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Fortition in Persian Phonological System

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Abstract
This study deals with fortition processes according to the theoretical framework of generative phonology to answer the cited questions: How phonological processes are applied in Persian phonological system as fortition? In other words, how do the data support the application of fortition processes in Persian? In which contexts do fortition processes apply in Persian? Synthetic process typology of phonological processes is investigated according to the phonological pattern of Persian; finally the most frequent fortition processes are selected. To see how these processes are applied in Persian as fortition, Standard Persian and four dialects out of twenty five dialects which show these processes are selected. The data are gathered in field study. Then, each of the fortition processes is probed on the Persian varieties to find the alternatives and underlying forms which are important to decide how the fortition processes are applied; and to find the positions in which fortition processes take place. The collected data support the fortition processes in Persian. The data show that the fortition processes tend to occur in inter-consonantal, pre-consonantal positions and morpheme, word and syllable initial positions. The data also show that word initial position has the highest frequency for fortition processes to occur. This support Kenstowichz's idea that mentions word initial is the typical position for fortition.
Keywords: fortition processes, generative phonology, synthetic process typology, Persian phonological system

1. Introduction

1.1. The Current Approaches to Lenition

In traditional approach, the typology of phonological processes is dualistic. There exist two types of phonological processes: lenitions and fortitions which are differentiated on the basis of the strength of sound, or energy expended in its production. Voiced sounds are called lenis (weak), whereas voiceless ones are called fortis (strong). The fortis/lenis distinction derives from the greater/lesser pressure of air built up under the vocal folds which, in turn, results in the greater/lesser force of articulation. The dualistic typology of processes reflects the force of articulation and involves its modification. Therefore, the processes of the lenition type substitute the fortis sounds with the lenis ones, whereas the processes of the fortition type substitute the lenis sounds with their fortis counterparts. Trask defined fortition in the following way: "Any phonological process in which some segment becomes 'stronger' (more consonant-like). An example is the development of the glide [j] into some kinds of fricative, affricate or plosive in most varieties of Basque" (Trask 1996: 149). The above definition highlights the nature of the fortition processes which affect the lenis sounds, transforming them into the fortis ones.

In the literature of Natural Phonology, phonological processes are divided into lenition and fortition on the basis of the functions they serve and the context in which they appear (Luschützky 2001). Both lenition and fortition operate on a segmental level, as opposed to prosodic processes which are located at a suprasegmental level (Luschützky 2001). Moreover, their labels refer to various aspects of language: centrifugal/centripetal refers to the phonetic space, strengthening or weakening refers to phonetic gestures whereas foregrounding or backgrounding address communicative teleology (Luschützky 2001). Fortition processes, also referred to as strengthening or centrifugal, perform the listener–friendly function. Since fortitions strengthen the clarity of perception, they enhance contrast for the sake of a better, sharper perception. They have a perceptual teleology. They operate independently of the context (rely on the system inventory) and are style-sensitive (appear in formal/lento/emphatic speech). The operation of fortitions consists in affecting the segments in strong positions. The nature of fortitions is paradigmatic due to the fact that this type operates on individual sound segments (Donegan – Stampe 1979). Within NP, "Fortitions create phonology. They not only refer to our perception of the speech act, they also account for it. Fortitions regulate what sort of thing can count as a mental representation, or mental intention, concerning speech. Lenitions, on the other hand, lead to phonetics. They regulate our notion about what is a suitable or affordable utterance" (Goman 1979: 43).

The OT approach (Boersma 1998, Kirchner 1998) advocates articulatory effort as the motivation of lenition and fortition. For instance, fortition is effort-based and driven by a natural need to maximize articulatory effort (Kirchner 1998). Articulatory effort is employed by Boersma in the sense of biomechanical parameters such as precision, distance, coordination, energy, mass etc. There is no denying that these parameters can be measured. Moreover, a holistic approach could be implemented, under which the parameters can be simply added. It would also be interesting to establish the role of individual parameters in the overall effort. The role could be resolved by in the OT literature (Boersma 1998) but failed to become a standardized measure. Thus, the idea of biomechanical parameters

as such is not subject to critique, unlike the lack of the idea's implementation. Besides, biomechanical parameters as the solely fortition criteria do not take into consideration the mental reality of processes.

