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The Adaptation of English Initial Clusters by Persian Learners

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Abstract

This study presents an overview of the different strategies that Persian learners of English employ to deal with initial clusters. While vowel epenthesis appears to be the most widespread repair strategy to conform such clusters to Persian phonotactics, the location of the epenthetic vowel varies. In this paper, we investigate two approaches that seek to explain the epenthetic site. The first of these, based on the Sonority Sequencing Principle, does not offer a plausible account, in particular with respect to the repair of s + sonorant clusters. The second approach, based on Fleischhacker (2001, 2005), argues that the epenthetic site is based on maximal perceptual similarity between input and output. An experiment with Persian listeners is reported which confirms the crucial role of perceptual similarity. Finally, we cast this approach into an Optimality Theory framework, which will be seen to make the right predictions for words with triconsonantal clusters.

Keywords: loanword adaptation, repair strategies, sonority sequencing principle, perceptual similarity,optimality theory

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1. Introduction

Accounting for the present data, we found out that Optimality Theory (OT) which is the most recent theory applied in phonology would be the best. Although OT has been developed only recently (Prince & Smolensky 2004), it is related to a number of previous theories. Within approaches to an adult second language phonology, it combines a relational approach and an independent approach: it requires us to examine the adult's pronunciations of words as reflecting his first language independent phonological system, while also focusing on the ways that the adult's second language system matches or differs from the adult's first language system[1].

It is widely accepted that the phonotactics of one's native language influences the way a foreign language is pronounced (Lado, 1957). Depending on their native language, learners of English will use different ways to tackle the problem of adapting clusters. For example, Spanish speakers apply prothesis to deal with initial /s/ clusters (e.g. Carlisle, 1994), while speakers of Korean consistently use epenthesis (Nam and Southard 1994). It is not uncommon that different types of clusters are resolved in different ways (Fleischhacker 2001, 2005), raising the question whether other factors besides L1-phonotactics also play a role.

In this paper, we investigated how Persian learners of English typically deal with clusters in the target language. We observe there is some variation in repair strategy: in particular, the location where epenthesis takes place may vary, depending on the type of cluster under consideration. We examined two possible explanations for this variation: the first makes reference to Sonority Sequencing and fails to account for the appearance of a vowel in /s/ plus sonorant clusters. The second approach is based on Fleischhacker (2001), who proposes an account in terms of maximal perceptual similarity between input and output. It was shown that such an account was also appropriate for Persian, on the basis of an experiment carried out with Persian listeners. Finally, we translated our account into Optimality Theory constraints. The phonological ranks thus proposed were confirmed by the data, which could even be extended to deal with longer clusters such as those in *street*, etc.

1.1 Persian: Phonological preliminaries

Persian syllable structure conforms to the following formula:

(1) Persian syllable structure

(C) V (C (C))

Single-consonant onsets and complex codas are both allowed in Persian, although both are optional. If it is assumed that vowel-initial syllables must be preceded by a glottal stop (Samareh, 1998, among others), then the onset is not optional, but obligatory on the surface. The following examples illustrate the different syllable structures allowed in Persian:

(2) Examples of permitted syllables in Persian

V	u	'he, she'
CV	ĵɑ	'seat'
VC	ɑb	'water'
CVC	dær	'door'
CVCC	?æsb	'horse'
CVCC	dæst	'hand'

Persian has the following consonant and vowel system:

(3) Persian consonants and vowels

Consonants

p t k q ?
b d g
f s ŝ x h
v z ʒ
r č
ĵ
m n j
l

Vowels and diphthongs

i u
e o ei ou
æ ɑ

1.2 Sonority sequencing principle

Most traditional accounts of syllable structure assume that there is some hierarchical relationship between syllabic constituents: syllables are divided into onset and rhyme, while the rhyme itself is divided into nucleus and coda (e.g. Selkirk, 1982). Within onset and coda, the order of consonants is determined by their relative sonority: within the onset the sonority rises, while it falls in the coda (see Clements, 1990, among many others). This generalization is referred to as the Sonority Sequencing Principle (SSP). Although the concept of sonority is universal, slightly different sonority hierarchies have been adopted for different languages. The following sonority scale is fairly uncontroversial:

(4) Sonority scale

Obstruents – Nasals – Liquids – Glides – Vowels

Least sonorous …………………Most sonorous

Concerning the type of sonorant segments, Selkirk (1982) and Steriade (1982) assigned a sonority value to each sound segment allowing us to determine the sonority distance between consonants in clusters.

