Nonce-loan judgments and impossible-nativization effects in Japanese

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• The Japanese lexicon is claimed to have a core-periphery structure that shows a hierarchy of foreignness

• But whether this is productive or not is controversial

• To test this, we collected nonce-loan nativization judgments from native Japanese speakers
Overview

- Research questions
  - Can a core-periphery structure be a **productive** synchronic phonology?
  - Do native Japanese speakers show a **hierarchy of foreignness** that matches the predicted one?
  - Do native Japanese speakers show **impossible-nativization effects**?
Overview

● Results
  ○ Speakers have a hierarchy of foreignness that is approximately like the predicted one
  ○ Most participants showed nativization preferences that look like impossible nativization effects
  ○ Not all participants had a consistent hierarchy across all constraint pairs

● Theoretical implications/future questions
Hierarchy of foreignness

- When words are borrowed, the phonological structure of the words is modified
- The existing loanwords often show that once-nativized foreign properties become more accepted and preserved
- This gradual phonological nativization aspect yields a “hierarchy of foreignness” (Kiparsky 1968)
  - Some non-native properties are seen as “more foreign” than others
A hierarchy of foreignness shows clear **implicational relations**

- Nativization of the phonological property B implies nativization of the phonological property A, but not vice versa (Kiparsky 1968)

- Ito & Mester (1995ab, 1999) argue that the phonological lexicon is organized in a **core-periphery structure**
Core-periphery structure

- Core-periphery structure has
  - Core stratum = lexical subclass in which the maximum number of markedness constraints are enforced
  - More peripheral strata = these phonological constraints gradually become dominated
Core-periphery structure

- Formal analysis of core-periphery structure (I&M 1999)
  - Markedness constraints form a **single hierarchy**: $A \gg B \gg C$
  - Stratum-specific faithfulness constraints model stratum-specific behavior

![Diagram of core-periphery structure]

**Diagram Notes**
- Constraints B & C dominated, constraint A
- Constraint C dominated, constraint A & B enforced
- Constraints A, B, & C enforced
Productivity of core-periphery structure

- Just a historical record of linguistic change? Or a productive part of the synchronic phonology?
- What kind of evidence would suggest a productive core-periphery structure?
Productivity of core-periphery structure

Evidence for productive core-periphery structure

● Stratum-specific phonological alternations (Ito & Mester 1999)
  ○ Is a phonological constraint that is violated in more-peripheral strata actively enforced in more-core strata?

● Another possible source of evidence is impossible-nativization effects (Ito & Mester 1999, 2001)
Impossible-nativization effects

● If the expected markedness constraint hierarchy is NoB » NoA
  ○ Possible: The nativization of B, but not A
  ○ Possible: The nativization of both A and B
  ○ Possible: The nativization of neither A nor B
  ○ **Impossible: The nativization of A, but not B**

● Given a choice of nativizing *only* A or *only* B, participants should consistently **prefer one option**
  ○ This is called an **impossible-nativization effect**
Japanese loanword phonology

- Japanese is rich in loanwords
- It is often described as having a stratified structure (e.g., McCawley 1968; Vance 1987; Ito & Mester 1995ab, 1999, Irwin 2011)
  - The lexical strata approximately correspond to etymological classes
Japanese loanword phonology

- We are most concerned with the following strata:
  - Native (the oldest)
  - Sino-Japanese (the second oldest)
  - Assimilated Foreign (the second newest)
  - Unassimilated Foreign (the newest)
Japanese loanword phonology

- These strata behave differently in terms of phonological properties
- There are five markedness constraints relevant to our study
  - The four strata can be distinguished by analyzing which of these constraints are dominated
Japanese loanword phonology

Constraints and definitions used here are adapted from the discussion in Ito & Mester (1999)

- **NoNT** Assign one * for every nasal-vcls obstruent sequence (Hayes 1999; Pater 2001)
- **NoP** Assign one * for every singleton [p]
- **NoDD** Assign one * for every voiced geminate obstruent
- **NoTI** Assign one * for every sequence of coronal plosive-[i]
- **NoSI** Assign one * for every sequence of coronal fricative-[i]
Japanese loanword phonology

- NoSI » {NoTI, NoDD} » NoP » NoNT
- The enforcement of these constraints is shown by active alternations (see, e.g., Ito & Mester 1999 for examples)
Interim summary

