OCP Effects in Turkish Partial Reduplication: Locality and Feature Specificity

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January 14, 2018
Turkish Partial Reduplication: Goals

Goals for today:

▶ We will re-examine the locality and feature specificity of the OCP effects in Turkish Partial Reduplication
▶ Methodologically, we will demonstrate that we can better understand the nature of the OCP effects
   ▶ by analysing a large sample of items
   ▶ by modelling the effects using regression
Turkish Partial Reduplication

- Turkish is an agglutinative language, with the majority of derivation achieved through suffixation.
- A rare instance of prefixation is the *partial reduplication* (or *emphatic reduplication*) found with modifiers, namely adverbs and adjectives.

\[(1) \quad \text{kara} \quad \text{‘black’} \quad \text{kap-kara} \quad \text{‘very black’} \]
\[
\text{belli} \quad \text{‘clear’} \quad \text{bes-belli} \quad \text{‘obvious’}
\]
Emphatic reduplication

- Emphatic variants are derived by prefixing a CVC syllable

<table>
<thead>
<tr>
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<th>Reduplication</th>
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<tbody>
<tr>
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<td>'very black'</td>
</tr>
<tr>
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</tr>
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</tr>
<tr>
<td>temiz</td>
<td>te-r-temiz</td>
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Emphatic reduplication

- Emphatic variants are derived by prefixing a CVC syllable
- The initial CV are identical to the word-initial CV of the base

((Lewis, 1967), call it linking consonants (LC).

(2)

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Emphatic reduplication

- Emphatic variants are derived by prefixing a CVC syllable
- The initial CV are identical to the word-initial CV of the base
- The reduplicant C ends in one of the four consonants: \(-p, -m, -s, -r\) (Lewis, 1967), call it *linking consonants (LC)*.

(2)

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</tr>
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**General points**

- The choice of the LC is not arbitrary or lexicalized
- It is subject to several dissimilation constraints or OCP (Leben, 1973; McCarthy, 1986; Odden, 1988, a.o.)
Demircan (1987) makes the following observations:

(i) The linker cannot be identical with any of the consonants in the base.

(ii) No gemination: the linker should not be identical to the C₁ of the base.

(iii) Avoid full reduplication: The linker cannot be identical with C₂ of the base with C₁VC₂ items.

(iv) Featural identity avoidance: the features of the linker should not be identical to C₂ of the base.
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(i) The linker cannot be identical with any of the consonants in the base.

(ii) No gemination: the linker should not be identical to the $C_1$ of the base. *sas + sari

(iii) Avoid full reduplication: The linker cannot be identical with $C_2$ of the base with $C_1VC_2$ items.

(iv) Featural identity avoidance: the features of the linker should not be identical to $C_2$ of the base.
Previous analyses: Kelepir (2000)

Kelepir (2000)

- Not only $C_1$ of the base, but also $C_2$ matters, (3).

(3)  
  a. **yeni** ‘new’  
  b. **yeşil** ‘green’

$yep$-**yeni** ‘completely new’  
$yem$-**yeşil** ‘completely green’

(Kelepir, 2000, 11)
Previous analyses: Kelepir (2000)

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- Not only $C_1$ of the base, but also $C_2$ matters, (3).

(3)  
  a. *yeni* ‘new’  
  b. *yeşil* ‘green’

$yep$-*yeni* ‘completely new’  
$yem$-*yeşil* ‘completely green’

(Kelepir, 2000, 11)

- The LC and $C_2$ of the base correspond with each other.
- Anti-faithfulness constraints force LC to be unfaithful to its correspondent in the base, following the Correspondence Theory

(McCarthy and Prince, 1995)
Previous analyses: Kelepir (2000)

Kelepir (2000)

- Base consonants contrast with their correspondent in the reduplicant in **Place and sonorancy**.