For the classes in (4), the sonority values shown in (5) can be adopted:

(5) Sonority values of consonant classes

Stops –	Fricatives –	Nasals –	Liquids –	Glides
1	2	3	4	5

In many languages, consonants must have a certain minimal sonority distance (s.d.) to be permissible. For instance, onset clusters with a large sonority distance, e.g. stops + glides (s.d. 4) are relatively more common than clusters with a small sonority distance, e.g. stop + stop (s.d.0) or nasal + liquid (s.d. 1) (Ladefoged 1982). The concept of sonority can also be used to determine whether epenthesis will take place and if so where. Singh (1985) argues that the epenthetic site is determined by the sonority profile of the cluster in question. Singh (1985: 273) observes that generally "an unacceptable word-initial consonant cluster is broken up by the insertion of a vowel before the more sonorous segment". Consequently, in a cluster with a rising sonority profile, a vowel is inserted into the cluster. This is referred to as ANAPTYXIS, and takes place in a cluster containing, for instance, an obstruent + sonorant. In a cluster with falling sonority, such as an /s/ plus stop cluster, a vowel is inserted before the sibilant, which is referred to as PROTHESIS. This pattern (anaptyxis in obstruent-sonorant clusters but prothesis in /s/ plus stops) is often found in the languages of the world (see again Fleischhacker 2001, 2005 for an overview).

1.3 Epenthesis in persian

After these preliminaries, we can examine the ways in which Persian learners treat clusters in English. The Persian data in (6) are reported in Fleischhacker (2001) and are confirmed by our own observations. They reveal that the anaptyctic or split pattern is the most common strategy of resolving stop + sonorant (TR) clusters.

(6) Anaptyxis in TR clusters

English target	Realization
black	[belæk]
class	[kelɑs]
drawer	[derɑver]
plaster	[pelɑster]
train	[teræn]

Singh's generalization, that "an unacceptable word-initial consonant cluster is broken up by the insertion of a vowel before the more sonorous segment" predicts that /s/ plus stop clusters should be resolved by prothesis. This is indeed what happens in Persian, as the data in (7a) show. However, the prediction is made that /sl-/ and /sn-/ clusters should be broken up by anaptyxis, because in these clusters the liquid and nasal are more sonorous than the fricative (recall (4)). However, this prediction is not borne out, as the data in (7b) show.

(7) a. Prothesis in clusters with /s/

English target	Realization
sport	[esport]
stamp	[estæmp]
Sri Lanka	[seri lɑnkâ]
swanhild	[sevɑnhild]

b. Anaptyxis in /sl-/ and /sn-/ words

English target	Realization
slide	[eslɑyd]
slow	[eslow[2]]
snack	[esnæk]
Smith	[esmit]

Any environment in which segments on the ends of the sonority scale behave differently from segments in an intermediate position on the sonority scale is prima facie evidence against the sonority approach to epenthesis. In the next section, we will therefore pursue an alternative account, based on perceptual similarity between English target word and realization.

