

Urdu Phonological Rules in Connected Speech

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Abstract

The present work deals with the phonological rules in Urdu language. All these rules have been reported by considering the multiple pronunciations of a word, which has same spellings and parts of speech (POS). For the confirmation of multiple pronunciations, firstly a word list of 13717 words has been extracted from 10 hours speech corpus of a female native Urdu speaker. Secondly, in order to confirm whether these multiple pronunciations are speaker dependent or language dependent, data from 9 more native speakers have been collected for the confirmation of multiple pronunciations. In this paper, phonological rules related to the segment alternation, segment deletion and segment insertion have been investigated. Analysis reports that (i) segment alternation occurs due to stress, (ii) unstressed articulation causes segment deletion and (iii) segment insertion emerges to break consonant cluster at coda position.

Keywords—Urdu phonological rules, multiple pronunciations, segment deletion, segment insertion, segment alternation, syllabification and restructuring

1. Introduction

Urdu is an Indo-Aryan language and it has 100 million speakers in all over the world and they have multiple pronunciations and accents [1]. In this study, Urdu phonological rules are reported based on multiple pronunciations of a word, which has same spellings and part of speech. For example, a word محبت (love /məhəbbət/) [2] has two more alternative pronunciations /məhəbbət/ and /məhəbbət/ and both of these pronunciations are equally intelligible among native Urdu speakers. The motivation of this study is to investigate the phonological phenomena behind these alternative pronunciations. Phonological rules mean the information of possible and non-possible

combinations of sounds in a language. The phonological rules also give information about the alternative or multiple pronunciations of a word [3]. In other words phonological rules deal with the words' morphology and concern with the way in which morphemes combine to form a meaningful word [4]. Studies reported that phonological variations are inevitable and unconsciously used by the native speakers [5].

Sometimes the multiple pronunciations raised controversy and confusion for the language users. Therefore, there is a big need to find out the types of variations and their possible reasons based on Urdu phonology. In connected speech production, Urdu has sound change rules almost similar to other languages i.e. alternation, assimilation, deletion, vowel lengthening, etc [6]. These sound change rules have produced multiple pronunciations of different surface form of an already existed phonetic script. However, the present study deals with only three important phonological rules; (i) segment alternation, (ii) segment deletion and (iii) segment insertion. All these phenomena have created multiple pronunciations therefore these issues are resolved by finding out the backend strategy of language and language users. It is also reported that few variations are speaker dependent and some are context dependent.

This paper proposes Urdu phonological rules in connected speech. The remaining paper has been arranged accordingly: studies on the phonological rules of different languages are reported in Section 2, Section 3 presents the methodology of this study, Section 4 reports results, section 5 is about data analysis and discussion of the proposed phonological rules in Urdu language, while the conclusion and future discussion are presented in Section 6.

2. Literature review

All languages (such as English, Czech, Japanese, Shona, Hungarian, Finnish, Setswana, Dutch, Russian, etc) have different phonological rules based on voice quality [7]. In order to acoustically analyze phonological rules of a speech, voice quality is an important factor because it is directly affected by the habitual variation of speakers' vocal apparatus. These variations contributed in accent variations and multiple pronunciations of a language. According to American National Standards Institute (ANSI) voice quality could be used for differentiating the speech variations which are based on the momentary actions of speech segments [8].

Every language has a unique and stereotypical speech segments i.e. consonant, vowel and approximant [4]. In connected speech production, these segments lose their individual features because one segment is coarticulated with other segments like a connected string of sounds [9] by taking or losing its individual features. The connected speech production is a complicated phenomenon because different segmental and supra-segment factors are involved in articulation [10]. Moreover, Vander reports that the motivation behind multiple pronunciations is also based on the attitude of the language users i.e. hypercorrection and overgeneralization [11].