1.2. The Evaluation of the Current Approaches

The evaluation of the current approach to lenition/fortition leads to the following observations. First, there is no exhaustive definition of lenition/fortition whereas the existing ones are either circular in the traditional approach (e.g. Trask 1996, Bussmann 1996) or automatic in the current approaches to lenition/fortition, i.e. they are based on the erroneous assumption that phonological processes are automatic, a mere substitution of weak sounds for the strong ones or an indiscriminate deletion/addition of sounds. If it were true, all languages of the world would be the same and this is simply not the case. Second, in the absence of a satisfactory definition of lenition or fortition it is still not clear what classifies a given process as lenition or fortition. Third, lenition is extensively covered but there are not equally numerous studies on fortition. As a matter of fact, it seems that only Goman (1979) directly addressed the issue of fortition in consonants, whereas typically, fortition is mentioned as the reverse of lenition and not studied in its own rights. Fourth, the current approaches classify processes as lenition/fortition on the basis how a process operates, not on what it does (procedure is considered, but its result is not taken into account at all). Evaluating the current debate on phonological processes, it appears that although lenition and fortition have an extensive literature, a number of controversial issues can still be identified. So to define the fortition process more accurately in Persian dialects, we concentrate on a combination of the abovementioned approaches.

Unfortunately, no exhaustive compilation of processes exists in the linguistic literature, presumably due to the fact that each theory investigates only selected aspects of processes and selected examples are provided. So, it is better to have a synthetic look at traditional, NP and OT approaches. The following table presents the processes discussed by various authors. It reflects the current approaches (the name, relevant source).

Table1. Synthetic Process Typology of fortition processes.

Diphthongization (Dressler1985:NP)	Epenthesis (Dressler1985:NP)	Vowel insertion (Dziubalska-Kołaczyk 2003: NP)	Lengthening (Dressler 1985: NP)	Strengthening: stopping, aspiration (Dressler 1985: NP)	Devoicing (Kirchner 1998:OT, Mateescu 2003: OT)

2. Cross Linguistic Review

We can prospect to find fortition processes in other languages. By studying a number of languages, kenstowicz concludes "the most typical environment for fortition in cross linguistics is word initial" (kenstowicz, 1994: 35). There are some descriptions of processes in fortition in the following table based on the selected languages:

Table2. Samples of fortition processes in word initial position

Language	Reference	Description of processes	Type of Process
Nepali	Acharya (1991)	ɖ̤ → ɾ^{h} /#_	Flapping
Hausa	Kraft & Kraft (1973)	ɸ → p /#_	Stopping
Pennsylvania German	Kelz (1971)	b → b̥ /#_	Devoicing
Pawnee	Parks (1976)	w → p /#_	Stopping
Carrier	Story (1984)	w → b /#_	Stopping

3. Research Questions and Theoretical framework

I'm going to study fortition in this paper according to the theoretical framework of generative phonology to answer the following questions:

1) How the mentioned processes are applied in Persian as fortition? In other words, how do the data support the application of fortition processes in Persian?
2) In which contexts do fortition processes apply in Persian?

So by dealing with related data we should reach to underlying representation through phonetic representation. In this case, we first discover the existent phonetic alternations. According to represented data, when one of the alternations appears in a place and the presence of the other is not possible the alternation between two features is cleared. After discovering the alternation, it is turn to discover the underlying representation of alternation. We use corpus internal evidence to reach this aim. First, two hypothesis are considered in this method. In one of the

hypotheses, it is hypothesized that the first feature is underlying feature, unless there is some evidence to violate this idea. In the other hypothesis, it is hypothesized that the second feature is underlying feature, unless there is some evidence to violate this hypothesis. Formalizing of phonological rules is the next step after discovering the underlying representation. In this step the derivation of surface representation from underlying form is shown.

4. Methodology

Synthetic process typology of phonological processes, which is cited in table 1, is investigated according to the phonological pattern of Persian; finally the most frequent six processes which include: epenthesis, vowel insertion, lengthening, stopping, aspiration and devoicing are selected. To see how these processes are applied in Persian as fortition, Standard Persian and four dialects out of twenty five dialects which show these processes are selected. The data are gathered in field study. Then, each of the above processes is probed on the cited varieties to find the alternatives and underlying forms which are important to decide how the fortition processes are applied in Persian and some of its dialects; and to find the positions in which fortition processes take place.

