Rethinking the *Core-Periphery* Model: Evidence from Japanese and English

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1   Overview

- Lexical items can be divided into "strata" based on their phonological and phonotactic behavior.

  - These strata correspond to both the origin of the lexical item as well as the time period during which the lexical item entered the language.
  - Kiparsky noted that these changes are gradual and hierarchical, with older strata showing heavier phonotactic restricitons.

- Itô and Mester (1995,1998) capture this generalization through their *Core-Periphery* model within Stratal Optimality Theory.

  - They posit multiple synchronic strata with the same overall ranking of markedness constraints.
    * Each stratum defined by a separate ranking of faithfulness constraints.
    * These different FAITH rankings within the same overall ranking of markedness constraints lead to the hierarchical nature of lexical strata.
    * This more constrained model provides a clear advantage over Cophonology models, which are free to posit an arbitrarily large number of arbitrarily ordered constraint sets within a language.

- I, on the other hand, argue for a return to a more traditional view of OT, namely that only one ranking of constraints exists that accounts for all synchronic behavior of these strata.

  - The multiple rankings of faithfulness constraints proposed by Ito and Mester reflect the constraint rankings present at different stages throughout the history of a language.
  - The hierarchical nature of the strata comes from the slow, gradual nature of sound change, and the constraint reranking that results from sound change.
  - Once a given constraint reranking has occurred due to sound change, younger generations of speakers can no longer generate these forms on-line using productive phonology.
    * They must therefore *update the lexical representations* of all items previously generated by the old constraint ranking, and separately store each alternation form in the lexicon.

– This *lexical updating* process effectively moves the alternation from the synchronic phonology to the mental lexicon.

2   Japanese Strata

2.1   Itô and Mester's *Core-Periphery* Analysis

- According to Itô & Mester (1993), Japanese can be divided into four distict strata: native, established Chinese loans, assimilated foreign words, and unassimilated foreign words.

- In Itô and Mester's analysis, each stratum is characterized by surface adherence to a different number of the stratum-defining constraint sets in their analysis, listed below:

  (1)
a.	SYLLSTRUC:	Prevents complex onsets and codas, as well as limiting codas to segments without place
b.	NOVOICEDGEM (NO-DD):	No voiced obstruent geminates (*bb, etc.)
c.	NOVOICELESSLAB (NO-P):	No singleton-p: prevents nongeminate [p]
d.	NONAS VOICELESS (NO-NT):	Postnasal obstruents must be voiced (*nt, etc.)

- The behavior of the four strata related to the constraints in (1) is shown in the table below, reproduced from (Itô & Mester 2004: 557).

  (2)
	SYLLSTRUC	NO-DD	NO-P	NO-NT
Yamato	✓	✓	✓	✓
Sino-Japanese	✓	✓	✓	violated
Assimilated Foreign	✓	✓	violated	violated
Unassimilated Foreign	✓	violated	violated	violated

- Note the hierarchical nature of the strata with regard to the constraints posited.

  – (Also note for later that the organization of the hierarchy corresponds to the age of the strata, with strata borrowed progressively later violating progressively more constraints.)

- To constrain their model, Itô and Mester require that a single ranking of constraints apply to every stratum of a language's lexicon, with the caveat that FAITH will rank lowest in the core stratum, but will be progressively higher ranked as one moves out through the strata toward the periphery of the language's lexicon.

- This approach is demonstrated below, in which we see two separate lexical items with an identical underlying form, /pan/, resulting in two different surface forms since they belong to two different strata.

– The assimilated foreign loan stratum values Faith over No-P, resulting in the more faithful surface form [pan], while the Sino-Japanese loan stratum values No-P over No-PFaith, resulting in the surface form [han].

(3)

	/pan/	No-DD	Faith/ Assimilated	No-P	Faith/ Sino-Japanese	No-NT
'bread'	☞[pan]			*		
Assimilated Foreign	[han]		*!			
'group'	[pan]			*!		
Sino-Japanese	☞[han]				*	

2.2 Exceptions to the CP Model, and an Alternative

- **The No-NT Alternations**

    – As noted above, No-NT is the constraint obeyed only by the Yamato stratum, and violated by the other three strata.

       * Itô and Mester illustrate this constraint with the gerundive and past tense endings of Yamato verbs, /-te/ and /-ta/ respectively, which become voiced following a root with a final voiced segment.

(4)

Root	Gerundive	Past
sin- 'die'	*sin-de*	*sin-da*
yom- 'read'	*yon-de*	*yon-da*
tob- 'fly'	*ton-de*	*ton-da*
mi- 'see'	*mi-te*	*mi-ta*
kaw- 'buy'	*kat-te*	*kat-ta*

    – In the Sino-Japanese stratum, on the other hand, nasal plus voiceless obstruent combinations are quite common, seen in words like *hantai* 'opposite' and *sinpai* 'worry'.

