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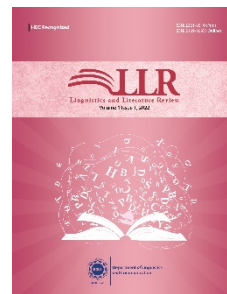|	
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An Orthographic Analysis of Sound Changing Rules in the Urdu Language

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Abstract

The current study aims to determine the sound-changing rules in the Urdu language and their underlying causes. For this purpose, words that exhibited distinct pronunciations as compared to their written forms were selected for the study. A list of 500 words was prepared from the Urdu dictionary "Feeroz-ul-Lughat," and twenty (20) proficient Urdu language speakers were selected to articulate these chosen words. The study's analysis was divided into three stages, namely recording, transcribing, and examining the speakers' pronunciations to identify the sound changing patterns; consulting the dictionary for standard transcriptions; and phonetically and orthographically transcribing and examining the selected words. The findings revealed various contextual occurrences in which phonological changes had occurred. Additionally, after a thorough examination, the evidence supporting or contradicting the existing sound-changing rules was explored through the selected words from the Urdu language. Markedly, this study aims to enhance the understanding of the phonological dynamics in spoken Urdu expressions as well as the major factors contributing to sound changes in the Urdu language.

Keywords: orthographic analysis, phonological constraints, sound changing rules, Urdu language

Introduction

Phonology is the field of study that examines how phonemes, or speech sounds, are classified and utilized in a language. It involves investigating the patterns of phonemes, the fundamental building blocks of language sounds, as well as their interactions and evolutionary changes (Cole & Hualde, 2011). Within phonology, researchers have identified phonological rules that govern sound changes and distinguish distinctive sounds in a language. The a fore mentioned rules play a crucial role in determining the possible combinations of sounds within a language's systematic framework,

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ultimately influencing words pronunciation to create meaningful expressions. Linguistic use phonemic transcription to express a method that represent words by using their basic sounds found in a particular language. Unlike phonetic transcription, which provides more extensive information on speech patterns, phonemic transcription focuses primarily on the key speech sounds (Fromkin, 2000, p. 489). Additionally, the morphology, or word structure, of words is a subject addressed by phonological rules (Odden, 2005). According to Jensen (2004), numerous studies have demonstrated that native speakers regularly and unintentionally employ phonological variants. Such variations are a common phenomenon among various languages across the globe, as languages may permit or restrict certain templates. The specific reasons for these limitations remain arbitrary and vary between languages. Despite the arbitrariness, there are remarkable and straightforward regularities in the functions of many phonological rules, even as they differ across languages. Some examples of phonological rules are mentioned here, highlighting the diversity and significance of these rules in shaping the phonetic landscape of languages.

1. *Assimilation:* It is a process by which two dissimilar sounds blend. For example, a nasal becomes a bilabial for the ease of speaking. This is primarily a speaker-oriented process. (Roach, 1992)

2. *Dissimilation:* It is a process in which two similar sounds have been altered for the listener's convenience. For instance, /fifəs/ into /fifts/.

3. *Epenthesis (Insertion):* In this sound-changing rule, one syllable structure that is subject to specific limitations causes speakers to introduce a vowel. For instance, /rizk/ /riz∂k/

4. *Deletion:* This sound-changing rule removing a segment is the opposite of the rule that involves inserting it. However, the goal, syllable rearrangement, can still be the same. In Urdu, /h/ at the end is quite common. As Ashamed: /∫∂rmɪ ndah/ /∫∂rmɪnda/

5. *Metathesis:* It is the phoneme of speaking reverse, for instance, /rik∫α/ becomes /ri∫kα/. This is only changing the order of sounds, not deletion or addition.

Urdu Language

Urdu, spoken by approximately 100 million people worldwide, holds the status of the official language in Pakistan. It boasts a wide array of long

nasal, long non-nasal, and short vowels, along with sporadic diphthongs, rendering it to a phonetically rich language. In contrast to English, Urdu possesses a notably more consistent spelling system. The representation of each letter by its fundamental sound is known as phonemic transcription, owing to the one-to-one correspondence between letters and sounds. The Urdu language has borrowed vocabulary from various languages spoken by Indian army soldiers, earning it the nickname of "the army's language" or /ləʃkəri zəban/. The language has historically featured four primary dialects: Dakhani, now known as Daccani, Pinjari, now known as Rekhta, and Modern Urdu. It is commonly written in the Persian script, which evolved from the Arabic script with additional letters influenced by local native tongues. Notably, Urdu is written from right to left, which is quite a challenging task to employ, a context-sensitive, and cursive Perso-Arabic writing system known as Nastaleeq script. Wali ([2003](#)) suggested that the study of phonetic transcription of the orthographic type of Urdu can lead to the development of phonological principles. Understanding how these principles change in phonetic transcription significantly offers valuable insights into the intricacies of the Urdu language.

Problem Statement

In Urdu language, a word with the same part of speech and spelling may have multiple pronunciations. For instance, the word "love /məhəbbət̠/" can be pronounced as "/mʊhəbbət̠/" or "/mohəbbət̠/," and all variations are easily comprehensible to native Urdu speakers. However, these diverse pronunciations have occasionally led to debates and misunderstandings among language users. Therefore, it is crucial to explore various phonological variations and their potential causes within Urdu phonology. The current study aims to identify the perceived sound change regulations in the Urdu language.

Research Objectives

The current study aims to look at phonological changes that occur in the Urdu language. For this purpose, this study intends to conduct research through several research objectives, which are as follows:

1. To list the commonly observed phonological changes in the Urdu language caused by the orthography.

2. To investigate these orthographic patterns that trigger sound changes in the Urdu language.

3. To find out the linguistic causes of these orthographic patterns of sound-changing rules in the Urdu language.

Research Questions

The current study responds to the following objectives to answer the aforementioned research questions:

1. What are the commonly observed phonological changes in the Urdu language caused by orthography?

2. How do these orthographic patterns trigger sound changes in the Urdu language?

3. What are the linguistic causes of these orthographic patterns of sound-changing rules in the Urdu language?

Research Significance

This research is significant because it identified and presented some of the most prevalent sound change rules within the Urdu language, supported by the relevant data. The study primarily focused on exploring the phonetic and phonological processes that lead to well-recognized sound alterations in the Urdu language. These identified rules would be thoroughly explained and discussed in this research. The findings of this study hold significant implications for transcription, pronunciation, and orthographic patterns within the Urdu language. By shedding light on these sound changing rules, this work contributes to a deeper understanding of the phonetic dynamics that influence spoken expressions in the Urdu language.

Delimitation of the Research

This research specifically aims to uncover the impact of orthographic rules and its relevancy with sound changing rules in the Urdu language. Furthermore, this study excluded other phonological, morphological and, syntactic influences to precisely focus on orthographic rules.