5. Data Presentation and Discussion

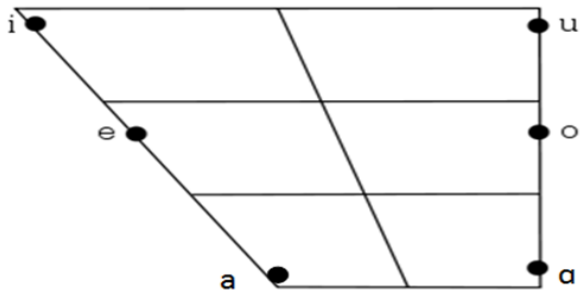
Before the representation of data, it seems necessary to represent Persian consonants table and vowels diagram:

Table3. Persian Consonants (Kambuziya, 2006b:111)

	Bilabial	***Labio-dental***	***Dental***	***Alveolar***	***Palato-alveolar***	***Palatal***	***Velar***	***Uvular***	***Glottal***
Plosive	p b		t d			c ɟ		ɢ	ʔ
Fricative		f v		s z	ʃ ʒ			χ	h
Affricate					tʃ dʒ				
Nasal	m			n					
Trill				r					
Lateral				l					
Glide						j			

Note: In Persian phonetic system, there are two palatal plosives /c/ and /ɟ/ but before back vowels they are pronounced [k] and [g], respectively; such as [kur] "blind", [ʔangur] "grips". So [k] and [g] are allophones of /c/ and /ɟ/ that make no meaning distinction.

Figure 1. Persian Vowels (Kambuziya; 2006b:111)



5.1. Epenthesis

5.1.1. Consonant insertion

The common insertions in Persian and related dialects are the glides [j] and [w] which are inserted between two vowels for hiatus avoidance and ease of articulation. In Eqlidi dialect after the deletion of glottal consonants /h/ or /ʔ/, the glides [j] or [w] are inserted when a suffix or a connective is added:

Standard Persian	Eqlidi dialect	Gloss
/deh/	[de:]	"village"
/deh + i/	[deji]	"a village"
/kuh/	[ku:]	"mountain"
/kuh + i/	[kuji]	"a mountain"
/ʔemlɑʔ/	[ʔemlo:]	"dictation"
/ʔemlɑʔ + i/	[ʔmloji]	"a dictation"
/kuh + o + daʃt /	[kuwo daʃt]	"mountain and plain"
/deh + o + ʃahr/	[dewoʃa:r]	"village and city"

There are two hypotheses for the alternation [j, w] ≈ [Ø]:

(a): The glides /j/ and /w/ are underlying forms, and a rule is needed to delete them in word final position.

(b): The glides [j] and [w] don't exist in underlying form, and they are inserted between two vowels for hiatus avoidance.

The above data show that glottal consonants in syllabic-final positions have a strong tendency to be deleted (a lenition process). Deletion of glottal consonants in underlying representation of these words is supported by compensatory lengthening of the existed vowel (kambuziya 2006a). Taking this point to consideration, we can say that glottal consonants [h] or [ʔ] in the above words are deleted because they are in final position, and when a vowel such as /i/ or /o/ is added to these words, the glides [j] or [w] are inserted between two vowels for hiatus avoidance . These glides are known as meditating consonants. Sadeghi (1886) writes " meditating consonant is a consonant used for taking apart two adjacent vowels where the first vowel comes in final position of previous morpheme and the next one comes in initial position of the next morpheme." one can see in the above data, by adding the indefinite suffix /i/ to the word "kuh", the glide [j] is inserted; because both the glide and the suffix vowel share the feature [+back], and by adding coordinative suffix /o/ to this word, the glide [w] is inserted; because both the glide and the suffix vowel share the feature [-back] . So choosing of either of these two glides between two vowels depends on the characteristics of added vowel: /Ø/ → [j] / V + ___ i , /Ø/ → [w] / V + ___ o

Standard Persian	Kermani dialect (Bafti veriety)	Gloss
/ʃemordan/	[ʔeʃmardɑ̃n]	"to count"
/ʃecast/	[ʔeʃcast]	"It broke"
/ʃecam/	[ʔeʃcam]	"tummy"
/ʃenid/	[ʔeʃnaft]	"S/He heard"
/ʃotor/	[ʔoʃtor]	"camel"
/ʃenɑxt/	[ʔeʃnɑxtɑ̃n]	"S/He knew"

The above data show an insertion of the glottal stop [ʔ] in the onset or the first position of the words which begin with a vowel. To understand the reason, let's have a look at the following data adapted from McKenzie's Pahlavi dictionary (2000):