According to sound change theory, it is inevitable to control sound changes in an utterance [12] as these are inherent variations and are called "non-programmed features" of alternative pronunciation [5]. This is clear by a research where a single speaker has repeated a single word 10,000 times but he would not been able to produce an exactly similar utterance. Although these utterances were similar based on the natural sound class but were different from each other based on the discrete sound features [3]. These segmental features are not enough because connected speech production is a complicated process [10]. Therefore, auditory transcription has a drawback that it cannot generate exact reproduction of human speech by using traditional phonetic symbols. These pronunciation differences are the part of phonetic grammar of a language [3]. The phonetic grammar is based on the phonological rules of a given language. There are

number of phonological rules existed in different languages of the world i.e. deletion, insertion, alternation, assimilation, nasalization, aspiration, voicing, etc [13]. But only segment alternation, segment deletion and segment insertion in different languages have been discussed in the subsequent sections.

2.1. Segment alternation

Segment alternation is a basic principle for multiple pronunciations. In connected speech, shuffling of one sound with another sound is called segment alternation [4]. In Hindi language, according to one rule, nasal consonant converts preceding oral vowel into a nasal vowel [14]. In German and Czech languages, word final voiced obstruents converted into voiceless stops i.e. /hond/ as /hont/. In some Spanish dialects, voiced stops become fricatives if surrounded by vowels [7]. In Turkish language, syllable final devoicing of voiced consonant has also been reported but this is not equally applicable to voiced fricative and sonorant [15]. In Farsi (Persian) language, /r/ phoneme appears in three allophonic forms [r], [r.] and [ɾ]. These forms are dependent to the phonological environment where the sound comes [4]. In Lithuanian language, assimilation of voicing and devoicing is also common [3].

2.2. Segment deletion

Deletion of a phonemic unit is called segment deletion. It is a very common phenomenon in connected speech production [13]. It occurs due to the laziness of people in articulation process [16]. In Hindi language, schwa and a nasal consonant are deleted when they are preceded by an oral vowel or a nasal vowel respectively [14]. In English language, according to the relative functional load (RFL) phenomenon, if the syllable final consonants /t, d, n/ are followed by an unstressed /l/ or /n/ then the latter consonants would take the quality of a complete syllable by the deletion of preceding schwa [17]. Moreover, it reports word final /ə/ deletion if it is followed by a stressed syllable [18]. In Turkish language, syllable medial and syllable final velar /g/ phoneme is deleted by converting the preceding short vowel into a long vowel [15].

2.3. Segment insertion

In a connected speech articulation, adding up of a phoneme is called segment insertion [19]. Articulation time [7] and speakers' attitude are the major elements for insertion [11]. Turkish language has complex consonant clusters both at onset and coda position. Same language behavior has been observed even in the articulation of English by the native Turkish people as in the word 'group' (collection of entities /grʊp/) which became /gʊrʊp/ [15]. In Armenian language, initial consonant cluster have been splitted by the insertion of /ə/ vowel. In Lomongo language, /j/ insertion took place in compound words [3].

2.4. Urdu phonological rules

In Urdu language, different phonological rules have already been discussed by other researchers. According to Hussain, Urdu has (i) nasal assimilation, (ii) velar assimilation, (iii) bilabial assimilation and (iv) /h/ deletion [6]. Akram has reported /ə/ insertion in order to control multiple onsets in a syllable [20] and Nawaz reported /ʔ/ deletion in Urdu speech articulation [18]. The previous studies on Urdu phonological rules only focus on the segmental feature analysis. However, this study reports that segment features are not enough to deal with the actual pattern of multiple pronunciations in Urdu language. Phonology of connected speech in Urdu is dependent on different factors i.e. segmental features, context, stress pattern, syllabification and restructuring [10].

3. Methodology

Urdu phonological rules are extracted from the speech of 10 speakers. Multiple pronunciations have been observed in their speeches which are different from the standard pronunciation of the words. In order to confirm; whether these pronunciations are mispronunciations or multiple pronunciations, firstly, 10 hours speech corpus of a native Urdu female speaker is studied for the initial analysis. This speech corpus is extracted from three corpora i.e. 35 million words' corpus; CLE Urdu Digest Corpus 1M and 2.6 million words' corpus of Urdu news [21]. The speech obtained from the corpora is annotated at multiple levels i.e. phoneme, syllable, word, phrase, stress,

utterance or sentence levels using Case Insensitive Speech Assessment Phonetic Alphabet (CISAMPA) method [22].