Literature Review

Phonological rules play a crucial role in guiding speakers of a language regarding possible phonemic combinations and various alternative pronunciations (Odden, 2005). In essence, phonological rules can replace the term "morphology" because phonemes, the fundamental building blocks

of language, also influence word morphology. This leads to significant potential morphological combinations that result in different pronunciations to create meaningful word forms (Jensen, 2004). In connected speech, unintentional and unavoidable phonological differences contribute to various sound changes, which is an impact of the orthographic rules (John, 1980). This sound changing is often referred to as phonological variations, which can result from the interaction of various linguistic factors. When speakers pronounce words in real-world communication, they often adapt their speech to achieve clarity and ease of articulation, leading to alterations in the phonetic patterns. Sound changing rules refer to alterations in the phonetic pattern of a language, which usually involves the addition or reduction of certain phonological elements (Lehmann, 1992). These rules modify specific features of phonemes, such as, articulation location, velum position, glottal articulation, openness, fronting, or labial articulation of vowels (Lehmann, 1992). The sound changes can be observed across various contexts, and they have a natural direction determined by the linguistic structure of a particular language.

In the recent scenario, sound changes are now primarily represented by distinctive features rather than rigid rules, as they were in the past. Lehmann (1992) classified sound changes into two types: conditioned and unconditioned changes. Conditioned changes occur in specific environments, while remaining the same in all others, whereas unconditioned changes affect the phonemes in all possible environmental contexts, albeit rare (p.191-194). These changes may occur due to the influence of neighboring sounds, syllable structure, or even cultural and social factors. Simple explanations of sound changes are often implausible; attributing all phonemes /x/ changing to /y/ at time z. Sound changes are much more nuanced and context-dependent. They can be manifested as mergers or splits, where a sound either merges with another phoneme's pronunciation or allophones of one phoneme diverge so much that new phonemes are created (Lehmann, 1992).

Understanding sound change rules is essential for grasping the dynamic nature of language. It sheds light on how languages have evolved and adapted approaches according to their speaker's needs. These changes occur gradually and can be driven by various factors, including language contact, migration, cultural interactions, and technological advancements. Sound changes contribute to the uniqueness and diversity of languages, making

each language a rich tapestry of historical developments and linguistic innovations.

The majority of structuralists in Europe and America believed phonetic processes to be "blind" to sound alterations, but Jakobson (1929) challenged this notion. Jakobson proposed that sound changes adhere to universal Grammar rules, implying universal implications. He likened sound change to an evolutionary biological process, making it both mechanically and structurally dependent. This perspective highlighted the intricate relationship between linguistic principles and the natural evolution of languages. Sound changes are often considered within the context of words and these rules often impact the pronunciation and structure of words, affecting the way they are articulated and understood by native speakers. By studying sound changes, linguists gain valuable insights into the historical development and ongoing transformation of languages, such as Urdu. Some universal sound change rules are mentioned here.

Principle 1. Unstressed syllables are more vulnerable than stressed syllables. The universal syllable types usually found in all languages are V and CV.VC and CVC patterns, with consonants following the vowel, are common but not universal.

Principle 2. Final consonants in a syllable are more vulnerable than initial consonants.

Principle 3. In consonant clusters, approximants vintage to an adjacent resilient consonant. However, outer consonants are more vulnerable than inner.

Principle 4. (a) In the final position, voiced sounds are more vulnerable than voiceless sounds, (b) Intervocalic ally, voiceless sounds yield to be voiced, (c) In the initial position, voiceless unaspirated sounds take priority.

Principle 5. In assimilation, the voicing value is determined by the second of the two consonants. The voicing value of a consonant may also change through assimilation: a voiced consonant becomes voiceless when preceding another voiceless consonant.

Principle 6. The place of articulation revenues to the second in assimilation. e.g. /n/ into /m/.

Principle 7. The manner of articulation changes are determined by the strengthening, as unstressed vowels may reduce to /∂/ losing their idiosyncratic properties (Hawkins, 1984).

The relationship between phonological forms and orthographic representations of words is a significant area of study in psycholinguistics. Previous research (Perre & Ziegler, 2008; Taft, 2001) has demonstrated the impact of spelling on phonemic awareness and word recognition. Orthography, as defined by the Oxford Dictionary, is the study of how letters are used to represent sounds and form words, encompassing spelling rules and conventions. Neo-grammarians depicted sound alteration as a solely phonetically conditioned process that occurs during speech production. These sound changes occur gradually, often spanning hundreds of years rather than decades (Hawkins, 1984). Mattingly (1972) emphasized the connection between spellings and phonological awareness of syllables, phonemes, and rimes in spoken words, highlighting the role of orthographic and morphological awareness in literacy learning.

However, many languages exhibited inconsistencies between their phonological rules and orthography. In such languages, spelling is irregular and does not consistently represent sounds (Kiani et al., 2011). This inconsistency violates the fundamental principle that each letter should represent one sound and each sound should be represented by one symbol. English is one such language, which use only 26 letters to represent 40 basic sounds (Fromkin, 2000). In the context of the Urdu language, the character set consists of 38 basic shapes without including 'Aerab' or diacritics used for pronunciation and vowel sounds. Urdu utilizes an opaque and challenging orthographic method, widely spoken, nevertheless it's less understood (Schmidt, 2003). The absence of vowel letters and the discreet use of diacritics in Urdu script pose challenges for readers (Rao et al., 2010). Although Urdu and Hebrew both lack vowel letters and diacritical marks, there are variations between them, with Urdu's cursive nature adding to its complexity (Farukh & Vulchanova, 2014).

The examination of phonological and orthographic interactions in languages like Urdu is crucial for gaining insights into the processes underlying reading and writing. Understanding how phonemes and letters interplay can aid language learners in improving their literacy skills and pave the way for effective language instruction strategies. Thus, by exploring the connections between phonological forms and orthographic

representations, researchers contribute to the broader understanding of language development and acquisition, fostering language fluency and proficiency in multilingual societies.

Figure 1

Urdu Alphabets

ا ب پ ت ٹ ث ج چ ح خ د ڈ ذ ر ڑ ز ژ

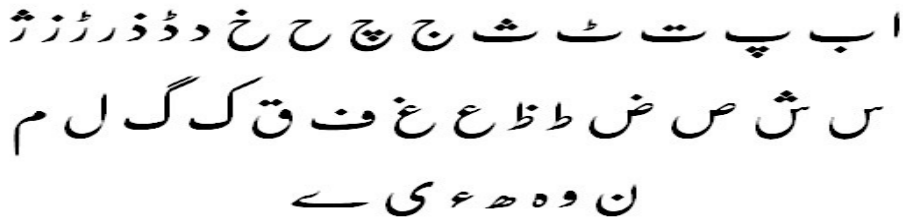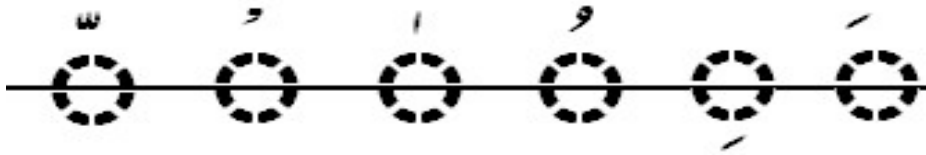س ش ص ض ط ظ ع غ ف ق ک گ ل م

ن و ہ ھ ء ی ے

Figure 2

Aerab (Diacritics)

In all languages, speakers possess abstract concepts of the sounds they produce, believing they accurately perceive the verbal sounds they articulate. However, there often exists a disparity between speakers' perceptions of the sounds they use in their language and the actual sounds they produce. To understand this phenomenon, linguists employ the terms "underlying representation" (UR) and "surface form" (SF). The underlying representation represents the speakers' mental phonemic abstract notions of language sounds, while the surface form refers to the real phone production in practice. To connect these two levels of representation and explain how particular allophones appear on the surface, linguists use rules to bridge the gap between the underlying and surface forms (Okum, 2015). By studying the relationship between UR and SF, linguists gain valuable insights into the complex processes that underline language production and perception.