1.4 Cluster dependent epenthesis asymmetries

Fleischhacker (2001, 2005) analyses a number of languages which show anaptyxis in some clusters and prothesis in others. Recall that in Persian prothesis takes place before sibilant + stop clusters while anaptyxis takes place in the case of stop + sonorant clusters and also, unexpectedly under a sonority-based approach, in /sl-/ and /sn-/ clusters. Fleischhacker (2001) also discusses the Persian pattern and observes that stop-liquid clusters are apparently more splittable than sibilant-liquid clusters. In Persian, all stop-liquid clusters are split up, but this is not the case for all sibilant-liquid clusters. For instance, a Persian speaker treats /sl/ differently from /sr/ (see 7a above). Fleischhacker (2001) argues that in languages displaying anaptyxis-prothesis asymmetries, the epenthesis site is chosen to maximize auditory similarity between the non-epenthesized input and the epenthesized output. Her claim is that the primary force at work in determining the epenthesis site is the goal of achieving the closest possible correspondence between input (i.e. target) and output (i.e. realization). In the absence of conflicting constraints, epenthetic vowels are located in minimally obtrusive contexts. In support of her claim, she presents two experiments with English listeners that corroborate her claim: for input obstruent + sonorant clusters, anaptyctic outputs are judged as sounding more like the input than prothetic outputs, and the opposite is true for input sibilant + stop clusters. The question is whether the idea of similarity between input and output can also resolve the location of epenthesis in s+sonorant clusters in Persian. To answer this question, we carried out a similarity judgement experiment with Persian listeners, reported on in the next section.

2. Methodology

2.1 Participants

The participants in this study were 45 students of both genders, randomly selected from a population of 150 students of English at Navid Language Institute, Yazd, Iran. They had studied English for two to four years formally in school and at the institute. The subjects were at the beginner, intermediate, and advanced levels (15 in each). Apart from the question whether our subjects would follow the principle of perceptual similarity, we were interested in the question whether different levels of proficiency in English would make a difference.

2.2 Procedure

The type of test was an auditory similarity judgment on the basis of an input form, which was read in three different ways by a female near-native speaker whose voice was recorded on tape. This experiment was designed to test three different categories of clusters:

a. s + stop clusters (ST)
b. s + sonorant clusters (SR)
c. obstruent + sonorant clusters (TR)

Most of the test items were verbs so that the subjects would not interpret the prothetic /ə/ as the indefinite article. The item types and the number of items for each category are illustrated in (8):

(8) Items	Number of items	Category
stop, stay, speak, spend, stand	**5**	**ST**
snort, snow, slide, smoke, slow	**5**	**SR**
train, claim, block, plan, drop	**5**	**TR**

Each ST, SR, and TR condition was associated with a prothetic and anaptyctic modification. For instance, in the case of ST clusters for an input like 'stop', three output forms [estop], [stop], and [setop] were provided on the tape. Before playing the tape, the instructor explained the task to be implemented. Each item was pronounced once, with a 5-second interval between items. Subjects were required to make an auditory similarity judgment between the output forms, and specifically to indicate the one that differed most from the other two. Similarly, three different output forms were also presented for the items in the other two categories, i.e. SR and TR, for which similarity judgements had to be made in the same way.

3. Results

An analysis of the answers revealed that in most cases, subjects judged similarity to be greatest between the target form and the usual Persian realization, rejecting the alternative that is not found[3]. Our statistical analysis is provided in the tables below.

Table 1.One-way ANOVA analysis of Persian speakers' performance on ST clusters

	Sum of Squares	Df	Mean Square	F	Sig
Between Groups	.133	**2**	6.667	1.050	.359
Within Groups	2.667	42	6.349		
Total	2.800				

The one-way ANOVA in Table 1 proves that the difference between the subjects in the three respective groups, concerning their performance on the perceptual similarity judgment of s + stop clusters, is not significant (F=1.050, P=.359). In other words, regardless of their language proficiency, all subjects performed similarly: all perceptually distinguished the input and its correspondent prothetic output form in the same way. For example, if the input form [stop], with the two possibilities [estop], [setop] was given to the subjects, most judged [stop] and [estop] to be most similar, as expected.

Table 2. One-way ANOVA analysis of Persian speakers' performance on SR clusters

	Sum of Squares	Df	Mean Square	F	Sig
Between Groups	.311	**2**	.156	1.581	.218
Within Groups	4.133	42	9.841		
Total	4.444	44			

Table 2 shows the performance of subjects with regard to the similarity judgment between the forms concerning SR clusters. As indicated in the table, there is no significant difference[4] at the .05 level (P=0.218) between the subjects in determining the input form beginning with SR clusters and its correspondent prothetic output form. For example, in the case of an input form like [snow], the prophetic output form [esnow] was judged to be most similar to the non-epenthesized form, whereas most subjects regarded [senow] as most dissimilar to the target.