    – Itô and Mester's ranking of No-NT over Faith in the Yamato stratum but below it in the SJ stratum effectively generates the desired forms:

(5)

		Faith/ SJ	No-NT	Faith/ Yamato
/shin-ta/ 'die'	[shinta]		*!	
Yamato	☞[shinda]			*
/hantai/ 'opposite'	☞[hantai]		*	
Sino-Japanese	[handai]	*!		

– However, Rice (1997) provides a list of Yamato words containing outright violations of NO-NT, including examples like *intiki* 'trickery' and *anta* 'you'.

  ∗ Crawford (2009) points out that *anta* is particularly interesting as it derives from *anata* via syncope, and coexists with the original form.

  ∗ In effect, this means that either the NO-NT constraint did not act as predicted for this Yamato form, or that this form has somehow moved from the core toward the periphery, as it now patterns with the Sino-Japanese stratum.

  ∗ Either way, this poses a problem for Itô and Mester. If the former, then their constraints have unexplained exceptions, and if the latter, then again we see that their theory has no mechanism to motivate movement of lexical items toward the periphery of the lexicon.

  ∗ Itô & Mester (1995) call exceptions like these "undoubtedly native, but peripheral" (p. 830), but provide no explanation for their behavior.

– With lexical updating, however, the analysis is straightforward.

  ∗ In Old Japanese, we see that no words with NT sequences surface at all, indicating that there was likely a highly ranked constraint preventing these sequences at the time.

  ∗ Once the constraints reranked to allow the ND sequences seen in borrowings, D/T alternations due to the older constraint ranking now had to be lexically stored, with no current phonological basis for the surface form.

  ∗ This lexical storage allows subsequent grammatical processes to produce segment collocations that would have previously been illicit.

  ∗ Thus, because stratal effects are lexical and not phonological, the syncope process that produced forms like *anta* is free to act without violating highly ranked constraints, in opposition to the predictions of the *Core-Periphery* model.

- **The No-P Alternation**

  – The classifier *pun* 'minute' combines with numbers to count time.

  – As a member of the Sino-Japanese stratum, it should (and used to) obey the NO-P constraint.

  – Recently, however, we have seen the paradigm level in fluent speech.

  (6)

Expected Compound Pronunciation	**New Compound Pronunciation**	Number Morpheme	Counter Morpheme	Meaning
ip-pun	**ip-pun**	ichi 'one'	pun	'one minute'
ni-ɸun	**ni-pun**	ni 'two'	pun	'two minutes'
san-bun	**san-pun**	san 'three'	pun	'three minutes'

  – Itô and Mester cannot motivate this movement toward the periphery of the language.

- I believe that each of these forms were lexically stored when the No-P constraint was deranked at the end of the Sino-Japanese period.
    * This resulted in three similar, yet separate, stored forms, all with the meaning 'minute'.
    * As Kiparsky (2012) states, "analogical change is grammar optimization, the elimination of unmotivated grammatical complexity or idiosyncrasy" (p. 21).
    * I argue that this levelling is *lexical simplification*, eliminating the unnecessary forms no longer motivated by active phonological processes.
- Now, recall example (3), in which Itô and Mester analyze both *pan* 'bread' and *han* 'group' with the same underlying form, /pan/.
- *Han* is a Sino-Japanese word, so when it was borrowed, initial *p* was not allowed in Japanese.
- However, I argue that by the time the constraint reranking that allowed the borrowing of Portuguese *pan* without modification occurred, the prior h/p alternations had become lexically stored.
    * The underlying form of *han* 'group', therefore, was updated by later generations of speakers to /han/, allowing *pan* 'bread' to be borrowed and stored as-is.
- My OT analysis of *pan* 'bread' and *han* 'group' becomes trivial, with only one constraint ranking, as seen below:

(7)

		SYLLSTRUC	FAITH	No-P
/pan/ 'bread' ☞[pan]				*
Assimilated Foreign [han]			*!	
/han/ 'group' [pan]			*!	
Sino-Japanese ☞[han]				*

- **No-DD Alternations**

    - According to Itô and Mester's analysis, borrowings from English ending with a voiced obstruent are adapted with a geminate obstruent that is either voiced or voiceless depending on whether the word is an unassimilated or assimilated borrowing, respectively.
        * Unassimilated loans rank No-DD lower than FAITH, while assimilated loans rank it higher.