Pahlavi	Kermani varieties	Standard Persian	Gloss
/stārag/	[ʔestɑle]	[setɑre]	"star"
/aʃcambaɟ/	[ʔeʃcam]	[ʃecam]	"tummy"
/spēd-dār/	[ʔespidɑl]	[sepidɑr]	"poplar"
/ʃcastan/	[ʔeʃcastɑ̃n]	[ʃecastan]	"to break"
/ʃnāxt/	[ʔeʃnɑxtɑ̃n]	[ʃenɑxt]	"S/He knew"
/spiʃ/	[ʔeʃpeʃ]	[ʃepeʃ]	"louse"
/ʃkuftan/	[ʔeʃkoftɑ̃n]	[ʃekoftan]	"to dehisce"
/ōspurdan/	[ʔespordɑ̃n]	[sepordan]	"to depute"

Most of the words in the middle era had a consonant cluster in their initial position which has been disappeared by an insertion process between two members of the cluster (like standard Persian) or at the first position of the cluster through the evolution from old and middle to modern era. The existence of a vowel in the initial position leads to the insertion of glottal stop in words initial position. We can mention three steps of change in the words from Pahlavi to standard Persian and the existent forms in Kermani varieties:

A) The Pahlavi forms of mentioned words had consonant clusters.
B) Insertion of mid vowel between two members of the initial cluster in standard Persian.
C) There is an insertion of a vowel before the initial cluster in Kermani varieties, and because of the particular characteristic of Persian syllable system we have also an insertion of glottal stop in early initial position.

In order to justify the insertion of glottal stop in early initial position, kambuziya (2006a:281) writes: "The insertion of glottal stop in initial position of the words which begin with a vowel is because of the particular characteristic of Persian syllable system. All of the Persian syllables have onset in which a consonant element exists. In case a morpheme or a word begins with a vowel in Persian, this empty onset is filled by a glottal stop." The following derivations are in accordance with the above information:

-UR:	**/#ʃcastan #/**
-Fortition Rule (insertion of vowel before the initial cluster):	**eʃcastan**
-Nasalization of the vowel:	**eʃcastãn**
- Fortition Rule (insertion of glottal stop):	**ʔeʃcastãn**
-PR in Kermani dialect (Bardsiri veriety):	**[ʔeʃcastãn]**

-UR	**/#ʃcastan #/**
-Fortition Rule (insertion of vowel inside the consonant cluster):	**ʃecastan**
-PR in standard Persian	**[ʃecastan]**

5.1.2. Vowel insertion

Standard Persian	Sabzevari dialect	Gloss
/zaxm/	**[zaxom]**	**"wound"**
/esm/	**[ʔesom]**	**"name"**
/paʃm/	**[paʃom]**	**"wool"**
/toxm/	**[toxom]**	**"seed"**
/nazm/	**[nazom]**	**"discipline"**
/xaʃm/	**[xaʃom]**	**"rage"**

The above data show a phonological alternation as [o] ≈ [ø]. There are two hypotheses to define the underlying form:

H_1: The vowel /o/ is the underlying form, and we need a rule to delete this vowel in standard Persian.
H_2: We should consider /ø/ or the inexistence of vowel as the underlying form, in that case there is a need for a rule to insert the vowel [o] between two final consonants.
There are two ways to shorten a long syllable in dialects:

A) Deletion of a consonant from final cluster.
B) Insertion of a vowel.

Insertion of a vowel between two consonants happens in most dialects and languages, and this is common in linguistics. There is a tendency toward using the short syllables rather than long ones in dialects. So the first hypothesis is rejected, and the second one, in which by inserting a vowel a long syllable changes to two short syllables, is justified.
To continue the debate, it seems necessary to mention 'sonority hierarchy principle':

Sonority or the level of natural loudness of phonemes has limitation in syllable structure. In phonetic systems of languages, the phonemes which have more sonority inside a syllable are closer to the nucleus. The level of sonority of phonemes increases, if we close to the nucleus from onset or coda (Kenstowicz 1994:252, Crystal 1995:359, Goldsmit 1999:333, Roca& Jonson 1999:437-9).

Consonant clusters exist in onset and coda in English, but there is limitation in the co-occurrence of consonant clusters, on which the sonority hierarchy principle has control. Based on this principle, the consonants in the onset consonant cluster toward the nucleus receive higher level of sonority; and the consonants in the final consonant cluster far from the nucleus receive lesser level of sonority (Spencer 1996:75).