Table 3. One-way ANOVA analysis of Persian speakers' performance on TR clusters

	Sum of Squares	Df	Mean Square	F	Sig
Between Groups	4.444	**2**	2.222	1.000	.376
Within Groups	.933	42	2.222		
Total	.978	44			

Table 3 shows that the subjects also did not differ significantly from each other on distinguishing two similar forms with TR clusters (P=0.376). For instance, they perceptually accepted the non-epenthesized input form [print] and the correspondent output form with anaptyxis to be the most similar, while rejecting the prothetic alternative [eprint]. The experiment shows that Persian speakers, regardless of proficiency level, regard the form in which epenthesis typically takes place as most similar to the target form. This shows that Fleischhacker's approach, which links the epenthesis site to the location where epenthesis is least perceptually intrusive, is on the right track. In the next section, we investigate how to translate this insight into an Optimality-theoretic framework.

3.1 Epenthesis in optimality theory

In Optimality Theory (Prince and Smolensky 2004), knowledge of language consists of knowing a universal set of structural constraints and their language-particular ranking. Constraints are mostly of two types: markedness constraints penalize structures which are less easy to articulate than alternative structures that do not violate these constraints (e.g. nasalized vowels are marked compared to oral vowels; syllables with a coda and marked compared to syllables without a coda; clusters are marked compared to single-consonant onsets) and faithfulness constraints penalize divergence from inputs. The constraint ranking computes the optimal output form (which will typically have violations of non-dominant constraints) for a certain candidate input (See e.g. Kager

(1999) for an introduction). Prothesis, the insertion of a vowel before a cluster, is one of the strategies that is applied to break up clusters. In Persian, prothesis happens in SC clusters (e.g. an input or target form 'snack', is adapted as [esnak]). In a rule-based framework, this can be expressed as follows:

(9) Epenthesis rule (prothesis)

Ø → [e] / __ SC

In OT, vowel epenthesis corresponds to a violation of the constraint DEP-IO, which militates against inserting a vowel, which makes inputs different from outputs. The general constraint is given in (13):

(10) DEP-IO

Assign a violation mark for any segment in the output that is not present in the input.

("No insertion")

If a constraint is violated (in this case, DEP-IO), there must be a higher-ranked constraint which is apparently more important. In this case, epenthesis is clearly triggered by the desire to avoid onset clusters. We will adopt the constraint in (14) for this purpose:

(11) *COMPLEX (ONSET) (*COMONS)

Assign a violation mark for any consonant cluster in the output.

("No onset clusters")

One other way (besides epenthesis) to satisfy the constraint in (14) would be too simply delete an onset consonant. This never happens in Persian. Since consonant deletion is never an option in the onset (although it might be a way of dealing with final consonant clusters in other parts of the grammar, cf. Karimi 1987), we assume the constraint in (15), which is also never violated in Persian:

(12) MAX-IO (ONSET) (MAXONS)

Assign a violation mark for any onset segment in the input which does not correspond to an onset segment in the output.

("No deletion in the onset").

Prominent positions are especially protected by faithfulness constraints, prominent positions are e.g. first syllables, stressed syllables or onsets. This can be related to the psycholinguistic prominence of such positions (Beckman 1998, Uffmann 2003, Van de Weijer 2009). How can we translate Fleischhacker's insight - borne out for Persian listeners in the previous section - that insertion, i.e. violation of DEP-IO, works in such a way that speakers preserve maximum similarity between target and realization into this framework? Fleischhacker (2001:10) provides evidence for the following scale along which languages adopt either prothesis or anaptyxis:

(13) ST

| ↑ Likelihood of prothesis
Sm
|
Sn
|
Sl
| ← Farsi
Sr
|
SY
| ↓ Likelihood of anaptyxis
TR

A language like Korean, which consistently applies prothesis, is located at the top end of the scale. Different languages will have different cut-off points in the hierarchy, but the strong prediction is that there are no languages which have, for instance, prothesis in /s/ plus stop clusters and obstruent plus sonorant clusters and anaptyxis for other clusters. Farsi applies prothesis in ST, sm, sn and sl- clusters and anaptyxis in the clusters 'below' sl-, i.e in sr-, s + glide and obstruent plus sonorant (see Fleischhacker 2001: 10). This scale can be translated into a family of DEP-IO constraints (cf. 13 above), following Fleischhacker. She proposes to relativize DEP-IO in such a way that it is sensitive to where a vowel is inserted. The general format of such constraints is given below:

(14) DEP-V/X_Y

A vowel present in the output context X_Y has a correspondent in the input context
X_Y.