Phonemic Form (UR)

↓

Rules

↓

Phonetic Form (SF)
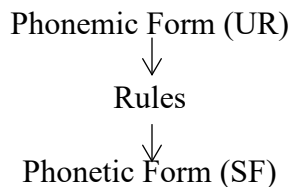
Urdu Phonological Rules

No serious effort has been made in studying the phonological rules governing the Urdu language. Additionally, other languages, especially English has seen a lot of developments. Fromkin (2000), Napoli (1996), and Clark & Yallop (1990) emphasized that comprehensive set of rules established for the languages plays a crucial role in understanding their structure ad usage. The basic and secondary Urdu letters, as well as the aerab, are shown in Figure 2. When these characters are combined together, a wide range of 44 consonants, 8 long oral vowels, 7 long nasal vowels, 3 short vowels, and a lot of diphthongs are produced (Saleem, 2002; Hussain 1997). The character set includes; basic and secondary letters, aerab (or diacritical marks), punctuation marks, and special symbols (Hussain & Afzal, 2001). There is forthright relation between sound change and the dialect or accent difference. Urdu does not allow two consonants at the initial position. So, consonant cluster at the initial stage does not exist, for instance, /skul/ becomes /ɪskul/ but in English it is very common as plate, speak, tree, skip, spreɪ, and many others. Nevertheless in Urdu Dictionary only two words are exceptions those are /prem/ and /pret∂m/. There is one constraint in the Urdu language that Words cannot be ended in short vowels. As the /n/ sound changes in the word /sanmp/ but not in /anmol/. For instance, changes in pronunciation might arise spontaneously out of the well-known phonetic variability of speech, while endogenous changes at higher levels of structure might be rare or non-existent. According to phonologists, the same process of sound change occurs in language acquisition, such as in common sound change of [s], →[h], and [h] →[Ø].

Some children pronounce silly as hilly, messy as mehi, in these sounds the /h /dropping is quite common in Urdu as well. There are many words in Urdu that are borrowed from Arabic, which end in "ئ", for example,. علی،ا د نی،مو سی. . Phonetically these words are pronounced as if the ending letter is "ا" instead of "ئ". So, this is a difference in pronunciation and transcription. The basic thing is that sound changes have an inherent direction that is set by their own idiosyncratic structure. (Hussain, 2004).

[mɪs], [fɪp], and [mæg] would be turned into[ms-Iz], [fip-s], and [mæg-z]. The fact that the native speaker will pronounce [mæg-z], rather than*[mæg-Iz] or *[mæg-s]. If the speaker came across the pronunciation or not because of the distribution of the allomorphs of the plural suffix, -Iz after sibilants, -s after voiceless non-sibilants, and -z after voiced non-sibilants.

The form of the plural depends on the nature of the last sound

If the noun ends in sibilant ([s], [z], [ʃ], [ʒ], [tʃ], [dʒ]: it takes [ɪz]

If the final sound is a voiceless non-sibilant: it takes a voiceless alveolar fricative [s]

If the final sound is a voiced non-sibilant: it takes a voiced fricative [z]

[Sonorant] = [voiced]   [Obstruent] = [voiceless]

The application of the rules of generative phonology, as outlined by Chomsky and Halle's ([1968](#)), rule orders is closely related to the rules themselves.

Urdu Letter to Sound Rules

a. Consonantal characters

b. Characters with dual (consonantal and vocalic) behavior

c. Modifier character for a vowel

d. Modifier character for a consonant

e. Vocalic and consonantal composite character

Aerab Set to Sound Rules

The Aerab set can similarly be broken down into the following groups:

a. Basic vowel specifier

b. Extended vowel specifier

c. Consonantal germination specifier

d. Dual (vocalic and consonantal) insertor

e. Vowel-aerab placeholder

Three characters of the Urdu language show dual behavior in certain contexts when they transform into consonants, as soon as they become vowels. These names are Alef (ا), Vao (و), and Yay (ی or ے). When Vao and Yay are in consonantal situations, they transform to the approximate /v/ sound and /j/, respectively (in the onset or coda of a syllable). However, they create lengthy vowels when they are the foundation of a

syllable. Consonant and vowel in the /bæl/ بیل sound as (یا ر) jar. Unlike various other languages, Urdu language only uses one consonant to represent each character in this category. Urdu has three fundamental vowels aerabs Zabar (Arabic Fatha), Zer (Arabic Kasra), and Pesh (Arabic Damma). The Alef Madda (آ). This character is a stylistic way of writing two Alefs, thus, it represents an Alef in consonantal position, and an Alef in vocalic position, forming /a/ vowel, for instance, اب (/∂b/, "now") vs. اب (/ab/, "water") (Hussain, 2004).

Minimal Pairs in Urdu

Letter Noon Ghunna (ں), which does not add any additional sound to the string but only nasalizes the preceding vowel. In Urdu it changes the meaning, for instance, (/ʤɑ/, "go") vs. (ʤã/, "life"). In English, aspiration has no bearing at all but in Urdu, it changes totally the meaning of words, such as /bap/ father /bʰap/ steam. Letters 'alif', 'dal', 'ray', and 'vao' only have two forms. These letters lack an initial or medial shape because they cannot link from the front with the following letter. In the end, it was determined that Urdu has fourteen vowels out of which, seven are long and seven are short (corresponding to each long vowel). Vowels, are more open than consonants, and they are an integral part of every language of the world.