Secondly, these phonological variations have been confirmed by obtaining the data from 9 native (7 males and 2 females) speakers of Urdu. All these speakers were graduates and use Urdu and Punjabi in their daily routine. Educated native speakers are deliberately selected in order to confirm; whether literacy plays any role in standard pronunciation or not.

10 hours corpus is comprised of 103902 words containing 9852 unique words, 13717 duplicates and 80333 English loan words and Urdu functional words. For in this research, only duplicate words list is used for further research in the alternative pronunciations of standard vocabulary. The word list of duplicates provides multiple instances of a word with same spellings including their transcription, parts of speech, number of syllables in a word, stress pattern and file ID.

Analysis of word list highlights that variations may occurred due to four reasons; (i) it might be an annotation error, (ii) mismatches may occur due to homographs or homophones having different parts of speech, (iii) mismatches may occur due to different stress patterns of a word in different files and (iv) variation may occur due to alternative pronunciations. In this research, first two types have been ignored but only third and fourth types have been considered for the confirmation of multiple pronunciations. The standard pronunciations of vocabulary have been confirmed by using "Urdu Lughat: Tarixi Usul Per" [2] and the meanings in English have been incorporated by consulting Oxford Urdu-English Dictionary [23].

4. Results

After analyzing the word list of multiple pronunciations of words with reference to the text-grid files, it is concluded that speaker has articulated same words with multiple pronunciations. Detailed results are given in the table 1; where TW means total words, SP stands for standard pronunciation and AP is used for alternative pronunciation.

Table 1: Single Speaker Speech Analysis Report

Total Number of Alternative (Duplicate) Words = 13717																						
	Segment Alternation							Vowel Deletion				Consonant Deletion			Vowel Insertion							
	Short-to-Short Vowel T=2530			Short-to-Medial and Medial-to-Short Vowel T=458		Medial-to-Medial Vowel	Long-to-Long Vowel	Disyllabic Word		Tri-syllabic Word		Polysyllabic Words			Monosyllabic Words T=633 Insertion=317							
	Short	to-Short	Vowel	Short	to-Medial	and	Medial	to-Medial	Short	to-Short	Short	to-Long	Long	to-Long	Short	to-Vowel	Tri-syllabic	Word	Polysyllabic	Words	before	before
Short	to-Short	Vowel	Short	to-Medial	and	Medial	to-Medial	Short	to-Short	Short	to-Long	Long	to-Long	Short	to-Vowel	Tri-syllabic	Word	Polysyllabic	Words	before	before	before
	ə→ ɪ	ə→ ʊ	ɪ→ ə	e→ ə	e→ ɪ	e→æ	e:→ æ:	ə→ φ	ɪ→ φ	ə→φ	e→φ	/j/	/h/	/v/	before /l/	before /r/	before /s/ or /z/					
TW	850	850	830	165	293	448	124	157	45	79	77	4403	4742	29	210	200	211					
SP	550	300	779	95	154	124	28	93	21	15	15	1578	806	3	100	100	106					
AP	300	550	51	70	139	324	96	64	24	64	62	2825	3936	26	110	100	105					

In order to confirm, these variations are speaker dependent or context dependent, 9 more native speakers have been selected for recordings. For this purpose, a mini corpus of 75 words' list (25 words of each category) has been selected for analyzing multiple pronunciations. Recording of these words have is carried in a carrier sentences to

avoid stress and boundary effects. The speech is recorded and annotated in PRAAT software using same methodology presented in [22]. Later on, these words and their multiple pronunciations are cross checked among 9 native speakers' speech. Detailed calculations are given in table 2.