(4)

<table>
<thead>
<tr>
<th>/\texttt{RED} - kuru/ ‘dry’</th>
<th>*\texttt{COR}\textsc{\textasciitilde}\texttt{COR}</th>
<th>*\texttt{\alpha\textsc{SON}}\textsc{\textasciitilde} \texttt{\alpha\textsc{SON}}</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. \texttt{\textbf{\textcircled{u}} kup}\text{-kuru}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. \texttt{kum}\text{-kuru}</td>
<td></td>
<td>*!</td>
</tr>
<tr>
<td>c. \texttt{kus}\text{-kuru}</td>
<td>*!</td>
<td></td>
</tr>
</tbody>
</table>

(Kelepir, 2000, 13)
The studies converge on the importance of $C_1$ and $C_2$, but the rest of the base is usually disregarded.
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- e.g. Wedel (1999, 2000) explicitly mentions that there should be a cut-off after $C_2$.
- This relates to *distance-based decay* (Zymet, 2014), in which the likelihood for the application of a phonological process decreases as transparent distance increases.
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- This relates to *distance-based decay* (Zymet, 2014), in which the likelihood for the application of a phonological process decreases as transparent distance increases.

The choice of the relevant features is usually heuristic.
Review of previous methodologies

Table: A summary of the data examined in 10 previous studies

<table>
<thead>
<tr>
<th>Sources</th>
<th>Intuition</th>
<th>Experiment</th>
<th>Type of Experiment</th>
<th># of Participants</th>
<th># of Items</th>
<th>Item Types</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hatiboğlu (1973)</td>
<td>Yes</td>
<td>No</td>
<td>-</td>
<td>-</td>
<td>142</td>
<td>Real</td>
</tr>
<tr>
<td>Demircan (1987)</td>
<td>Yes</td>
<td>Yes</td>
<td>Forced-Choice (FC)</td>
<td>100</td>
<td>130</td>
<td>Real (110), Nonsense (20)</td>
</tr>
<tr>
<td>Dobrovolsky (1987)</td>
<td>Yes</td>
<td>No</td>
<td>-</td>
<td>-</td>
<td>9</td>
<td>Real</td>
</tr>
<tr>
<td>Taneri (1990)</td>
<td>-</td>
<td>Yes</td>
<td>FC</td>
<td>32</td>
<td>300</td>
<td>Real</td>
</tr>
<tr>
<td>Wedel (1999)</td>
<td>Yes</td>
<td>Yes</td>
<td>FC</td>
<td>-</td>
<td>125 + 80</td>
<td>Real</td>
</tr>
<tr>
<td>Yu (1999)</td>
<td>Yes</td>
<td>No</td>
<td>-</td>
<td>-</td>
<td>152</td>
<td>Real</td>
</tr>
<tr>
<td>Kelepir (2000)</td>
<td>Yes</td>
<td>No</td>
<td>-</td>
<td>-</td>
<td>89</td>
<td>Real</td>
</tr>
<tr>
<td>Sofu (2005)</td>
<td>-</td>
<td>Yes</td>
<td>FC</td>
<td>25 adults, 89 children</td>
<td>38</td>
<td>Nonsense</td>
</tr>
<tr>
<td>Sofu and Altan (2008)</td>
<td>-</td>
<td>Yes + Corpus</td>
<td>FC</td>
<td>80</td>
<td>132</td>
<td>Real</td>
</tr>
<tr>
<td>Kaufman (2014)</td>
<td>-</td>
<td>Yes</td>
<td>1-FC, 2-Rating</td>
<td>1-16, 2-50</td>
<td>1-44, 2-45</td>
<td>1-Nonsense, 2-Real</td>
</tr>
</tbody>
</table>

- The judgements are often based on the researcher’s intuitions only.
- The experiments are exclusively designed for Forced-Choice.
This study I

Re-examined the nature of (i) similarity and (ii) proximity of OCP

- Feature – by quantitatively examining all features, rather than heuristically.
- Locality – all consonants in the base, not just $C_1$ and $C_2$
This study II

Employed both the **forced-choice task and the rating task** (this talk)

- Many bases have alternative LCs across participants in the forced-choice task, namely, quite a bit of variation (see also Wedel 1999, 2000)

- Most studies did not utilize the rating task
Modelled the OCP effects using regression following Graff and Jaeger (2009) which analysed the effect of OCP on the generative potential of syllable types of Javanese, Dutch and Aymara.