Figure 3
Relative Vowel Qualities
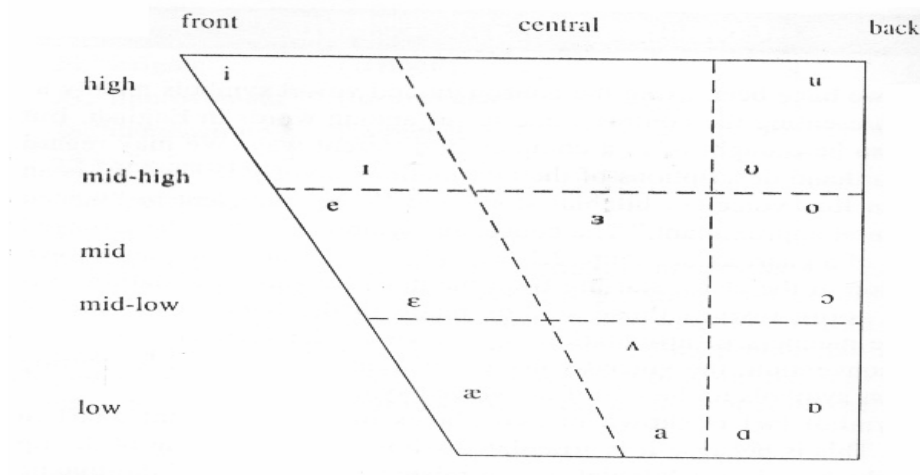
Hussain ([1997](#)) mentioned in his thesis that in Urdu, only long vowels and consonants are written. Short vowels are only represented by diacritics, for instance, zabar, zer, and pesh. The vowel system established by Kachru ([1990](#)), and Hussain ([1997](#)) has undergone some additions (Khan, 1997, p. 41).

Letter-to-Sound Conversion

Urdu has a fairly regular mapping between its graphemic and phonemic representations.

Letter-to-Sound conversion process
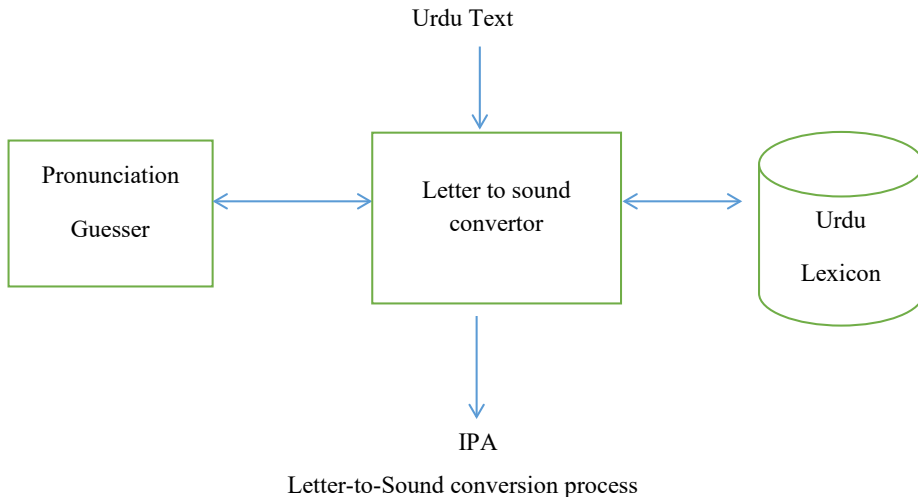
Sound Change Rules in Urdu

Urdu displays multiple sound change rules due to co-articulation, giving an improved surface or phonetic form to represent the underlying phonemic string. The Phonemic form is evident in the orthographic representation of words in many cases. Hussain ([2005](#)) suggested the following rules in the Urdu language.

- *Velar assimilation* n → [+velar]/____ [+stop, +velar, -nasal]
- *Nasal assimilation* V [+long] → [+nasal]/____[+nasal]
- */h/ deletion and vowel lengthening* V [+short] h → [long]#
- */h/ deletion* h →Ø / V[long]____#

Stress Assignment

Syllable weight affects stress in the Urdu language. A moriac count of each syllable can be used to illustrate this weight. Short vowels tend

to be lighter than long vowels. Short vowels are mono-moraic in Urdu, whereas long vowels are bi-moraic. Each coda consonant has a weight equivalent to a single mora. Table 1 below shows the moriac count of various syllable templates of Urdu.

Table 1

Urdu Syllable Template	Moraic Count
CV	1
CVV	2
CVC	2
CVVC	3
V	1
VV	2
VC	2
VVC	3

Methodology

Nature of the Study

The aim of this study is to conduct an orthographic analysis and identify sound changing rules in the Urdu language. Therefore, the nature of the study is a qualitative approach, this approach allows for a comprehensive investigation of the phonetic and phonological changes that occur in the Urdu language.

Research Instrument

To achieve the objectives of the study, a word list of 500 words was prepared. These words were randomly selected from the dictionary based on their property to be pronounced differently from their written forms. The 2019 edition of the Urdu dictionary "Feeroz-ul-Lughat," containing approximately 25,000 words, served as the prime subject of investigation.

Participants

A sample size of twenty participants of varying ages and genders (male and female) were chosen as speakers to pronounce this prepared word list. These participants were native Urdu language speakers with their mother tongues being Saraiki, Punjabi, or Urdu, and they were conveniently selected from public universities in Pakistan, ranging from 18-35 years of

age and holding undergraduate and graduate degrees, ensuring their familiarity with the Urdu language.

Data Collection

The chosen participants' audio recordings served as the primary form of data collection. These participants received the prepared word list along with some instructions and; consequently, the audios were recorded. It was ensured that the people who were chosen for the data collection would be familiar with these words. Using PRAAT software, the participants' pronunciation of the words was recorded in an acoustic chamber at 8000Hz (Farukh et al., 2014).

Analytical Framework

The analytical framework adopted for this study draws heavily from the research of renowned linguists like William Labov, Patricia Keating, John Wells, Alan Cruttenden, and Mirjam Ernestus, who have extensively explored phonetic variation, sound changes, and phonological processes in various languages, including the English language. These scholars have utilized phonetic and phonological analysis, including phonemic transcription, as a fundamental approach to investigate the intricate nuances of speech sounds and dialect variations. Their studies have inquired a detailed phonetic analysis of speech recordings and experimental methods to delve into the complexities of sound patterns and phonetic shifts. The use of this method by multiple linguists adds to its credibility and authenticity, making it a common and reliable choice in linguistic research. This orthographic analysis of the prepared words list conducted on three different levels. First, Phonemic Transcription: The audios of the participants were transcribed into phonemic symbols to capture the specific sounds used by the speaker of the Urdu language. The speech data was annotated using the International Phonetic Alphabet (IPA). Second, analysis of pronunciations: examining the pronunciations of words by native speakers to identify any sound changes or variations. Third, making comparison with dictionary transcriptions: comparing the transcriptions of words in dictionaries with the actual pronunciations to identify phonemic (orthographic), phonetic discrepancies, and sound changes. This comparison revealed various environments in which phonological changes were observed. Based on this analysis, new sound changing rules were formulated. Some sound changing rules, such as assimilation, deletion, metathesis, and insertion, were already

known from the previous research, which were highlighted in the subsequent literature review. Thus, by analyzing several hundred words, this study identified and devised new sound changing rules in the Urdu language. The research findings contributed to a better understanding of phonological patterns and sound changes in Urdu.

Results and Discussion

The Table 2 below presents the concise results of the research conducted on orthographic analysis of sound-changing rules in the Urdu language. The first objective of the study was to compile a list of sound change rules of Urdu language frequently influenced by orthography. Consequently, the table encompasses the following information.