Based on the scale in (16), different constraints can be ranked on a universal ranking scale:

(15) DEP-V/S_T»DEP-V/S_N»DEP-V/S_L»DEP-V/S_R»DEP-V/S_Y» DEP-V/T_R

S_T : s plus stop ; S_N : s plus nasal ; S_L : s plus lateral ; S_R : s plus rhotic ; S_Y : s plus glide ; T_R : obstruent plus sonorant

This hierarchy expresses that it is universally worse to insert a vowel into an s plus stop cluster than to insert a vowel into an s plus nasal cluster, which again is worse than inserting it into an s plus l cluster, which is worse than inserting it into an s plus r cluster, which, finally, is worse than inserting it into a stop plus sonorant cluster. In other words, the latter constraint, penalizing epenthesis into a stop + sonorant cluster, is most easily violated. Let us compare possible candidates for target realizations of the words *sport*, *class* and *snack*. The candidates that are not found are marked with a * in (19):

(16) ***sport*** ***[seport] / [esport]**
class **[kelas] / *[eklas]**
snack ***[senak] / [esnak]**

The difference between these competing outputs is that in the first forms there are no (nonword-final) consonant clusters at all, while the second candidates have medial consonant clusters. This should be ruled for words like *class*. One constraint that will achieve this is one that demands that all consonants must be prevocalic, formulated as follows by Fleischhacker (2001: 31):

(17) C/V

A consonant must be prevocalic

This constraint must be ranked lower than the constraint against epenthesis into /s/ plus stop and /s/ plus /l/ (or /n/) clusters, because in the outputs for such forms the C/V constraint is violated. Let us review the constraints involved in Farsi vowel epenthesis. In Farsi, the constraint *COMPLEX (ONSET) is never violated on the surface. It is also not possible to delete onset consonants, which would be a violation of MAX-ONSET. Both constraints are therefore undominated in the grammar. Epenthesis into SR- and TR- clusters is allowed but not into other types of clusters (s plus stop, s plus nasal, s plus l). We adduced the constraint

C/V in order to make this difference. This leads to the following constraint hierarchy for Farsi:

(18) *COMPLEX,MAX-IO (ONSET)

|

DEP-V/S_T » DEP-V/S_N » DEP-V/S_L »

|

C/V

|

DEP-V/S_R » DEP-V/S_Y » DEP-V/T_R

Let us illustrate this ranking on the basis of some of the words that we have seen so far:

(19) Evaluation of *class*

klas	*COMP	MAX-ONS	DEPV/S_T	DEPV/S_N	DEPV/S_L	C/V	DEPV/S_R	DEPV/S_Y	DEPV/T_R
klas	*!					*			
>kelas									*
eklas						*!			
las		*!							
ekas		*!	*	*					

This tableau shows that input forms like /klas/ cannot be pronounced unaltered because of high-ranked *COMPLEX. It is not an option to delete an onset consonant because of MAX-IO (ONSET). The form [kelas] is better than [eklas] because in the latter form the [k] does not precede a vowel: therefore this form violates the constraint C/V. The fact that [kelas] violates DEP-V/T_R is of no importance, because this constraint is low-ranked.

(20) Evaluation of *sport*

This tableau shows the influence of the constraint against inserting

sport	*COMP	MAX-ONS	DEPV/S_T	DEPV/S_N	DEPV/S_L	C/V	DEPV/S_R	DEPV/S_Y	DEPV/T_R
sport	*!					*			
seport			*!						*
>esport						*			
port		*!							
eport		*!							

vowels into a *s* plus stop cluster, DEP-V/S_T. Since this constraint is higher-ranked than the constraint C/V, the form [seport] is comparatively worse-formed than [esport]. The latter candidate therefore wins out, in spite of its CV/V violation.

