than stressed (long) vowels. If in a given language the amount of nasal coarticulation induced on a neighboring vowel is constant, we would expect for a short vowel adjacent to a nasal to be more nasalized than a long one. In other words, we would expect for ΔV/N_–Ṽ/N_ to be greater when the vowels are long than when they are short. What we find in Krenak is a language-specific instantiation of the more general pattern in (3): shielding protects the most endangered V–Ṽ contrasts. I show that the contrast-based analysis proposed for (1) can easily be extended to account for these patterns.

(3) Contextual asymmetries in shielding

	Context of shielding V/N_	V/_N]$_\sigma$	V/_]$_\sigma$N	*Attested?*	*Example*
a.	✓			Yes (42)	Kaiwá (Bridgeman 1961)
b.		✓		Yes (4)	Nadëb (Barbosa 2005)
c.	✓	✓		Yes (7)	Krenak (Pessoa 2012)
d.	✓	✓	✓	Yes (2)	Karitiâna (Storto 1999)
e.		✓	✓	No	
f.	✓		✓	No	
g.			✓	No	

Predictions. Faced with an insufficiently distinct V–Ṽ contrast, a language has two options: preservation through enhancement (e.g. by shielding) or neutralization. A contrast-based analysis predicts that contextual asymmetries in the typology of V–Ṽ neutralization should mirror those from the typology of shielding. This is because the motivation for the two phenomena is the same: they are both strategies to avoid insufficiently distinct V–Ṽ contrasts. So if two contexts C_1 and C_2 differ in that V–Ṽ is better cued in C_1 than C_2, then both enhancement and neutralization phenomena targeting V–Ṽ in C_1 must also target V–Ṽ in C_2. Preliminary results of a study on contextual V–Ṽ neutralization suggest that this prediction is correct: the typologies are identical.

(4) Contextual neutralization of vowel nasality

	Context of neutralization V/N_	V/_N]$_\sigma$	V/_]$_\sigma$N	*Attested?*	*Example*
a.	✓			Yes (10)	Coatzospan Mixtec (Gerfen 1999)
b.		✓		Yes (2)	Brazilian Portuguese (Medeiros 2011)
c.	✓	✓		Yes (1)	Kiowa (Watkins 1984)
d.	✓	✓	✓	Yes (3)	Lua (Boyeldieu 1985)
e.		✓	✓	No	
f.	✓		✓	No	
g.			✓	No	

Are there alternatives? A contrast-based analysis accurately predicts three generalizations regarding the typology of shielding: (i) the existence of shielding in some context *x* implies the existence of a V–Ṽ contrast in *x*, (ii) shielding in a context where V–Ṽ is more distinct implies shielding in a context in which it is less so, and (iii) contextual asymmetries in the typologies of shielding and V–Ṽ neutralization are identical. I argue that no alternative can predict even one of these generalizations, let alone all three. From this, we can conclude two things: environmental shielding is contrast preservation, and contrast is an essential part of phonological analysis.