The first column represents name of the sound-changing rules that were observed in the Urdu language during the analysis. These rules were, namely Assimilation, Dissimilation, Deletion, Metathesis, Insertion, Nasalization, and Meaning Change. The second column indicates the number of different pattern variations that were found for each sound-changing rule. For example, for the "Assimilation" rule, there was one pattern variation observed, for "Dissimilation," there were three visible pattern variations, and so on.

A pattern variation refers to different contexts or conditions under which a particular sound-changing rule is usually applied. For instance, the "Assimilation" rule has one pattern variation, meaning that it occurs in a specific way under one condition. On the other hand, the "Deletion" rule has eight pattern variations, suggesting that it is more versatile and can be manifested in various ways; based on different linguistic factors.

Table 2

Sound Changing Rules and Pattern Variations in Urdu Language

No#	Frequent found Sound Changing rules	Pattern variations
1	Assimilation	1
2	Dissimilation	3
3	Deletion	8
4	Metathesis	1
5	Insertion	2
6	Nasalization	1
7	Meaning change	1

1.Assimilation

It is noticed that in the Urdu language, some words take the alveolar nasal sound /n/ in their orthographic form but when uttered the alveolar nasal /n/ changed into the bilabial nasal /m/. The participants also applied the same pattern, while pronouncing these words. Similarly, the standard Urdu transcription for these words also used the same phoneme. According to Roach ([1992]), such a phenomenon is known as assimilation.

Pattern No. 1: In the phenomenon observed, whenever an unaspirated voiced alveolar nasal /n/ precedes an unaspirated bilabial stop, it undergoes a sound change and becomes an unaspirated voiced bilabial nasal /m/. This pattern is evident in various words, including [kanp], [dhanp], [konpəl], [gʊnbəd], [tʃənbeli], [anbrin], and [kʊnbə]. Table 3 presents some of these words for the reference.

Table 3
Assimilation

		Alveolar nasal sound /n/ changes into bilabial nasal /m/	
No	Words	Orthographic (phonemic) form	Speakers (phonetic) form
1	انبار	/anbar/	/ambar/
2	سنبل	/sunbal/	/sumbal/
3	سانپ	/sanp/	/samp/
4	چنپا	/tʃ∂np∂/	/tʃ∂mp∂/
5	انبیاء	/anbia/	/ambia/
6	انبساط	/anbisat/	/ambisat/
7	زنبیل	/zanbil/	/zambil/
8	زنبور	/zanbur/	/zambur/
9	ذنب	/zanb/	/zamb/
10	جنبش	/dʒʊnbish/	/dʒʊmbish/
11	سنبل	/sʊnbal/	/sʊmbal/
12	منبہ	/munba/	mumba
13	سنبھل	/sanbʰal/	/sambʰal/

Cause of Assimilation

This process of sound change is caused by the speakers and speakers go for alternate sounds for ease of speech. Zia (2002) was of the view that the Urdu language has this pattern if a nasal consonant is followed by a consonant that is at the labial place, the particular nasal consonant becomes bilabial. The words below show a change of consonant place of articulation from alveolar to labials.

2. Dissimilation

It is noticed that in the Urdu language, some words take Flap[r] in their orthographic form but when uttered they change into the Retroflex [ɽ]. The participants also applied the same pattern, while pronouncing these words. Additionally, the standard Urdu transcription for these words is also used like the same phoneme.

Pattern No. 1: The sound of the flap[r] becomes retroflex [ɽ] after the alveolar stop. For example word گَھاٹی /gʰatri/ the sound of flap "[r]" becomes retroflex "[ɽ]" after the alveolar stop.

Table 4
Dissimilation (a)

No	Words	Orthographic (phonemic) form	Speakers (phonetic) form
1	گَھاٹی	/gʰatri/	/gʰat ɽ i/

Similarly, another word also undergoes the same pattern that word is پنچھ /pantʃʰ/ the unaspirated voiceless palatal stop sound [tʃ] becomes aspirated voiceless palatal stop [tʃʰ] at the end of the word. Another word, انت /unt/ unaspirated voiceless palatal stop changed into /untʰ/ aspirated voiceless palatal stop because an unaspirated sound became an aspirated sound. This situation is known as dissimilation where two similar sounds are made dissimilar for ease of hearing. The rules governing these changes are dissimilation rules. Zia (2002) said that the dissimilation rules in the Urdu language don't follow specific rules, they seem quite random.

Pattern No. 2: When the alveolar comes after the nasal it becomes aspirated. The sound" [tʃ] becomes [tʃʰ] aspirated in the end of the word.

Table 5

Dissimilation (b)

No	Words	Alveolar come after nasals it becomes aspirated (Sound [tʃ] becomes [tʃʰ] aspirated in the word end)	
		Orthographic (phonemic) form	Speakers (phonetic) form
1	پنچ	/pantʃ/	/pantʃʰ/
		Sound [t] becomes [tʰ] aspirated in the word	
2	انت	/unt/	/untʰ/

Another interesting pattern was detected during the analysis in the Urdu language, indicating that aspirated sounds at the end of the words are not allowed. So, aspirated consonant at the word boundary becomes unaspirated. For example, in the word دودھ /dʰ/ aspirated voiceless dental stop becomes /d̪ /unaspirated voiceless dental stop as in /d̪ud̪ʰ/ becomes [d̪ud̪] and word ٹھٹھا /tʰ∂tʰa/, which dissimilates to /tʰ∂ta/.

Pattern No. 3: Aspirated sounds on word edges become unaspirated.

Table 6

Dissimilation (c)

No	Words	Aspirated sounds on word edges becomes unaspirated	
		Orthographic (phonemic) form	Speakers (phonetic) form
1	دودھ	/d̪ud̪ʰ/	/d̪u d̪/
2	ٹھٹھا	/tʰ∂tʰa/	/tʰ∂ta/

Cause of Dissimilation

According to Alderete (1997), similar sounds generally require less articulatory effort to produce dissimilar sounds. However, in certain cases, the speaker may need to make two sounds less similar to each other due to the distinctiveness factor. For instance, if two consonants share the same place and manner of articulation and are very similar, they are likely to dissimilate. As a result, two adjacent sibilants may undergo dissimilation.

3. Deletion

It is a very common phenomenon in languages around the world. The major cause of this process is the laziness of the speakers' in the articulation process. In the Urdu language, this process plays multiple roles. A pattern is observed in the Urdu language that words do not end with a short vowel

that's why when /h/ is deleted. Then the short vowel becomes a long vowel to fill the empty time slot of /h/. The reason for /h/ deletion occurs at the of the word's final position because it is articulated without stress in the word (Farooq & Mumtaz, 2016).

Pattern No. 1: A rule that deletes the /h/ sound and lengthens the short vowel.