(21) Evaluation of *snack*

snack	*COMP	MAX-ONS	DEPV/S_T	DEPV/S_N	DEPV/S_L	C/V	DEPV/S_R	DEPV/S_Y	DEPV/T_R
snack	*!					*			
senack				*!					
>esnack						*			
nack		*!							
enack		*!							

This tableau shows why *snack* is treated similarly to *sport*: [senak], with anaptyxis, is ruled out because of higher-ranked DEP-V/S_N. The fact that [esnak] violates C/V is, again, not crucial. The grammar so far, drawn up on the basis of biconsonantal clusters, also makes a prediction with respect to words starting with three consonants, such as *street* or *split*. How are these treated by Persian learners? The predicted output is a combined pattern of prothesis and anaptyxis (i.e. [esteri:t]), as the following tableau (from which we have omitted some non-crucial constraints for readability) shows:

(22) Prediction for /stri:t/

Stri:t	DEPV/S_T	C/V	DEPV/S_R	DEPV/S_Y	DEPV/T_R
seteri:t	*!				*
estri:t		**!			*
>esteri:t		*			

This prediction is correct (Fleischhacker 2001: 33). Other examples, from our own observations, include the following words (note that the epenthetic vowel is subject to vowel harmony):

(23) English target	**Realization**
strong	[esterâng]
stress	[esteres]
struggle	[esterâgel]
string	[esti:ring]
structure	[esterâkt□er]
spread	[espered]

We conclude that the OT analysis presented so far makes the right predictions for all cases known to us.

4. Implications

4.1 Theoretical significance

Recently, the development of the constraint-based framework of optimality theory has been adopted and applied to the assessment and treatment of adult foreign language learning with phonological disorders.

The present research has studied optimality theory about the acquisition of consonant clusters. This theory answers some questions about the ultimate attainment in the acquisition of phonology.

The role of UG and its principles in first language acquisition is not questionable, but in L2 and especially on L2 phonological acquisition there are a lot of unanswered questions. This research has tried to find some answers to a trivial part of these questions.

4.2 Pedagogical significance

This study can be applied pedagogically, because teachers, syllable designers and material producers in teaching phonology are greatly concerned with the learners' pronunciation. The result of this study, specially its findings on different modification patterns can help syllabus designers and material developers in providing appropriate syllabi and texts for teaching phonology.

5. Conclusion

In this paper, we investigated the adjustment of English clusters by Persian learners. Different clusters were repaired by epenthesis at different locations: prothesis was found in *s* plus stop, lateral or nasal clusters ([esport, eslayd, esnow]) and anaptyxis was found in other clusters (s plus r, obstruent plus sonorant ([seri, kelas]). The difference in epenthesis location is a mystery in sonority-based approaches, but can be explained by taking into account the perceptual similarity between target word and actual realization. An experiment which confirmed the role of perceptual similarity was carried out and confirmed this insight. The production strategy by Persian speakers can be captured by an Optimality Theory grammar of conflicting constraints, which makes the correct predictions for the realization of the different types of clusters.

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Notes:

1. We like to emphasize that the data in this study are not accounted for by contrastive analysis hypothesis which is in line with behaviorists and structuralists; rather OT which is the most current generative approach accounts for the data.
2. Selow is also observed in Persian: motor/ mashin dâre ru selow kār mikon. However, the data did not come up with such token. I admit that this might be observed, as an anonymous reviewer correctly points out.
3. People may say the number of participants is not large enough. Although we accept this idea; if all characteristics of a true experimental research are not followed, we still have a quasi-expriment attempting to uncover a causal relationship. In such cases, quasi-experimentation often involves a number of strategies to compare subjectivity, such as rating data, testing, surveying, and content analysis. Rating essentially is developing a rating scale to evaluate data. In testing, experimenters and quasi-experimenters use ANOVA (Analysis of Variance) tests to measure differences between control and experimental groups, as well as different correlations between groups (Patton 1997).
4. Although the difference between the level groups is not statistically significant, the means of the target native form of the higher groups were constantly exceeding those of the lower groups.