Table 2: Nine Speakers Speech Analysis Report

Total Number of Alternative Words = 75																						
	Segment Alternation							Vowel Deletion				Consonant Deletion			Vowel Insertion							
	Short-to-Short Vowel T=25			Short-to-Medial and Medial-to-Short Vowel T=25		Medial-to-Medial Vowel	Long-to-Long Vowel	Disyllabic Word		Tri-syllabic Word		Polysyllabic Words			Monosyllabic Words T=25 Insertion							
	Short	to-Short	Vowel	Short	to-Medial	and	Medial	to-Medial	Short	to-Short	Short	to-Long	Long	to-Long	Short	to-Vowel	Tri-syllabic	Word	Polysyllabic	Words	before	before
	ə→ ɪ	ə→ ʊ	ɪ→ ə	e→ ə	e→ ɪ	e→æ	e:→ æ:	ə→ φ	ɪ→ φ	ə→φ	e→φ	/j/	/h/	/v/	before /l/	before /r/	before /s/ or /z/					
SP 2	13	15	10	7	13	24	06	14	24	14	12	15	16	17	17	25	15					
SP3	13	15	11	17	12	20	12	22	7	7	9	13	7	7	19	18	25					
SP4	24	14	11	11	19	13	22	22	17	17	15	19	17	17	23	22	22					
SP5	14	18	12	23	15	13	11	19	11	18	7	18	11	11	20	22	12					
SP6	17	22	10	22	11	16	21	12	23	23	17	7	23	23	23	23	24					
SP7	18	20	11	12	16	18	18	18	22	22	11	17	21	22	22	22	14					
SP8	19	22	13	11	17	10	13	17	12	12	23	11	24	24	19	24	18					
SP9	22	20	11	12	15	10	12	22	18	9	17	23	13	23	19	23	19					
SP10	5	11	19	14	14	10	14	24	12	15	19	22	18	23	20	25	14					
TN	145	157	108	129	132	134	129	170	146	137	130	145	150	167	182	204	163					
%age	64	70	48	56	59	60	57	75	65	61	58	64	67	74	81	91	72					

5.1. Segment alternation

5. Data analysis and discussion

Like many other languages, Urdu also has sound change rules, which become the cause of multiple pronunciations of an already existed phonetic script. Data analysis confirms that there are three main categories of alternative pronunciations of the same vocabulary. Those are:

1. Segment Alternation
2. Segment Deletion
3. Segment Insertion

Phonemic alternation occurs due to the shuffling of one sound with another. The first principle for multiple pronunciation is segment alternation; “except in case of suppletion, every morpheme has only one phonological form. Any variation in the phonetic shape of a morpheme results from the operation of regular phonological rules”. According to the definition, morphology does not allow alternative pronunciations of a segment but phonology supplies the information at which context a segment could alternate its stereotypical features.

These phonologically variant segments are called “alternants” [4].

Urdu also has different “alternants” but native speaker articulated one “alternant” at a time. According to the present data analysis, Urdu native speakers switch between multiple pronunciations by substituting one vocalic segment with another. This alternation occurs at four levels;

- (i) Short to short vowel alternation
- (ii) Short to medial and medial to short vowel alternation
- (iii) Medial to medial vowel alternation
- (iv) Long to long vowel alternation

All these alternations are discussed in the subsequent sessions. However, the reasons of first two types are not discussed, as data indicates they might be speaker dependent variations.

5.1.1. Short to short vowel alternation

First condition is short-to-short vowel alternation; it occurs when one short vowel alternates with another short vowel e.g. in the word بلند (high /bəlɒŋd/), /ə/ is converted into /o/ and formed an alternative pronunciation /bəlɒŋd/.

5.1.2. Short to medial and medial to short vowel alternation

Second condition is medial to short vowel and short to medial vowel alternation; it occurs when a medial vowel substitutes with a short vowel or a short vowel alternates with a medial vowel e.g. the word اختلاف (conflict /ɪxtələ:f/) has two multiple pronunciations /ɪxtəla:f/ and /ɪxtɪla:f/. The word شاعر (poet /ʃa:ɪr/) has two multiple pronunciations; the standard pronunciation /ʃa:ɪr/ and other alternative pronunciation with the medial vowel /ʃa:er/. In the first example, medial vowel substitutes with a short vowel. In the second example, short vowel alternates with a medial vowel. Sometimes phonemic alternation also causes change in syllabification of the word by taking diphthong form. Mostly short and medial vowels substitute in this order i.e. /e/ medial vowel substitutes with short vowel [ə/ɪ] while /o/ short vowel substitutes with medial vowel /o/ and vice versa.