Table 7
Deletion (a)

No	Words	Deletion of /h/ sound and lengthening of the short vowel	
		Orthographic (phonemic) form	Speakers (phonetic) form
1	شرمنده	/ʃ∂rmɪ ndah/	/ʃ∂rmɪnda/
2	تشبیہ	/t̪∂ʃb ɪ h ɪ/	/t̪∂ʃbi/
3	تراویح	/t̪∂rav ɪ h/	/t̪∂ravi/
4	تسبیح	/t̪∂sb ɪ h /	/t̪∂sbi/
5	رابطہ	/rabt∂h/	/rabta/
6	پندره	/p∂ndr∂h/	/p∂ndra/
7	خدشہ	/x∂dʃ∂h/	/x∂dʃa/
8	وجہ	/v∂d ʤ∂h/	/v∂d ʤa/

In a likewise manner, in the case of deletion, one more distinguished pattern was observed that aspirated voiceless glottal stop /ʔ/ is normally not articulated in all contexts in the Urdu language. It is only articulated at the word beginning; however, that again depends on the speaker.

Pattern No. 2: Deleted aspirated voiceless glottal stop /ʔ/ after a vowel.

Table 8
Deletion (b)

No	Words	Deleted of glottal stop /ʔ/ after a vowel.	
		Orthographic (phonemic) form	Speakers (phonetic) form
1	عظم	/ʔ∂z∂m/	/ɑz∂m/
2	دعا	/d̪ʊʔa/	/d̪ʊa/
3	عادت	/ʔad∂t/	/ad∂t/
4	عجیب	/ʔ∂ʤib/	/∂dʤib/
5	عرصہ	/ʔ∂rsa/	/∂rsa/
6	عید	/ʔid̪/	/id̪/

Additionally, long vowel deletion is not permitted in the Urdu language, whereas short and medial vowel deletion is casually allowed (Farooq & Mumtaz, 2016). Here, it is observed that the words with a medial cluster at the phonetic level have alternating forms with clusters broken up by schwa. Plus, a suffix and inflectional ending, for instance, both /n∂m∂k/ and /n∂mkin/ have /n∂m∂k/ in their underlying forms, and then a perfectly general rule is made of the delete the schwa.

Pattern No. 3: Deletion of short vowel /∂/ Schwa.

Table 9
Deletion (c)

No	Medial cluster (phonemic) form	Cluster broken up (phonetic) form
1	l∂t∂k	l∂tka
2	∂t∂k	∂tka
3	p∂k∂r	p∂kra
4	m∂t∂k	m∂tka

Furthermore, one new pattern was observed during the analysis of the words alif, which represent a central vowel /a/ sound when appearing at the start of the syllable it is deleted and in transcription, the vowel sound represented by this letter is deleted.

Pattern No. 4: Deletion of Alif /a/ central vowel sound when it comes before lateral alveolar /l/.

Table 10
Deletion (d)

No	Words	Alif /a/ central vowel sound is deleted when it comes before lateral alveolar /l/	
		Orthographic (phonemic) form	Speakers (phonetic) form
1	با لکل	/bɪalkul/	/bɪlkʊl/
2	با لفر ض	/bɪalf∂rz/	/bɪlf∂rz/

One unique pattern was identified as aspirated, voiceless, glottal stop /h/ got deleted if it came after the unaspirated, voiced, velar nasal /n/ that was replaced by a nasal vowel. The following examples demonstrated that each time aspirated, voiceless, glottal stopped, it came after the unaspirated,

voiced, velar nasal /n/, and was replaced by back nasal vowel /ũ /and central nasal vowel /ã/.

Pattern No. 5: Deletion of /h/ sound when /n/ is nasalized and replaced by a nasal vowel

Table 11
Deletion (e)

No	Words	Orthographic (phonemic) form	Speakers (phonetic) form
		Deletion of /h/ sound when /n/ is nasalized and replaced by nasal vowel	
1	منہ	/mnh/	/mũ/
2	با نہہ،	/bnh/	/bã/

Another striking pattern of deletion of unaspirated voiced nasal /n/ sound was noticed in the Urdu language if a word has two syllables and the first syllable's last sound is nasal /n/ then it would be deleted during the pronunciation of the word and the vowel sound before it would be nasalized. The important thing to note here is that if the vowel appeared before nasal /n/ is a short vowel sound then it will be changed first into a long vowel and then nasalized. In the table given below, it is evident that each time a nasal /n/ was deleted the short vowel simultaneously changed into a long nasal vowel.

Pattern No. 6: Deletion of /n/ and nasalization of vowel.

Table 12
Deletion (f)

No	Words	Orthographic (phonemic) form	Speakers (phonetic) form
		Deletion of /n/ and nasalization of vowel	
1	کنوان	/kʊnvã/	/kũã/
2	کنول	/k∂nv∂l/	/kãv∂l/
3	گنوار	/g∂nvar/	/gãvar/

The deletion of unaspirated, voiced, palatal stop /j/ occurs in words medially to form a diphthong. If an unaspirated, voiced, palatal stop /j/ occurs before the long vowel sound then in pronouncing the speaker will not utter the /j/ sound in fact it changes into a diphthong.

Pattern No. 7: Deletion of unaspirated, voiced, palatal stop /j/ replaced by a diphthong.

Table 13

Deletion (g)

Deletion of unaspirated, voiced, palatal stop /j/ replaced by diphthong			
No	Words	Orthographic (phonemic) form	Speakers (phonetic) form
1	کیوں	/kɪjũ:	/kɪũ:/
2	کیا	/keja	/kæa/

However, in some cases, unaspirated, voiced, palatal stop /j/ deletion occurs without making a diphthong as in the words given below. It is evident from these examples that the unaspirated, voiced, palatal stop /j/ was deleted and replaced by a vowel sound.

Pattern No. 8: Deletion of unaspirated, voiced, palatal stop /j/ replaced by long vowel sound.

Table 14

Deletion (h)

Deletion of unaspirated, voiced, palatal stop /j/ replaced by long vowel sound			
No	Words	Orthographic (phonemic) form	Speakers (phonetic) form
1	حیثیت	/hæ:sɪjjət̪/	/hæ:sɪ:ət̪/
2	لیے	/lɪje:/	/lɪe:/

Cause of Deletion

Most of the time it is observed that speakers do not tend to articulate it. The reason for its deletion in the word is that whenever it occurs after a vowel, which lengthens to occupy its time slot,it gets deleted. According to Waqar and Waqar (2002) speakers deleted phonemic segments due to their laziness, which is another factor, responsible for the change in pronunciation.

4.Metathesis

There is no denying that metathesis doesn't happen often; yet it happens roughly in every language in the world. This process is different from other phonological processes because of its unpredictable nature and

irregularities. It is also considered a unique process because of its existence in other processes, speakers simplify the utterances. Whereas in metathesis, segments order changes to replace, excluded, and, disfavored a sequence with an accepted one (Baloch et.al, 2017). For instance, in the word نقصان /nuqsan/ the sounds in the middle segment of the word switched their places. In a likewise manner, a sequence is made, which is accepted by the speakers. The same situation has been noticed in the word /kechar/ and /riksha/ in which segments of the words are reordered by the speakers for the ease of pronunciation.