(8)

		SYLLSTRUC	FAITH/ Unassimilated	NO-DD	FAITH/ Assimilated
	[bag]	*!			
/bed/ 'bed' ☞[beddo]				*	
Unassimilated [betto]			*!		
	[bag]	*!			
/bag/ 'bag' [baggu]				*!	
Assimilated ☞[bakku]					*

- Crawford (2009), however, shows that there are in fact *five* different possible adaptation mechanisms for English borrowings with a final voiced consonant: voiced geminates, devoiced geminates, voiced singletons, devoiced singletons, and a lengthened vowel before a voiced singleton.

- In fact, since the earliest attestation of these types of borrowings, geminating the voiced stop has been *consistently* the *most* popular mechanism for adapting them to Japanese pronunciation. Crawford states the following about the data:

  > "Among the entire set of words collected from Arakawa, the only ones which are listed with three or more attestations with a voiceless geminate are *betto* 'bed', *handobakku* 'handbag', *operapakku* 'operabag', and *buru-dokku* 'bulldog'. Of these, both *bed* and *operabag* are also attested with alternate forms, *beddo* and *operabaggu*, that have a voiced geminate." (p. 61)

- Given the complexity of the borrowing data in the chart above and the paucity of the devoiced geminate data, NO-DD seems an odd candidate for a constraint that differentiates recent loanword strata.

- It seems more likely that these different adaptation mechanisms are due to different constraint rankings in the dialects or even idiolects of the original borrowers, and that different forms of borrowed terms diffused unequally through the rest of the language.

- Whatever the reason for the existence of these multiple borrowing mechanisms, it seems fairly clear that once successfully borrowed and lexicalized, these alternations are governed not by separate rankings of phonological constraints, but by these lexical items possessing distinct underlying forms.

• In this section, we have seen **three separate shortcomings** of the *Core-Periphery* model: exceptions created by synchronic phonological processes, exceptions created by lexical processes (analogy), and exceptions due to oversimplification of complex data.

• In my analysis, however, these processes are not only unproblematic, but are motivated and expected.

3   Capturing generalizations: English fricative data

- In modern English, /f/, /s/, and /θ/ all contrast with their voiced counterparts, /v/, /z/, and /ð/ word-initially, medially, and finally.

- In Old English, however, these pairs were allophones, with the voiceless forms appearing initially and finally, and the voiced forms appearing medially between voiced segments.

- Geminate voiceless fricatives, which are no longer present in modern English, could appear medially and finally.

(9)   **English fricative distribution before the 12th century**

		Foot-initial	Foot-medial	Final
Labial	Short (vl)	f	-	f
	Short (vd)	-	v	-
	Long	-	fː	fː
Dental	Short (vl)	θ	-	θ
	Short (vd)	-	ð	-
	Long	-	θː	θː
Alveolar	Short (vl)	s	-	s
	Short (vd)	-	z	-
	Long	-	sː	sː

- By the 14th century, however, the following four changes occurred to generate the modern distribution of English fricatives.

  - Final [ə] was deleted, making final voiced and voiceless fricatives phonemic.
  - Initial [f] and [v] were borrowed, placing them in phonemic distribution as well.
  - Prosodic developments led to voicing of initial [ð] in words like *the* and *this*.
  - Geminates degeminated.

(10)   **Modern English fricative distribution**

		Foot-initial	Foot-medial	Final
Labial	Short (vl)	f	f	f
	Short (vd)	v	v	v
Dental	Short (vl)	θ	θ	θ
	Short (vd)	ð	ð	ð
Alveolar	Short (vl)	s	s	s
	Short (vd)	z	z	z
Palatal	Short (vl)	ʃ	ʃ	ʃ
	Short (vd)	(ʒ)	ʒ	(ʒ)

- **A Synchronic *Core-Periphery* Treatment of the English Fricative Data**

  – English has a large number of lexical strata, but only two are relevant for our purposes.
    * First is the **'Native'** stratum, composed of all lexical items present in Old English before the adaptation of loanwords with initial voiced fricatives.
    * The second I call the **'Loan'** stratum, characterized by a high ranking of FAITH to ensure the surfacing of underlying /v/ and /z/.
    * This stratal division is necessary to separate early Latin borrowings whose underlying voiced fricatives do not surface from late Latin borrowings whose do.

  – I propose the following constraints to account for the data:
    * ***Finalə** prevents final [ə], and is the constraint that governs Deletion.
    * ***InitialLabiodental/AlveolarVoicedFricative(*InitialVZ)** prevents initial voiced [v] and [z], and governs Borrowing.
    * **Initial ð** is governed by *INITθUNSTR, which prevents initial [θ] in prosodically unstressed words.
    * ***Gem** governs Degemination by preventing geminate consonants.

  – Using these constraints, we are able to generate a tableau that accounts for the modern English fricative data.