Based on auditory judgment, this hypothesis suggests that the vowels in the nucleus have the highest level of sonority; and toward the boundary of syllables, the level of sonority decreases. Of course this is true for the syllables which have some consonants on their boundaries. So the nucleus of a syllable is the focus of attention in sonority, and other consonants sit in the closest or the furthest place from the vowel, which is the nucleus of the syllable, according to the grade of sonority.

According to Carr (1993) two main factors determine how sonorous a sound is: the degree of obstruction of the vocal tract during the production of the sound, and whether the sound is voiced or not. Oral stops have a high degree of obstruction, the stricture of complete closure, and are thus less sonorant than fricatives. All voiced sounds are more sonorous than their voiceless counterparts, so that, within the class of obstruents, the hierarchy reads as follows: voiced fricatives> voiceless fricatives> voiced stops> voiceless stops, where '>' means 'more sonorant than'. The class of sonorant consonants (sonorants) are all considered more sonorant than the class of obstruents. Among the class of sonorants, there is disagreement as to which are more sonorous than others, but it is common to take glides to be more sonorant than liquids, which in turn are more sonorant than the nasal stops (nasals). The most sonorant of all classes is vowels, which have a structure of open approximation and are typically voiced. Among the vowels, the more open a vowel, the more sonorant it is, since openness equates with less obstruction in the vocal tract. A general depiction of the sonority hierarchy would be: vowels>glides>liquids>nasals>obstruents. The sonority hierarchy is said to figure in processes of lenition, with speech sounds becoming more sonorous as they are lenited. In processes of fortition, sounds are said to move up the sonority hierarchy, becoming less sonorous. The sonority hierarchy is also said to figure in the sonority sequencing principle. The following hypothetical pattern shows this matter:

stop, affricative, fricative, nasal, liquid, glide, Vowel, glide, liquid nasal, fricative, affricative, stop

\- → + ← -

Now we can easily investigate the reason of inserting a vowel between the consonants of a final consonant cluster according to sonority hierarchy principle in Sabzevari dialect. The above data show the second consonant of the final cluster is more sonorous than the first consonant of the cluster. When the sonority hierarchy principle is observed in final consonant cluster in this dialect, there is no need for inserting a vowel inside the cluster such as the following data:

Standard Persian	Sabzevari dialect	Gloss
/aʃc/	[ʔaʃʧ]	"tear"
/dard/	[dard]	"pain"
/tʃasb/	[tʃasb]	"glue"
/cerm/	[cerm]	"worm"
/Galb/	[Galb]	"heart"

The sonority hierarchy principle is observed in the above data, so there is no insertion between the consonants in final consonant cluster. The process of insertion the vowel [o] between the consonants in final consonant cluster can be shown as: /ø/ → [o] / #CVC$_1$_____ C$_2$# where C$_2$ > C$_1$ in sonority scale and C$_2$= m (bilabial nasal)

5.2. Lengthening (vowel harmony)

Standard Persian	Sabzevari dialect	Gloss
/cetɑb/	[kutɑb]	"book"
/derɑz/	[durɑz]	"long"
/ʃekɑr/	[ʃugɑr]	"hunt"
/medɑd/	[mudɑd]	"pencil"
/menɑr/	[munɑr]	"pillar"
/lebɑs/	[lubɑs]	"attire"

There is a mid vowel with the feature [-back] in the first syllable of the above words, and there is the vowel /ɑ/ with the feature [+back] in the second syllables. The data show the mid vowel in the first syllable and the back vowel in the second syllable assimilate with each other in [+back] feature. This process can be shown as follow:

/e/ → [u] /____ C_0ɑ

V → V / _____C_0 V

[-back, -low] [+back, +high] [+back, +low]

5.3. Stopping

Standard Persian	Eqlidi dialect	Gloss
/ta.vi.le/	[te.bi.la]	"barn"
/gus.fand/	[gus.band]	"sheep"
/ceʃ.var/	[ceʃ.bar]	"country"
/nɑn.vɑ/	[nũn.bo]	"baker"

Standard Persian	Sharrezaee dialect	Gloss
/nɑn.vɑ/	[nũm.bɑ]	"baker"
/vɑ.fur/	[bɑ.fur]	"an opium-smoking pipe"
/ha.vu/	[ha.bu]	"a rival wife"
/ɟuʃ.vɑ.re/	[guʃ.bɑ.ra]	"earring"
/ej.vɑn/	[ʔej.bun]	"balcony"

There are two hypotheses for the alternation [f, v] ≈ [b]:

(a): The words in Eqlidi and Sharrezaee dialects are underlying forms, and the stop consonant /b/ in initial position of a syllable changes to continuant consonant [f] or [v].