Pattern No. 1: The rule that transposes or reorders two sounds or sound sequences are usually adjacent to each other.

Table 15
Metathesis

| No | Words | Transposes or reorders two sounds or sound sequences | |
		Orthographic (phonemic) form	Speakers (phonetic) form
1	نقصان	/nuqsan/	/nusqan/
2	ركشہ	/riksha/	/rishka/
3	کیچڑ	/kechar/	/chekar/

Cause of Metathesis

The cause of metathesis sound change rule in the Urdu language that can be attributed to the reordering or transposition of sounds within a word. This phenomenon may occur due to natural speech patterns, articulatory ease, or the influence of neighboring sounds in the word.

5.Insertion

In this process, one phonemic feature is added to the word. However, in the case of the Urdu language insertion process works in two ways but a little differently. First, it is noticed that in the Urdu language, if a word has a consonant cluster at the onset, then a vowel sound is added at the start of the word. For instance, in the case of the word سکول /skul/ after the insertion of a vowel sound became /iskul/. In this phonological rule, a word ended up having two pronunciations. One is the standard pronunciation /skul/ and the other is the alternative pronunciation, which came into being because of the insertion process /iskul/. According to Hulst (1979), the insertion process

occurred in a language because of the speakers' attitudes, hypercorrection, generalization, and overuse of the norms.

Pattern No. 1: There is the insertion of vowels in the words, which have consonants cluster at the onset because the Urdu language does not allow consonant clusters at the onset.

Table 16
Insertion (a)

| No | Words | Insertion of vowel in words in onset | |
		Orthographic (phonemic) form	Speakers (phonetic) form
1	سکول	/skul/	/iskul/
2	سٹول	/stul/	/istul/

Second, if a word has a consonant cluster in the coda, then a vowel sound is added to the coda of the word. For instance, in the case of the word آمر / əmr/ after the insertion of a vowel sound became /əmər/. In this phonological rule, a word usually end up having two pronunciations. One is the standard pronunciation /əmr/ and the other one is the alternative pronunciation, which came into being because of the insertion process /əmər/.

Pattern No. 2: There is an insertion of vowels in the words which have consonant clusters in the coda.

Table 17
Insertion (b)

| No | words | Insertion of vowel in words in coda | |
		Orthographic (phonemic) form	Speakers (phonetic) form
1	آمر	/əmr/	/əmər/
2	قبر	/qəbr/	/qəbər/

Cause of Insertion

The major reason for insertion in Urdu language is the articulation time of articulators (Panevov & Hana, 2010). Speakers' attitudes, such as hypercorrection and generalization about rules, also equally contribute to this phenomenon, as they tend to overdo things they like or dislike.

6.Nasalization

It is often noticed that in the Urdu language, every long vowel that comes before a nasal and is included within a syllable is nasalized. Short vowels are unaffected and the letter "m" has no impact on nearby segments. For instance, in word من /mann/ changes into /mãnn/.

Pattern No. 1: Every long vowel that comes before a nasal that is included within a syllable is nasalized.

Table 18

Nasalization

| No | words | Long vowel comes before a nasal also nasalized | |
		Orthographic (phonemic) form	Speakers (phonetic) form
1	من	/mann/	/mãnn/
2	ہانڈی	/handi/	/hãndi/

Cause of Nasalization

It is possible only in those languages that have nasal vowels. Therefore, the speaker of the language switches the oral vowel with the nasal vowel for ease of articulation.

7.Meanings Change

Sound changing rules are unique in the Urdu language because these rules not only introduce possible or non-possible combinations in the Urdu language but it also change the meanings of the words. For example, the preposition word, کا /kɑ/, when nasalized becomes /kɑ̃/ کا ں (sound of crow). Here the addition of the nasal vowel changes the meaning and category of the word. A preposition changes into an onomatopoeia word. Another word باپ /bɑp/ (father) is aspirated then it becomes بھاپ /bʰɑp/ (steam). Here, aspiration has changed the meanings of a word.

Pattern No. 1: Nasality and aspiration change meanings.

Table 19

Change meanings

| No | words | Nasality and aspiration change meanings | |
		Orthographic (phonemic) form	Addition (phonetic) form
1	کا	/ka/	/kɑ̃/ کا ں
2	باپ	/bɑp/	/bʰɑp/ بھاپ

Cause of Meaning Change

The cause of the meaning changes or sound changing rules in the Urdu language can be influenced by various linguistic and sociolinguistic factors. These may include, language contact with other languages, historical developments, borrowing of words, shifts in pronunciation patterns, and regional variations. Additionally, changes in social and cultural contexts can contribute to the evolution of word meanings in Urdu language.

Conclusion

The current study offers an orthographic analysis of the sound change rules in the Urdu language. Through phonemic and phonetic transcriptions of words, readers can readily identify the discrepancies between written and spoken forms. The findings of this analysis revealed that Urdu language speakers' articulate words according to various phonological contexts and rules, shaped by their acoustic training. While the alternative pronunciations may deviate from the orthographic transcription, they are widely employed by speakers as the prevailing speaking accent in Pakistan, remaining equally intelligible across the region. The rules presented in this study emerged from the analysis of orthographic patterns found in Urdu dictionaries and from speakers' pronunciations. The phonological variations encompass a range of phenomena, including the substitution of one consonant with another, the change from aspirated to unaspirated consonants and vice versa, consonant and vowel deletions, vowel insertions in coda and onset positions, nasalizing changes that alter meanings, and transformations of vowels into nasal vowels, among others. Furthermore, the research exposed various other pronunciation intricacies, which were not a part of this study, and were subjected to future investigation. Additionally, the study confirms the acceptance of certain pronunciations as "alternative pronunciations" among Pakistani Urdu speakers. Notably, the observed phonological and sound change norms, along with their acoustic variations, were consistent across all participants, allowing for their application to the broader Urdu-speaking community in Pakistan. This study provided valuable insights into the intricate sound change rules governing Urdu pronunciation. Thus, by delving into phonological patterns and acoustic variations would also enhance the dynamic phonetic landscape of the Urdu language and their understanding. These findings have various implications for language teaching, preservation of language, and research, contributing to a

comprehensive appreciation of diverse ways in which Urdu is spoken and understood in Pakistani context.

Suggestions

The current existing vocabularies of the Urdu language are undoubtedly valuable resources, as they furnish definitions, morphological particulars, and occasional word origins. Nonetheless, they come with specific constraints particularly in terms of keeping up with the evolving nature of language and incorporating recent language changes. As languages naturally evolve, new words, pronunciations, and meanings emerge, necessitating regular updates and expansions in the dictionaries. Therefore, it is suggested that to improve the comprehensiveness of the Urdu lexicon, and it becomes essential to consider the phonological information and sound change rules. By incorporating these aspects, dictionaries can offer valuable insights into the pronunciation patterns of various words, making it easier for users to access and understand different pronunciations. Phonetic information can serve as a useful resource for language learners, researchers, and enthusiasts seeking to delve deeper into the phonetic intricacies of the Urdu language. Furthermore, the study highlighted and suggested the importance of creating phonetic dictionaries specifically tailored to the Urdu language. Such phonetic dictionaries would not only record the phonological rules and sound change patterns in the language but also capture the acoustic variations employed by Urdu language speakers in Pakistan.