5.1.3. Medial to medial vowel alternation

Third condition is; medial vowel alternates with another medial vowel e.g. the word احترام (respect /eɦtɪra:m/) has another alternative pronunciation /æɦtɪra:m/. In polysyllabic words, if the letters الف، ح come together at word initial place as in the word احسان (good deed /ehas:n/) such type of words have standard transcription with /e/ medial vowel but speakers have alternated /e/ medial vowel with /æ/ medial vowel and the same is the case with the word احتجاج (protest /eɦtɪdʒa:dʒ/) which has another alternative pronunciation /æɦtɪdʒa:dʒ/. Condition for their alternations is;

- i. In polysyllabic words, if the word is articulated with stress then /e/ medial vowel would be substituted with /æ/ medial vowel.

5.1.4. Long to long vowel alternation

Fourth condition is the long vowel alternation with long vowel as in the word تینیس (twenty three /tɛ:i:s/). It has two pronunciations; one is the standard one /tɛ:i:s/ and the other is the alternative pronunciation /tæ:i:s/ of the same word (for more examples see appendix). In polysyllabic words, this phenomenon has been commonly observed both at word initial and word medial positions. Especially, if the letters الف and ع co-occur at word initial position as in the word اعتبار (Trust /eʔteba:r/), this would not be wrong if we take /e:/ long vowel as a standard segment [18]. The conversion of long vowel /e:/ with the long vowel /æ:/ occurs in the polysyllabic words;

- i. When stress /e:/ long vowel is substituted with /æ:/ long vowel.

5.2. Segment deletion

In a connected speech, segment deletion of a phoneme is also called elision. It is common in casual connected speech [13] which causes re-syllabification [24]. According to Waqar and Waqar speakers deleted phonemic segments due to their laziness which is another factor, responsible for the change in pronunciation [16] e.g. the word بسر (to live /bəsər/) has another alternative pronunciation as /bəsɪ/. Vowel deletion reduces number of syllables as well. Different types of phonemic deletions are observed in

this research; (i) short or medial vowel deletion, (ii) /h/ deletion, (iii) /j/ deletion and (iv) /v/ deletion.

1. Segment deletion always occurs at word medial or word final syllable but never at word initial position.
 2. Sometimes consonantal deletion converts its preceding short vowel into long vowel e.g. in the word حصہ /portion/, hissəh/ changes into /hissa:/
 3. Long vowel deletion is not possible.
 4. Short or medial vowel deletion has been observed in disyllabic and tri-syllabic word.
 5. Stress plays an important role in segment deletion.
- i. Unstressed articulation causes vowel deletion in bi and tri-syllabic (polysyllabic) word.
 - a. By reducing stress in disyllabic words, firstly short vowel deletion occurs in the last syllable then syllabic reformation takes place. The re-syllabification occurs due to consonant clusters at coda position. For example, the word امر (eternal /ə.mər/) converts into /əmr/.
 - b. Vowel deletion occurs in tri-syllabic (polysyllabic) words due to unstressed articulation of the penultimate syllable of the word, which not only causes segment deletion but also becomes reason for reformation of syllables in the word. This phenomenon is called vowel syncope [25]. Vowel is the nucleus of the syllable therefore vowel deletion demands re-syllabification [9]. It is a complicated process as it follows phonotactic rules of the language [24] e.g. Urdu phonotactic rules do not allow consonant cluster (/df/, /tm/, /tb/, /xr/, etc) at word initial position [20] and same is the case at syllable initial position. For example the word آخرت (hereafter /a:xrət/) converts into /a:xrət/.
 - ii. /h/ deletion occurs at word final position if it is articulated in connected speech without stress as the word بادشاہ (king /ba:ɖʃa:h/) turned into /ba:ɖʃa:/ and بچہ (child /bəʃʃəh/) converted into /bəʃʃə:/ [6].