- The Japanese lexicon supports the phonological constraint hierarchy of NoSI » {NoTI, NoDD} » NoP » NoNT

- But do native Japanese speakers also have a productive grammar like this?
  - Do native Japanese speakers show this hierarchy of foreignness?
  - Do native Japanese speakers show impossible-nativization effects?
Experiment design

● Nonce loanword nativization experiment: Japanese loans from English nonce words
  ○ Methodology based on Pinta’s (2013) Guarani experiment
  ○ We added audio stimuli

● Task: Given...
  ○ a nonce loan that violates two constraints
  ○ two response options, each satisfying one constraint
Which constraint is satisfied at the expense of the other?
Experiment design

Predictions:

- If the ‘hierarchy of foreignness’ supported by alternations in lexical strata is productive:
  - Participant preferences should match
    NoSI » \{NoTI, NoDD\} » NoP » NoNT

- If core-periphery structure is productive:
  - Each participant should follow some consistent hierarchy (impossible-nativization effects)
  - This need not be the same for all participants
Experiment design

Stimuli

• 5 constraints (NoSI, NoTI, NoDD, NoP, NoNT)
  ○ All possible pairwise comparisons
    → 10 constraint pairs

• For each constraint pair
  ○ Four English-like nonce words
  ○ Order of constraint violations counterbalanced
Experiment design

Example: Nonce loans and responses for NoP versus NoSI

● The “repairs” /si/ → [ɕi] and /p/ → [h] occur in existing words

<table>
<thead>
<tr>
<th>English nonce word</th>
<th>Satisfies only NoSI</th>
<th>Satisfies only NoP</th>
</tr>
</thead>
<tbody>
<tr>
<td>/si/ → [ɕi]</td>
<td>[pimsɪl]</td>
<td>[pimwɕirw]</td>
</tr>
<tr>
<td>/p/ → [h]</td>
<td>[polsɪft]</td>
<td>[horwsɪfɔto]</td>
</tr>
<tr>
<td>sifpem</td>
<td>[ɕɪfɛm]</td>
<td>[ɕɪfəɾpɛməs]</td>
</tr>
<tr>
<td>silpesk</td>
<td>[ɕɪlpɛsk]</td>
<td>[ɕɪɾpɛɾpeswkw]</td>
</tr>
</tbody>
</table>

● Epenthesis and vowel nativizations, etc., as required for phonotactics
Experiment design

Three practice items

- For familiarity with the task of choosing one nativization
  - Only one M constraint involved in each practice item

- One real loan, two nonce loans
  - Real loan is controversial (gives task a context)

  \[ \text{Twitter} \quad [\text{twɪɾə}] \rightarrow [\text{tswɪttaː}] \sim [\text{twɪttaː}] \]

- Other design details
  - Stimuli presented as audio, orthography; audio could be replayed
  - Order of response choices was counterbalanced
  - Sequence of stimuli was randomized for each participant
Experiment design

Example screen from experiment

借用語に関する調査

下の借用（カタカナ語として導入）したい英単語の音声を聞いてください。音声は何度でも聞くことができます。

pimsll

どちらの借用（カタカナ語）がより自然な日本語ですか？より自然な方を選んでください。

ピムスイル

ピムシル

次へ進む
Experiment design

Example screen from experiment (translation)
Experiment design

- Experiment carried out over the internet
- Preceded by an audio-check question
  - Is participant using audio?
  - Does participant understand Japanese?
- Followed by a brief questionnaire
  - demographic information
  - participant’s strategies used in experiment
Experiment design

Participants: $n=40$

- Recruited via Facebook and email
- Self-reported native speakers of Japanese, raised in Japan, over age 18
- Gender: female: 26 | male: 13 | unspecified: 1
- Age: birth year range 1959 (age 58)–1997 (age 20)
  - Median 1985 (age 32)
Experiment design

Participants: $n=40$

- Education:
  
<table>
<thead>
<tr>
<th>Educational Level</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>High school graduate</td>
<td>1</td>
</tr>
<tr>
<td>Tech school/junior college</td>
<td>2</td>
</tr>
<tr>
<td>4-yr university in progress</td>
<td>7</td>
</tr>
<tr>
<td>4-yr university degree</td>
<td>17</td>
</tr>
<tr>
<td>MA program in progress</td>
<td>1</td>
</tr>
<tr>
<td>MA degree</td>
<td>5</td>
</tr>
<tr>
<td>PhD program in progress</td>
<td>3</td>
</tr>
<tr>
<td>PhD degree</td>
<td>4</td>
</tr>
</tbody>
</table>
Predictions—recap