Recommendations

As a phonetically rich language with diverse regional dialects and accents, documenting these acoustic variations would provide a comprehensive view of how Urdu is spoken across different communities and regions. Phonetic dictionaries can serve as invaluable tools for linguists and language experts, aiding them in understanding the nuances of the Urdu language's pronunciation and facilitating research on phonological phenomena. Moreover, they can contribute to language preservation efforts, ensuring that the phonetic heritage of Urdu is documented and passed on to future generations accurately. In short, the incorporation of phonological information, sound change rules, and acoustic variations through phonetic dictionaries would undoubtedly enrich the Urdu lexicon. This step would not only improve the accessibility and usability of the language for learners

and researchers; nevertheless, it will also contribute to a deeper understanding and preservation of the unique phonetic characteristics of the Urdu language.

References

Alderete, J. (1997). Dissimilation as local conjunction. *Proceedings of North East Linguistics Society*, *27*(1), 17–32.

Baloch, H., Syed, N. A., & Hasan, G. (2017). Metathesis in Balochi. *Dialogue*, *12*(1), 96–106.

Chomsky, N., & Halle, M. (1968). *The sound pattern of English*. Harper & Row Publishers.

Clark, J., & Yallop, C. (1990). *An introduction to phonetics & phonology*. Basil Blackwell.

Cole, J., & Hualde, J. I. (2011). *Underlying representations*. In M. van Oostendorp (Ed.), *The Blackwell companion to Phonology* (1–26). Wiley Publishers.

Farooq, M., & Mumtaz, B. (2016). Urdu phonological rules in connected speech. *Language & Technology*, *4*(1), 15–23.

Farukh, A., & Vulchanova, M. (2014). Predictors of reading in Urdu: does deep orthography have an impact? *Dyslexia*, *20*(2), 146–166. https://doi.org/10.1002/dys.1474

Fromkin, V. A. (2000). *Linguistics: An introduction to linguistic theory*. Blackwell Publishers.

Hawkins, E. W. (1984). *Awareness of language: An introduction*. Cambridge University Press.

Hulst, V. H. (1979). Rule conversion in phonology. *Dutch Lexicological Institute Leiden. 14*(1), 336–349. https://doi.org/10.1515/9783110860023-027

Hussain, S. (1997). *Phonetic correlates of lexical stress in Urdu* (Publication No. 9814230) [Doctoral dissertation, Northwestern University]. ProQuest Dissertations Publishing. https://tinyurl.com/yc397was

Hussain, S. (2004). *Letter-to-sound conversion for Urdu text-to-speech system* [Paper presentation]. Workshop on Computational Approaches to Arabic Script-Based Languages, United States.

Hussain, S. (2005). *Phonological processing for Urdu text to speech system*. Center for Research in Urdu Language Processing, NUCES. https://tinyurl.com/ezsv8vef

Hussain, S., & Afzal, M. (2001, December 30–30). *Urdu computing standards: Urdu zabta takhti (uzt) 1.01* (Paper presentation). IEEE International Multi Topic Conference, 2001. IEEE INMIC 2001. Technology for the 21st Century, Lahore, Pakistan. https://doi.org/10.1109/INMIC.2001.995341

Jakobson, R. (1929). *Remarks on the phonological evolution of Russian compared to that of other Slavic languages*. Unity of Czechoslovak Mathematicians and Physicists.

Jensen, J. T. (2004). *"Distinctive features," in principles of generative phonology*. John Benjamins Publishing Company.

John, O. J. (1980). *The application of phonological universals in speech pathology. Phonology laboratory.* University of California Press.

Kachru, Y. (1990). Hindi-Urdu. In B. Comrie (Ed.), *The major languages of South Asia, the Middle East and Africa*. Routledge.

Khan, M. A. (1997). *Urdu ka soti nizaam.* Center for Research in Urdu Language Processing, NUCES.

Kiani, Z., Khan, A. Q., & Bukhari, N. H. (2011). Bilabial assimilation in Urdu: An acoustic analysis. *Language in India*, *11*(4), 173–185.

Lehmann, J., Schmidt. S. M., & Steck, J. (1992). Strong competitive inhibition of porcine pancreaticalpha-amylase by amino-deoxy derivatives of maltose and malt-triose. *Carbohydrate Research*, *237*, 177–183. https://doi.org/10.1016/S0008-6215(92)84241-J

Mattingly, I. G. (1972). Reading, the linguistic process, and linguistic awareness. In J. F. Kavanagh & I. G. Mattingly (Eds.), *Language by ear and by eye: The relationship between speech and reading* (pp. 125–126). Massachusetts Inst. of Technology.

Napoli, D. J. (1996). *Linguistic: An introduction.* Oxford University Press.

Odden, D. (2005). *Feature theory: Introducing phonology*. Cambridge University Press.

Okum, B. (2015, December 15). Level of representations. *Linguistics Networks*. https://www.linguisticsnetwork.com/levels-of-representation/

Panevov, J., & Hana, J. (2010). *Intro to linguistics phonology*. University of California.

Perre, L., & Ziegler, J. C. (2008). On-line activation of orthography in spoken word recognition. *Brain Research*, *1188*, 132–138. https://doi.org/10.1016/j.brainres.2007.10.084

Rao, C., Vaid, J., Srinivasan, N., & Chen, H.-C. (2010). Orthographic characteristics speed Hindi word naming but slow Urdu naming: evidence from Hindi/Urdu bi-literates. *Reading and Writing*, *24*, 679–695. https://doi.org/10.1007/s11145-010-9256-9

Roach, P. (1992). *Introducing phonetics*. Penguin Group.

Saleem, A. M. (2002). Assimilation rules in Urdu. *Center for Research in Urdu Language Processing*, *139*(1), 207–219.

Schmidt, R. L. (2003). Urdu. In G. Cardona, & D. Jain (Eds.), *The Indo-Aryan languages*. (pp. 286–350). Routledge.

Schmitz, S. (2006). *The relationship between phonology and orthography and the issue of orthographic reform for English*. Grin Verlag.

Taft, M. (2001). Processing of orthographic structure by adults of different reading ability. *Language and Speech*, *44*, 351–376. https://doi.org/10.1177/00238309010440030301

Wali, A. (2003). The rules governing the writing-pronunciation contrast in Urdu: A phonological study. *Center for Research in Urdu Language Processing*, *16*(1), 15–23.

Waqar, A., & Waqar, S. (2002). Identification of diphthongs in Urdu and their acoustic properties. C*enter for Language Engineering*, *14(2),* 16–25.

Zia, A. (2002). *Assimilation and dissimilation rules in Urdu*. Dokumen. https://dokumen.tips/documents/assimilation-and-dissimilation-rules-in-urdu.html?page=1