- Allowing us to statistically examine a number of competing OCP factors as well as nuisance factors
Research questions and Roadmap

- **Feature specificity**: How is the OCP effect specified?
- **Positional specificity**: What is the scope of the OCP effect? Does it stop after C2? Is there a decay in strength by proximity?
- **Syllable structure**: Does the syllable structure of the base form interact with the relative strength of the OCP effects of each consonant position? If so how?
162 items were tested.

These items were evenly divided into 5 lists.

Each participant was asked to perform both a rating task and a forced-choice task (not reported in this talk). The order of the tasks was randomized.
For each base form, all four of its reduplicated forms (each with a different LC) were shown on the same screen. The order of these forms was randomized per participant.

Items were presented orthographically.

Each reduplicated form was rated on a scale of naturalness: DOĞAL DEĞİL ‘not natural’ [1 to 7] DOĞAL ‘natural’
Data was collected using Experigen (Becker and Levine, 2010).

209 participants were analysed (out of the 283 participants tested).

- Filters: Turkish as L1; born in Turkey; no language-related disorders; reported their gender, education level and whether or not they have linguistic training.

- Each item was rated by at least 40 participants.
At what level of granularity do we expect OCP to operate over?

- **Total identity**
  - Sometimes total identity is permitted in languages with strong OCP effects.  \(\text{(MacEachern, 1999)}\)
  - Total identity should be treated separately from partial identity  \(\text{(Gallagher and Coon, 2009)}\)

- **Partial identity**
  - Sum of matched features – assuming each matched feature has the same weight
  - Individually matched features – allowing each matched feature to weigh freely
Focused on CONSONANT INITIAL items in the base

Divided our consonant initial items into three groups by the number of consonants they contain in the base form.

- $42 \times C_1 C_2$
- $57 \times C_1 C_2 C_3$
- $30 \times C_1 C_2 C_3 C_4$
For each group of items, we determined the level of feature specificity by:

- Using mixed effects modelling with `lmer` (Bates et al., 2015) in R
- Fitting five models with different specifications of OCP factors
- Conducting model comparisons using Akaike Information Criterion
  - AIC (Akaike, 1987) rewards the goodness of model fit and penalizes the number of estimated parameters.
  - The results are the same with Bayesian information criterion (BIC).

The lower the better!
Model formation

Rating \sim

**OCP factors**

Model_{ID}: \text{IDEN}(C_i) + \ldots

**Nuisance factors**

+ BIGRAM FREQ. + PREVIOUS RATING
+ (1| LC) + (1| SYLL. STRUCTURE) + (1| SPEAKER) + (1| ITEM)
Model formation

Rating $\sim$

**OCP factors**

Model$_{ID}$: $\text{IDEN}(C_i) + \ldots$

Model$_{SF}$: $\text{SUMFEAT}(C_i) + \ldots$

**Nuisance factors**

$+ \text{BIGRAM FREQ.} + \text{PREVIOUS RATING}$

$+ (1|\text{LC}) + (1|\text{SYLL. STRUCTURE}) + (1|\text{SPEAKER}) + (1|\text{ITEM})$
Model formation

Rating $\sim$

**OCP factors**

- Model_{ID}: $\text{IDEN}(C_i) + \ldots$
- Model_{SF}: $\text{SUMFEAT}(C_i) + \ldots$
- Model_{IF}: $\text{INDFEAT}(C_i) (\text{SON}(C_i) + \text{ANT}(C_i) + \text{COR}(C_i) + \text{LAB}(C_i) + \text{CONT}(C_i) + \text{STRID}(C_i) + \text{NAS}(C_i) + \text{VOICE}(C_i)) + \ldots$

**Nuisance factors**

- $+ \text{BIGRAM FREQ}.$
- $+ \text{PREVIOUS RATING}$
- $+ (1| \text{LC}) + (1| \text{SYLL. STRUCTURE}) + (1| \text{SPEAKER}) + (1| \text{ITEM})$
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Rating ~

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Model$_{ID+SF}$: $\text{IDEN}(C_i) + \text{SUMFEAT}(C_i) + \ldots$