- If the ‘hierarchy of foreignness’ supported by alternations in lexical strata is productive:
  - Overall, participant responses should match
    NoSI » {NoTI, NoDD} » NoP » NoNT

- If core-periphery structure is productive:
  - Each participant should have some consistent hierarchy of preferences (impossible-nativization effects)
  - This need not be the same for all participants
Results (1): Hierarchy of foreignness

- Stratum-specific alternations predict hierarchy as follows: NoSI » {NoTI, NoDD} » NoP » NoNT
  - Did each constraint pair match the predicted outcome?
- Pooled results approximately support the above hierarchy
- Main differences:
  - One reversal of an expected ranking
  - Additional variability in the middle range
Results (1): Hierarchy of foreignness

Did each constraint pair match the predicted outcome?

Points of agreement | **NoSI** » {**NoTI, NoDD**} » **NoP** » NoNT

- NoSI very highly prioritized
- NoTI and NoDD varied both *between* and *within* participants
- NoSI, NoTI, NoDD all higher than NoP
Results (1): Hierarchy of foreignness

Did each constraint pair match the predicted outcome?

<table>
<thead>
<tr>
<th>NoSI » NoTI → NoDD » NoNT → NoP</th>
<th>Points of difference</th>
<th>NoSI » {NoTI, NoDD} » NoP » NoNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>● NoP was prioritized below NoNT: NoNT » NoP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>● NoNT also varied with NoTI and NoDD: {NoTI, NoDD, NoNT}</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Results (1): Hierarchy of foreignness

In summary:

● Stratum-specific alternations predict M hierarchy
  NoSI » {NoTI, NoDD} » NoP » NoNT

● Pooled results support the following hierarchy
  NoSI » {NoTI, NoDD, NoNT} » NoP
  ○ As predicted: NoSI highest, NoTI ~ NoDD, NoP low(ish)
  ○ Reversal: NoNT » NoP
  ○ Variability: NoTI ~ NoDD ~ NoNT
Discussion (1): Hierarchy of foreignness

Consistently **high rank for NoSI** matches predictions

- Almost no evidence in existing loans that it is *ever* violated
- Very small number of (possible) exceptions:

  **Citibank** \[\text{Citibank} \rightarrow \text{citibank} \rightarrow ?\text{citibank}\]  
  Ito & Mester (1999: 77)

  **season** \[\text{season} \rightarrow \text{season} \rightarrow ?\text{season}\]  
  Irwin (2011: 84)

}s
Low rank for **NoP** is surprising: Should be **higher**—?

- Many \([h] \sim [p] (\sim [b])\) alternations in Native and SJ forms, with \([p]\) appearing only when \([pp]\) or \([mp]\)

  \[
  \begin{align*}
  \text{[nihai]} & \text{ ‘2 cups’ (SJ)} \\
  \text{[ippai]} & \text{ ‘1 cup’} \\
  \text{[sambai]} & \text{ ‘3 cups’}
  \end{align*}
  \]

  \(( [h] \text{ after vowel) } \text{ (geminate [p] ok) } \text{ (post-N voicing)} \)

  - Plausible analysis as \(/p/\) (e.g., McCawley 1968)
  - There is also a non-alternating \(/h/\)!

- Consequence: There should be *many* synchronic examples of NoP enforcement (=alternating \([h]\))
Discussion (1): Hierarchy of foreignness

But the story of [p] is actually more complicated

- Another stratum—Mimetic
  - Similar to Native in many ways
  - But does allow singleton [p] (morpheme-initially)
    - *pittari* ‘right on, precisely’, *pikapika* ‘bright, shiny’

- Anecdote: Japanese-speaking phonology students who encounter analysis of [h~p~b] as /p/ often seem surprised

- Is the [h~p~b] alternation now morphophonological?
Discussion (1): Hierarchy of foreignness

But the story of \[p\] is actually more complicated

- How illegal was singleton \[p\] before Foreign strata came in?
  - \[p\] was apparently never nativized even in the earliest ‘Foreign’ borrowings (Irwin 2011: 95–96)
    - for source \[p\], Irwin lists only Japanese \[p\] as a possible outcome
    - for loanword \[h\], Irwin does not list source \[p\] as a possible origin
Discussion (1): Hierarchy of foreignness