(b): The words in Standard Persian are underlying forms and the continuant consonants /f/ or/v/ in syllable- initial change to the stop consonant [b].

As kenstowicz (1994, p.35) has mentioned that word initial is the typical position for fortition, and the change of continuant consonants into plosive is a kind of fortition; the second hypothesis is accepted. Another reason for rejecting the first hypothesis is that by accepting this hypothesis, we cannot predict in which context /b/ changes to [f] and in which context changes to [v].So /f/ and /v/ are underlying structures and in syllable- initial position change to stop [b]. {/f/, /v/} → [b] / {$___, # ____

5.4. Aspiration

One of the important allophones of stops /p, t, k/ in Persian is their aspirated version which takes place in word-initial, onset position of stressed syllables in the most Persian words. (Samareh, 1985).

UR (Standard Persian)	PR(Standard Persian)	Gloss
/par/	[p^har]	"feather"
/cerm/	[c^herm]	"worm"
/se.pɑh/	[se.p^hɑh]	"army"
/pa.ras.tu/	[p^ha. ras.t^hu]	"swallow"
/ser.ke/	[ser.c^he]	"vinegar"

The words in the second column are strengthened by audible breath in the articulation, including voiceless plosives. Because aspiration is the allophonic variety of the phonemes /p/, /b/, and /t/ in Persian, then the aspirated versions cannot be the underlying forms. So /p/, /b/ and /t/ change to their aspirated versions in word-initial or onset position of stressed syllables: {/p/, /b/, /t/} → {[p^h], [b^h], [t^h]} / {$___, # ____

5.5. Devoicing

Standard Persian	Delvari dialect	Gloss
/Gɑb/	[kɑv]	"frame"
/Gadam/	[kejam]	"step"
/Galam/	[kelem]	"pen"
/Gejtʃi/	[keitʃi]	"scissors"
/Gand/	[kand]	"lump sugar"
/Gabr/	[kavr]	"grave"

The data shows that the voiced stop /G/ has been changed to voiceless stop [k] in word-initial before a vowel:

/G/ → [k] / # _ V

We can decide from the alternation [G] ≈ [k] that /G/ in Standard Persian words is underlying representation, because the word-initial position is a typical position for fortition not lenition, and devoicing is a kind of fortition process. But it seems the following data show some contradictory examples, as devoicing process takes place at the end of the words; and we know that the final position is the position of lenition not of fortition:

Standard Persian	Kermani dialect	Gloss
/ɑrd/	[ʔɑrt]	"flour"
/kud/	[kut]	"dung"
/kɑrd/	[kɑrt]	"knife"
/dud/	[dut]	"smoke"
/sard/	[sart]	"cold"
/masdʒed/	[masdʒet]	"mosque"
/sefid/	[ʔespit]	"white"
/mahd/	[maht]	"kindergarten"
/sendʒed/	[sendʒet]	"oleaster"
/tord/	[tort]	"brittle"
/rud/	[rut]	"stream"
/xɑbɑlud/	[xewɑlut]	"sleepy"

If we take the historical considerations into account, we find that most of the modern words which now end to the consonant /d/ in middle era ended to the consonant /t/ such as the word [mard] "man" which was pronounced in middle Persian as /mart/. So we can say the words in Kermani dialect preserve the phoneme /t/ and have not changed to [d] as in standard Persian. Bagheri (1994:133) writes "the existed phoneme [d] in modern Persian words is either the remained form of /d/ or is the changed form of the phoneme /t/ from the ancient era which is altered beside a vowel or the two phonemes /n/ and /r/". Then there is no devoicing process takes place in the above data.

3.3 Conclusion

The collected data from Standard Persian and some of its dialects support the fortition processes in Persian as five processes which are part of fortition type. The data shown that the fortition processes tend to occur in inter-consonantal, pre-consonantal positions and morpheme, word and syllable initial positions as follows:Table4. The position of Fortition processes in Persian dialects

Fortition Processes	Position				
	Morpheme Initial	Syllable Initial	Word Initial	Inter-Consonantal	Pre-Consonantal
Consonant Insertion			√		
Vowel Insertion				√	
Lengthening					√
Stopping		√	√		
Aspiration		√	√		
Devoicing			√		

As can be seen from the above tables, the word initial position has the high frequency for fortition processes to occur. This support Kenstowichz's idea (1994, p.35) which mentions that word initial is the typical position for fortition.

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