**Nuisance factors**

+ BIGRAM FREQ. + PREVIOUS RATING
+ (1| LC) + (1| SYLL. STRUCTURE) + (1| SPEAKER) + (1| ITEM)
Model formation

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**OCP factors**

Model_{ID}: \textbf{IDEN}(C_i) + \ldots

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Model_{ID+SF}: \textbf{IDEN}(C_i) + \textbf{SUMFEAT}(C_i) + \ldots

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**Nuisance factors**

+ \text{BIGRAM FREQ.} + \text{PREVIOUS RATING}
+ (1| \text{LC}) + (1| \text{SYLL. STRUCTURE}) + (1| \text{SPEAKER}) + (1| \text{ITEM})
## Model comparison: AIC

### Table: Model comparison for feature specificity: AIC

<table>
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<tr>
<th>Model</th>
<th>ID</th>
<th>SF</th>
<th>IF</th>
<th>ID+SF</th>
<th>ID+IF</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>17025.01</td>
<td>16709.70</td>
<td>16157.00</td>
<td>16564.84</td>
<td>16074.27</td>
</tr>
</tbody>
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### Table: Model comparison for feature specificity: AIC

<table>
<thead>
<tr>
<th>Model</th>
<th>C1C2</th>
<th>C1C2C3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model ID</td>
<td>17025.01</td>
<td>23551.39</td>
</tr>
<tr>
<td>Model SF</td>
<td>16709.70</td>
<td>22911.93</td>
</tr>
<tr>
<td>Model IF</td>
<td>16157.00</td>
<td>22150.26</td>
</tr>
<tr>
<td>Model ID+SF</td>
<td>16564.84</td>
<td>22550.91</td>
</tr>
<tr>
<td>Model ID+IF</td>
<td>16074.27</td>
<td>21869.73</td>
</tr>
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</table>
Model comparison: **AIC**

<table>
<thead>
<tr>
<th>Model</th>
<th>$C_1 C_2$</th>
<th>$C_1 C_2 C_3$</th>
<th>$C_1 C_2 C_3 C_4$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model $ID$</td>
<td>17025.01</td>
<td>23551.39</td>
<td>12173.19</td>
</tr>
<tr>
<td>Model $SF$</td>
<td>16709.70</td>
<td>22911.93</td>
<td>12039.80</td>
</tr>
<tr>
<td>Model $IF$</td>
<td>16157.00</td>
<td>22150.26</td>
<td>11392.33</td>
</tr>
<tr>
<td>Model $ID+SF$</td>
<td>16564.84</td>
<td>22550.91</td>
<td>11712.59</td>
</tr>
<tr>
<td>Model $ID+IF$</td>
<td>16074.27</td>
<td>21869.73</td>
<td>11156.53</td>
</tr>
</tbody>
</table>
Model $ID + IF$ consistently yielded best fit across item groups ($C_1C_2, C_1C_2C_3$ and $C_1C_2C_3C_4$).

This indicates that both total identity and partial identity played a role.

Crucially OCP of individual features are weighted differently.

This is consistent with Graff and Jaeger (2009)’s findings.
Previous work converge on the importance of $C_1$ and $C_2$. The rest of the base ($C_3$, $C_4$ ...) is usually disregarded.

- Suggested that the dissimilation effect ceases abruptly after $C_2$ (Wedel, 2000) ($yalpak$, $garip$, and $kelepir$ all favour ‘p’ as the LC)
- Re-examine the importance of consonants beyond $C_2$ (namely $C_3$ and $C_4$)
Statistical modelling

- Starting with the superset model with OCP predictors associated with all consonants
- **Drop OCP predictors** that are associated with each consonant position in bulk
- Model comparison using AIC (obtained the same results with BIC, and likelihood $\chi^2$-test)
**Model comparison: AIC**

\[ \Delta \text{AIC}: \text{AIC}_{\text{subset}} - \text{AIC}_{\text{superset}} \]

- A \( \Delta \text{AIC} \) of > 2 indicates a significant difference.
- The higher the \( \Delta \text{AIC} \), the more important the dropped consonant is.