- iii. Usually, /j/ deletion occurs word medially to form a diphthong e.g. the word کیوں (why /kijū:/) as /kiū:/ and کیا (what /keja:/) as /kæa:/ [26]. However in some cases /j/ deletion occurs without making diphthong as in the word حیثیت (status /hæ:sijət/) as /hæ:sr:ət/ and لیے (for /lije:/) as /li:e/
- iv. /v/ deletion occurs by the substitution of /v/ consonant with the vowel. /v/ deletion occurs inter vocally in two ways; by making diphthongs i.e. the word ہوئی (was /hovi:/) converts into a monosyllabic word /hu:i:/ [26]. While on the other hand, unstressed articulation also causes /v/ deletion, without making diphthong as in the word ہندووں (Hindues /hɪndʊvɔ:/) v deletion occurs without making a diphthong /hɪndʊ:ɔ:/

5.3. Segment insertion

The addition of a phonemic segment in a word is called insertion or epenthesis [19]. Articulation time of articulators is the major reason for the segment insertion [7] and it may be speakers' attitude i.e. hypercorrection and generalization about rules because people overdo things when they like and dislike them [11]. In Urdu connected speech, the segment insertion, especially the insertion of /ə/ has been commonly observed phenomenon among ten speakers' speech. Multiple pronunciations of monosyllabic words occur due to the insertion of a short vowel which ultimately increases number of syllables in a word. Syllable is factorable unit of the word which associates the linear string of segments in a structure [20]. For example, the word امر (work) has two multiple pronunciations; one is the standard pronunciation /əmr/. The other is the alternative pronunciation /əməɾ/ with /ə/ insertion and syllabic reformation. This insertion might be the effect of over generalization of the word امر (eternal, /əməɾ/).

1. Vocalic segment insertion (only short vowel /ə/) takes place in order to break word final consonant cluster and this insertion happens in three contexts which are as follows;
 - a. If consonant is followed by a liquid sounds /l/ or /r/ e.g. قبر (grave /qəbr/) as /qəbər/ and اصل (original /əsl/) as /əsəl/.

- b. If consonant is followed by a bilabial nasal sound /m/ e.g. in the word کرم (fate /kərm/) as /kəɾəm/.
- c. If consonant is followed by an alveolar fricative consonant /s/ or /z/ e.g. in the word حبس (congestion /həbs/) as /həbəs/.

It is confirmed after analyzing speech corpus that multiple pronunciations of words occur due to different phonological rules in Urdu language. All these reported rules are discussed and marked after taking consents from Urdu native speakers. It is observed that in connected speech production (i) phonological variations occur only in open class words i.e. noun, adjective etc (ii) unstressed articulation causes segment deletion of /ə/, /h/, /j/ and /v/, (iii) segment deletion always occurs in disyllabic or trisyllabic words (iv) segment deletion always occurs at word medial or word final position (v) sometimes consonantal segment deletion converts preceding short vowel into long vowel and (vi) long vowel deletion is not possible. Moreover, (vii) segment insertion took place in consonant clusters at coda position when a consonant is followed by liquid sound, bilabial nasal sound or an alveolar fricative. It is also noticed that (viii) segmental alternations have occurred due to stress, (ix) speakers' education is not the guarantee for the articulation of standard pronunciation

6. Conclusion and future discussion

This research presents phonological rules related to segment alternation, deletion and insertion in Urdu speech. Using these rules, the existed Urdu lexicons can be updated as they give only morphological information of the word without incorporating new language changes. Incorporation of phonological information will be help in finding out alternative pronunciations of the word.

There are other issues as well which have not been discussed here but would be investigated in future research. This includes study of short vowel insertion in polysyllabic Urdu words; alternative selection of short or medial vowel in a word, /h/ deletion at word medial position and multiple

pronunciations of proper nouns. Moreover, the role of socio-cultural and educational background of the person in multiple pronunciations would also be studied in future.

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Appendix

Short Vowel Alternation			
Words	English	SP	AP
بلند	high	bələŋd̪	bɒləŋd̪
محبت	love	məhəbbət̪	mɒhəbbət̪

Short to Medial and Medial and Medial to Short Vowel Alternation				
Words	English	SP	AP	
ارتكاب	committing an offence	ɪrʔekɑ:b	ɪrʔɪkɑ:b	ɪrʔəkɑ:b
استعمال	use	ɪstʔema:l	ɪstɪmɑ:l	ɪstəmɑ:l
محمد	Proper noun	mohəmməd̪	mohəmməd̪	