(11)

			*GEM	*FINALə	FAITH/*Loan*	*INITIALVZ	*INITθUNSTR	FAITH
/draivə/		[draivə]		*!				
Native	☞	[draiv]						*
/offɚ/		[offɚ]	*!					
Native	☞	[ofɚ]						*
/θɪs/		[θɪs]					*!	
Native	☞	[ðɪs]						*
/væn/		[væn]				*!		
Native	☞	[fæn]						*
Latin								
/fɪʃʃes/		[fɪʃʃes]	*!					
Native	☞	[fɪʃes]						*
/ziːl/	☞	[ziːl]				*		
Loan		[siːl]			*!			
/væt/	☞	[væt]				*		
Loan		[fæt]			*!			

- **An Alternative Analysis: Updating Lexical Representations**

  – As stated above, I argue that only one set of constraints is necessary to accurately describe the phonological processes active at any given time in Old, Middle, and Modern English, that no stratum-specific reranking of FAITH is necessary, and that the very idea of "multiple strata", while descriptively and historically interesting, is unnecessary to account for the data.

– The surface alternations between Native vocabulary and loans which require separate strata in the Core-Periphery model, I instead attribute to differences in underlying representation that are simply maintained on the surface.

– Perception studies such as Dupoux *et al.* (1999) show that perception of non-native strings by native speakers is heavily influenced by the phonotactic constraints of their native grammar.

  ∗ It is unlikely that borrowed words are accurately stored in the borrowers' lexicons as they are pronounced in the source language, especially when that underlying form would contain segments unpronounceable by speakers of the borrowing language.

  ∗ It's far more likely that Old English speakers borrowed Latin [vannus] with an underlying /f/ from the start than with an underlying sound they were unable to pronounce (or even distinguish at that time) due to the then-highly ranked *INITIALVZ constraint (cf. Itô & Mester (2004) for similar Japanese examples).

– Almost a thousand years after these Latin borrowings, these four major changes were realized by different processes almost simultaneously.

  ∗ This is unlikely to be a coincidence; more probably, some systematic, foundational aspect of the English consonant system changed fundamentally.

  ∗ The generalizations about these changes are simple and straightforward: **initial and final voiced fricatives appeared**, and **geminates degeminated**.

  ∗ The constraint rerankings that made these changes possible allowed English speakers to distinguish fricative voicing in initial position, so borrowings with initial voiced fricatives could now be adapted as such.

– To account for these generalizations, I collapse the separate constraints preventing initial and final voiced fricatives in the *Core-Periphery* model into a single constraint, *EDGEZ, in order to capture the generalization that all of these separate processes are merely different facets of the same phenomenon.

  ∗ This was not possible in the Core-Periphery model due to native words like *the*.

(12) **Constraint ranking for Middle English fricatives with lexical up-dating**

			*Gem	*Finalə	*InitθUnstr	Faith	*EdgeZ
/draivə/		[draivə]		*!			
Native	☞	[draiv]				*	*
/offə˞/		[offə˞]	*!				
Native	☞	[ofə˞]				*	
/θɪs/		[θɪs]			*!		
Native	☞	[ðɪs]				*	*
/fæn/		[væn]				*!	*
Native	☞	[fæn]					
Latin							
/ziːl/	☞	[ziːl]					*
Loan		[siːl]				*!	
/væt/	☞	[væt]					*
Loan		[fæt]				*!	

– The *Core-Periphery* model requires separate *ad hoc* constraints governing initial voiced fricatives due to the strict phonological requirements of the strata.

– In my model one constraint is able to account for all of the fricative voicing data.

  * This elegance and simplicity comes at the cost of specifying different underlying representations for the borrowed Latin lexical items, but each of these representations themselves follows naturally from the constraint rankings active at that time during the development of the language.

  * Not only is my model able to do the work of the *Core-Periphery* rankings with fewer constraints, but I also capture the wider generalizations about the actual processes active in Old and Middle English to produce these forms that the *Core-Periphery* model misses (that the allowance of initial [v] and [z] is due to reranking of the same constraint as the allowance of [ð], for example).

4   Conclusions

• I have shown first and foremost that not all alternations present in a data set are the result of traditional interaction of phonological constraints.

• Accordingly, the *Core-Periphery* model fails when grammatical processes affect individual lexical items.

  – One could stipulate that these lexical items have moved from one stratum to another, but Itô and Mester provide no machinery for doing so in their model.

  – Also, and more importantly, the *Core-Periphery* model has no way of *motivating* these movements.

- We also must realize that determining the proper underlying form for a given lexical item is far more important than previously recognized in OT, since the outputs of a function are only as good as its inputs.

  - The idea that OT itself places no constraints on potential inputs is central and necessary to the theoretical framework, but there is no rule to my knowledge against recognizing that OT-external factors, such as cognitive and acquisition processes, must.

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