**Table: Model comparison: AIC_{subset} - AIC_{superset}**

<table>
<thead>
<tr>
<th></th>
<th>( C_1C_2 )</th>
<th>( C_1C_2C_3 )</th>
<th>( C_1C_2C_3C_4 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drop C₁</td>
<td>779.21</td>
<td>1639.22</td>
<td>607.54</td>
</tr>
<tr>
<td>Drop C₂</td>
<td>835.34</td>
<td>1151.18</td>
<td>361.02</td>
</tr>
<tr>
<td>Drop C₃</td>
<td>–</td>
<td>514.86</td>
<td>165.22</td>
</tr>
<tr>
<td>Drop C₄</td>
<td>–</td>
<td>–</td>
<td>356.50</td>
</tr>
</tbody>
</table>
Feature specificity: Summary I

- All $\Delta$AIC were well above 2.
- Importantly, unlike what all the previous work have suggested (Demircan, 1987; Kelepir, 2000; Wedel, 2000), these findings show that the OCP effect operates well beyond $C_2$.

- For instance, beyaz ‘white’ and bayat ‘stale’ have identical consonants except for $C_3$ ([z] vs. [t]) (n.b. vowels identity do not matter (Yu 1999)),

- The LC [s] is only dispreferred with beyaz (z-rating: 0.1124), while it is the most preferred LC with bayat (z-rating: 1.1019).
Interestingly, distance decay does not always play a role. ∆AIC does not necessarily drop as distance increases.

With $C_1 C_2$ items, there is an increase in importance from $C_1$ to $C_2$.

With $C_1 C_2 C_3 C_4$, $C_4$ was more important than $C_3$.

Perhaps the OCP effect interacts with syllable structures?

e.g. *derin* vs. *durgun*
To establish whether the OCP effects interact with syllable structures, we

- fitted new models with interaction terms between syllable structure and each of OCP factors
- performed model comparisons to see if these interaction terms contribute significantly to the model fit

These comparisons suggest that syllable structures interact with OCP
- Given the interaction, we repeated the analyses of positional specificity on each type of syllable structures.
For statistical reasons, we focused on the syllable structures that have sufficient number of word types (> 10).

<table>
<thead>
<tr>
<th>Number of Consonants</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>C₁VC₂ (23)</td>
<td>C₁VC₂VC₃ (37)</td>
<td>C₁VC₂C₃VC₄ (20)</td>
<td>C₁VC₂VC₃C₄VC₅ (5)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C₁VC₂V (19)</td>
<td>C₁VC₂C₃V (14)</td>
<td>C₁VC₂VC₃V (4)</td>
<td>C₁VC₂VC₃VC₄V (1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>C₁VC₂C₃V (4)</td>
<td>C₁VC₂VC₃VC₄V (1)</td>
<td>C₁VC₂C₃VC₄V (1)</td>
<td></td>
</tr>
</tbody>
</table>
As we will see, the patterns can be explained with a combination of two factors:

- Distance decay
- Coda vs. Onset

We speculate that both of these factors are at work.
Analyses: Syllable structure: $C_1VC_2V$ and $C_1VC_2$

Variable importance: $C_1VC_2V$ and $C_1VC_2$
Analyses: Syllable structure: $C_1VC_2VC_3$ and $C_1VC_2C_3V$

Variable importance: $C_1VC_2VC_3$ and $C_1VC_2C_3V$
Analyses: Syllable structure: \( C_1VC_2C_3VC_4 \)

Variable importance: \( C_1VC_2C_3VC_4 \)
Why Coda > Onset? LC itself is also a coda consonant.
Why Coda $>$ Onset? LC itself is also a coda consonant.

An example: $sìk$ ‘tight’ vs. $sìkì$ ‘frequent’

- $C_2$ /k/ should disprefer LC [p]
- $C_2$ /k/ in $sìk$ should disprefer LC [p] more than that in $sìkì$.

Averaged by-participant z-normalised rating:

- $sip + sik$ (0.1023) is less acceptable than $sip + sìkì$ (0.7715)
OCP constraints are more graded than they have been previously proposed.

The OCP constraints need to treat individual features as free parameters in the similarity computation across all consonants in the base.
Position in syllable structures interact conditions the OCP effects.