- Speakers may not have much of a productive restriction against [p], despite the [h~p~b] alternations
- Our nonce-loan nativization results support this view
  - NoP is consistently the lowest ranked
Discussion (1): Hierarchy of foreignness

**NoNT** also surprising: Higher, more variable than expected

- NoNT considered active in Native stratum only (I&M 1999)
- Unclear if NoNT is *truly* productive even for Native forms!
  - Alternations primarily occur in verbs (not nouns)
  - A few NoNT *violations* in Native stratum (K. Rice 1997)
    But: These forms are typically syncopated, so there may be output-output faithfulness to the unsyncopated variant (I&M 2003)
- On the other hand, some Sino-Japanese forms do exceptionally *undergo* postnasal voicing (Ito & Mester 2003)
  - Might be precedent for exceptional high rank (?) of NoNT
Discussion (1): Hierarchy of foreignness

In summary:

Pooled results across all subjects provide evidence for a hierarchy of foreignness

- The hierarchy differs somewhat from that predicted by stratum-specific alternations (as in Ito & Mester 1999)
  - NoSI very high (expected) — [si] is very ‘foreign’
  - NoP very low (unexpected) — [p] is not so ‘foreign’

- NoTI, NoDD, and NoNT are variable between speakers and apparently even within speakers
Discussion (1): Hierarchy of foreignness

In summary:

Pooled results across all subjects provide evidence for a **hierarchy of foreignness**

- Existing stratum-specific alternations may not be the only factor determining this hierarchy
- There are also individual differences among participants
If core-periphery structure is productive:

- Participants should show **impossible-nativization effects**
  - Given a choice of nativizing *only A* or *only B*, participants should consistently prefer one option

- The implicational relations between multiple pairs of constraints should be **transitive** (if $A \gg B$ and $B \gg C$ then $A \gg C$)
  - Each participant should follow *some* transitive hierarchy of preferences among nativizations
  - The hierarchy may not be the same for all participants
Results (2): Core-periphery structure

Participants should show **impossible-nativization effects** → Did each participant treat each constraint pair consistently?

- Participants were *likely* to have **uniform responses**
  - High proportion of constraint pairs (\(M_i, M_j\)) with 4/4 responses supporting \(M_i \succ M_j\) or \(M_j \succ M_i\)

- Participants were *unlikely* to have **constraint ties**
  - Low proportion of constraint pairs (\(M_i, M_j\)) with 2/4 responses supporting \(M_i \succ M_j\)
Results (2): Core-periphery structure

Participants were *likely* to have **uniform responses**

- No participants had 4/4 rankings for all 10 pairs
- 21/40 (52.5%) had 4/4 rankings for 6–9 pairs
  - 2/40 (5%) had 4/4 rankings for 9 pairs
  - 4/40 (10%) had 4/4 rankings for 8 pairs
  - 5/40 (12.5%) had 4/4 rankings for 7 pairs
  - 10/40 (25%) had 4/4 rankings for 6 pairs
Participants were likely to have **uniform responses**

- More uniform responses than would be expected if participants were choosing responses randomly
  - “Predicted distribution” is exact binomial probability

![Graph showing predicted vs. observed distribution of uniform responses.](image)
Results (2): Core-periphery structure

Participants were *unlikely* to have *constraint ties*

- 29/40 participants (72.5%) had at most 2 ties
  - 11/40 participants (27.5%) had no ties
  - 18/40 participants (45%) had ties for 1–2 pairs
- 11/40 participants (27.5%) had ties for 2–5 pairs
- No participants had ties for more than 5 pairs
Results (2): Core-periphery structure

Participants were *unlikely* to have **constraint ties**

- **Fewer** tied responses than would be expected if participants were choosing responses randomly
  - “Predicted distribution” is exact binomial probability

![Predicted vs. observed distribution of constraint ties](image)
Results (2): Core-periphery structure

Interim summary:

- We found that participant responses are more consistent than would be predicted by chance
- Thus, participants do often show impossible-nativization effects
Results (2): Core-periphery structure

If core-periphery structure is productive:

- The implicational relations between multiple pairs of constraints should be transitive (if A → B and B → C then A → C)
  - Each participant should follow some transitive hierarchy of preferences among nativizations
  - The hierarchy may not be the same for all participants
- We found that some, but not all, participants have a transitive hierarchy
Results (2): Core-periphery structure

Did each participant have a transitive hierarchy?