Medial to Medial Vowel Alternation (e → æ)				
Words	English words	SP	AP	
			SS	US
احترام	respect	ehʔera:m	æhʔera:m	ehʔera:m
اعتجاج	Protest	ehʔedʒɑ:ʔ	æhʔedʒɑ:ʔ	ehʔedʒɑ:ʔ
اعتبار	Care	ehʔija:ʔ	æhʔija:ʔ	ehʔija:ʔ
احرام	Unstitched white cloth for Hajj	ehra:m	æhra:m	ehra:m
احساس	Feeling	ehsa:s	æhsa:s	ehsa:s
احسان	Good deed	ehsa:n	æhsa:n	ehsa:n
اكام	pillar	ehka:m	æhka:m	ehka:m
اقدام	phlebotomy	ehʔema:m	æhʔema:m	ehʔema:m

Long to Long Vowel Alternation (e: → æ:)				
Words	English words	SP	AP	
			SS	US
اعجاز	miracle	e:ʔdʒɑ:z	æ:dʒɑ:z	e:ʔdʒɑ:z
اعتماد	Trust	e:ʔtɛma:d	æ:tɛma:d	e:ʔtɛma:d
اعتراض	objection	e:ʔtɛra:z	æ:tɛra:z	e:ʔtɛra:z
اعلان	to announce	e:ʔla:n	æ:la:n	e:ʔla:n
اعتبار	Trust	e:ʔtɛba:r	æ:tɛba:r	e:ʔtɛba:r

Vowel Deletion			
Words	English Words	SP	Deletion
اعتماد	Trust	e:ʔtɛma:d	e:ʔma:d
اعتراض	objection	e:ʔtɛra:z	e:ʔra:z
آزرت	hereafter	a: xɪrəʔ	a: x rəʔ
اعتجاج	Protest	ehʔedʒɑ:ʔ	ehʔ dʒɑ:ʔ
امر	eternal	ə mɛr	əmr

جبل	mountain	dʒə bəl	dʒəbl
اعتراض	objection	e: ʔɛ ra:z	e:ʔ ra:z
آزرت	hereafter	a: xɪrəʔ	a: x rəʔ

Short Vowel /ə/ Insertion before Liquid Sounds					
List of Words	English Words	SP	Word final Consonant Cluster	Manners of Articulation	AP
اسل	Original	əsl	Alveo-Fricative+ Lateral	Any Consonant followed by Laterals /l/ or /r/ consonant; triggered schwa insertion	əsəl
غسل	Bath	xosl	Alveo-Fricative+ Lateral		xosəl
مث	Example	mɪsl	Alveo-Fricative+ Lateral		mɪsəl
فصل	Bounty	fəzl	Alveo-Fricative+ Lateral		fəzəl
عدل	justice	ədʒl	Dental Lateral +		ədʒəl
تفصل	Wisdom	əʒl	Uvular Lateral +		əʒəl
ذكر	account/talk	zɪkr	Velar + trill		zɪkər
عصر	Time Period	əsɪr	Alveo-Fricative + trill		əsər
قبر	Grave	qəbr	bilabial + trill		qəbər
كفر	unbelief	kʊfr	Labiodental + Lateral		kʊfər
قدر	Value	qədɪr	Dental + trill	qədər	
جبر	cruelty	dʒəbr	bilabial + trill	dʒəbər	

Short Vowel /ə/ Insertion before /m/					
Words	English Words	SP	Consonant Cluster	Articulation Manners	AP
قسم	Kind	qɪsm	Alveo-Fricative+ Bilabial Nasal	Any Consonant followed by bilabial nasal /m/	qɪsəm
حکم	Order	hokm	Velar + Bilabial Nasal		hokəm
جرم	sin	dʒɔrm	liquid+ Bilabial Nasal		dʒɔrəm
کرم	fate	kɔrm	liquid+ Bilabial Nasal		kɔrəm
علم	education	ɪlm	liquid+ Bilabial Nasal		ɪləm

Short Vowel /ə/ Insertion before Alveo-fricative Consonants				
Words	English Words	SP	Word final Consonant Cluster	AP
انز	extract	əxz	velar + alveo-fricative	ə xəz
سب	congestion	həbs	Bilabial stop + alveo-fricative	həbəs
لفظ	word	lɔfz	labiodental + alveo-fricative	lɔfəz
قرض	loan	qərz	trill + alveo-fricative	qərəz
قبض	constipation	qəbz	bilabial stop + alveo-fricative	qəbəz