The strength of OCP is a function of both the proximity from LC and whether the consonant is a coda or not.
Acknowledgements

- Ryan Bennett (UCSC) for his generative feedback and suggestions during the development of the project
- John Harris (UCL) for inspirational discussions about the findings
- Andrew Nevins (UCL) for discussions on task effects
- Hezekiah Akiva Bacovcin (UPenn) for advice on statistical analyses
- Abstract reviewers of OCP 15th, OCP 14th and AMP 2017.

All errors remain our own.
Thank you & Teşekkür ederim!
On the whole, they are strongly correlated $R^2 = 0.85$.

The prominent rating differences at 0% (FC)

FC appears to be less variable in the unacceptable end of the rating spectrum
Wedel (1999, 2000) suggest the following generalizations and corresponding OT constraints:

- [p] is not selected if C1 is labial: \(^*_{\text{PLOSIVE-}\alpha\text{PL}}\)
- The interpolated consonant [LC] must be non-identical to C1: \(^*_{\text{GEM}}\)
- The interpolated consonant [LC] must be non-identical to C2: \(^*_{\text{REPEAT}}\)

(5)

<table>
<thead>
<tr>
<th>RED-{p,m,s} + /mest/</th>
<th>*REPEAT</th>
<th>*GEM</th>
<th>*PLOSIVE-(\alpha)PL</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. mes-mest</td>
<td>*!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. mem-mest</td>
<td></td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>c. mep-mest</td>
<td></td>
<td></td>
<td>*</td>
</tr>
</tbody>
</table>

(Wedel, 2000, (7))
The feature systems we use are based on Erguvanlı Taylan (2015). For our data set, the relevant features are:

- **Class:** SON
- **Place:** ANT, COR, LAB
- **Manner:** CONT, STRID, NAS
- **Voicing:** VOICE
Nuisance factors

- **Ease of articulation effect** (Demircan, 1987) / **Perceptual distinctiveness** (*GEM and *PLOSIVE-αPL) (Wedel, 2000)
  - Fixed Effect: Bigram frequency of LC + C₁
Nuisance factors

- **Ease of articulation effect** (Demircan, 1987) / **Perceptual distinctiveness** (*GEM and *PLOSIVE-αPL) (Wedel, 2000)
  - Fixed Effect: Bigram frequency of LC + C₁
- **Carry-over effects** from previous trials (Fecteau and Munoz, 2003)

- Syllable structure variations (e.g. CC items consists of CVC and CVCV)
  - Random effect: random intercept of syllable structure
- Speaker and item variations
  - Random effect: random intercept of speakers and items
Nuisance factors

- **Ease of articulation effect** (Demircan, 1987) / **Perceptual distinctiveness** (*GEM and *PLOSIVE-\(\alpha\)PL) (Wedel, 2000)
  - Fixed Effect: Bigram frequency of LC + \(C_1\)
- **Carry-over effects** from previous trials (Fecteau and Munoz, 2003)
  - Fixed Effect: Response of the previous trial
- **General preference for a particular LC** (cf. markedness constraints (Yu, 1999))
Nuisance factors

- **Ease of articulation effect** (Demircan, 1987) / **Perceptual distinctiveness** (*GEM* and *PLOSIVE-αPL*) (Wedel, 2000)
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- **Speaker and item variations**
  - Random effect: random intercept of speakers and items
Model comparison: AIC, BIC and $\chi^2$

- $C_1C_2$: 
  $\Delta AIC = 308.21$, $\Delta BIC = 191.88$, $\chi^2(17) = 386.39$, $p < 0.001$

- $C_1C_2C_3$: 
  $\Delta AIC = 567.12$, $\Delta BIC = 252.38$, $\chi^2(44) = 704.15$, $p < 0.001$

- $C_1C_2C_3C_4$: 
  $\Delta AIC = 592.39$, $\Delta BIC = 364.65$, $\chi^2(35) = 693.68$, $p < 0.001$
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- These comparisons suggest that syllable structures interact with OCP


Kelepir, M. (2000). To be or not to be faithful. In *Studies on Turkish and Turkic Languages: Proceedings of the Ninth International Conference on Turkish Linguistics*, pp. 11–18.