- Each participant has 4 responses for a given constraint pair
- Criteria for this analysis:
  - 4 or 3 “A » B” responses means A » B
  - 0 or 1 “A » B” responses means B » A
  - 2 “A » B” responses means A=B (tied; variable)

- Are all 10 pairs’ rankings transitive for each participant?
  - No inconsistencies, where A » B and B » C, but C » A
Results (2): Core-periphery structure

Only about half the participants have a transitive hierarchy

- constraint hierarchy is transitive (may include tied rankings) 17

- tied ranking(s); at least one is transitive, but at least one is inconsistent 8

- no transitive ranking 4 23

- more than two pairs of tied constraints (transitivity status unknown) 11
Discussion (2): Core-periphery structure

What factors predict transitive vs. inconsistent hierarchies?

- More likely to have transitive rankings
  - Participants who rated the task as ‘hard’
  - Participants who used more-implicit strategies—?

- No effect was found for...
  - Age
  - Dialect region
  - Education level or amount of English exposure
  - Self-reported use of audio vs. orthography in task
Discussion (2): Core-periphery structure

Significant effect of ‘ease’ rating

<table>
<thead>
<tr>
<th></th>
<th>‘easy’</th>
<th>‘hard’</th>
</tr>
</thead>
<tbody>
<tr>
<td>inconsistent</td>
<td>10</td>
<td>13</td>
</tr>
<tr>
<td>transitive</td>
<td>2</td>
<td>15</td>
</tr>
</tbody>
</table>

Fisher’s exact test: $p=0.041$

- Participants who found the task ‘hard’ were more likely to have transitive rankings
Discussion (2): Core-periphery structure

Possible effect of implicit vs. explicit strategies

- Implicit vs. explicit processing of experiment tasks can produce qualitatively different response patterns (Moreton & Pertsova 2016)
  - Implicit processing — ≈ intuition
  - Explicit processing — ≈ problem-solving

- Participants who respond on the basis of “intuition” might be more likely to be accessing their phonological grammar
Discussion (2): Core-periphery structure

Possible effect of implicit/explicit strategies

Strategies: Made reference to...

- Sounding natural [4]
- Nonsegmental factors [3]
  (note: these were actually controlled!)
- Similarity to existing loans [2]
- Multiple strategies mentioned [2]
- “None” [8] or no response [8]
- Avoiding specific segments [8]
- Sound similarity [3]
- Orthography [2]
Discussion (2): Core-periphery structure

- Caveat: Numbers of participants in these categories are small
- Strategies with high proportions of “transitive” rankings seem likely to be implicit
  - “Sounding natural” — looks like intuition
  - Nonsegmental factors, such as pitch accent, were controlled — participants who thought they were using these probably weren’t really doing so
- Some of the strategies with low proportions of “transitive” rankings seem likely to be explicit
  - Orthography
  - Avoiding specific segments
Discussion (2): Core-periphery structure

In summary:

- Participants show **impossible-nativization effects**
  - Responses to constraint pairs are largely consistent
  - ∴ Participants prefer some nativizations over others

- But: Only about half of the participants had **transitive** implicational relations across constraint pairs
  - Use of explicit strategies in the experiment may have masked participants’ true grammars (needs further study)

- **Some (not all) participants have core-periphery structure**
Conclusions and implications

● Result (1): Pooled results across all subjects provide evidence for a hierarchy of foreignness — but:
  ○ Existing alternations do not entirely predict the hierarchy
  ○ There are individual differences among participants

● Future directions: Why a different hierarchy?
  ○ Reexamine the true productivity of alternations?
  ○ Role for surface frequency of ‘foreign’ structures?

● Future directions: Why individual differences?
  ○ Role for sociolinguistic factors in what feels ‘foreign’?
Conclusions and implications

● **Result (2):** Some (but not all) participants have **productive core-periphery structure**
  ○ Participants do show **impossible-nativization effects**
  ○ But: Only **transitive** for about half of the participants

● Future directions: Why non-transitive results?
  ○ True transitivity masked by use of **explicit strategies**?

● What if the lack of transitivity is really in the **grammar**?
  ○ Implications for theoretical analysis of stratal phonology
  ○ **Faithfulness ranking** that changes across strata? (contra Ranking Consistency; Ito & Mester 1999)
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