Primary and Secondary Levels of Urdu Lexical Stress

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Abstract

The present study aims to investigate primary and secondary levels of Urdu lexical stress in multi-syllabic Urdu words. Previous researches (Hussain, 1997, 2005) on Urdu lexical stress reveal that Urdu has single stress per word. Hussain's (2005) work records some evidence for secondary stress in multisyllabic words of Urdu. The present study utilizes vowel duration cue for lexical stress detection to furnish preliminary foundation of primary and secondary stress in Urdu multi-syllabic words. For this purpose, one extreme position, low-back vowel /a:/ has been selected. This vowel has been embedded in different bi-syllabic and tri-syllabic Urdu words. The recordings have been collected from 7 Urdu speakers and three contexts have been focused; primary stress, secondary stress and no stress. The speech has been recorded using PRAAT software on mono-channel in an anechoic room. The results show that tri-syllabic words of Urdu have multiple stresses.

Keywords: primary stress, secondary stress, lexical stress, multi-syllabic words

1. Primary and Secondary Levels of Urdu Lexical Stress

Almost all the linguists have consensus upon the central concept of lexical stress and that is its prominence (Hussain, 1997; Roach, 1998; Ladefoged & Johnson, 2010). In a multisyllabic word, a stressed syllable stands prominent than the others. A multisyllabic word can have more than one stress; however, there is just one main stress and other stresses are secondary and tertiary according to the degree of their strength (prominence). This study strives to sift through the patterns of primary stress in general and of secondary stress in specific in Urdu words.

Languages can be classified into different categories regarding their lexical stress systems. Some languages have fixed lexical stress which means a specific syllable initial, final, penult or antepenult bears stress. While others have variable stress systems which means any syllable can be stressed in different contexts or following different criteria. Czech, French, Polish, Macedonian, Latin, Old Lesbian and Classical Arabic are some of the examples of fixed stress languages (Lehiste, 1970; Hyman, 1977). Variable lexical stress is difficult to predict. Assamese, Dutch, English, Greek and Russian are some examples of the variable lexical stress systems. English lexical stress system, for example, is wavering and not consistent on a single type. That is the reason that English word stress is complex.

Preliminary studies (Hussain, 1997; Masica, 1991; Mehrotra, 1965) on Urdu stress reveal that Urdu is one of the New Indo-Aryan languages and NIA languages are syllable or mora-timed and not stress timed. Urdu is sensitive to the syllabic weight and as syllables are light, heavy and super-heavy; so super-heavy syllable at the end of the word carries weight. There are exceptions too. This phenomenon has been discussed in detail in the 'Literature Review' section.

Literature on lexical stress of Urdu is not sufficient enough to form a theory. Hussain's (1997) work is the sole effort in this field and thus the field contains a large scope in it for the potential

researchers. Hussain (1997) explores primary stress in Urdu bi-syllabic and tri-syllabic words. Stress patterns in four and more than four-syllabic words are still to be explored. Moreover, secondary and tertiary degrees of Urdu stress are still unrevealed. This study is an endeavour to investigate primary and secondary stress in multi-syllabic Urdu words. Specifically, this study strives to chronicle the existence of the secondary stress in Urdu words.

2. Literature Review

Different languages have different rules for lexical stress assignment. Some have fixed criteria, which means, a particular syllable always bears stress. On the contrary, there are some other languages which have varying criteria for stress marking. It means different syllables in different words can bear stress. As lexical stress is realized on the basis of its prominence; thus there needs to be some theory which establishes relationship between different syllables on the base of the degree of prominence of different syllables in a word. Metrical stress theory devised by Hayes (1995) formally treats stress on the base of relative prominence between two syllables.

2.1 Metrical Stress Theory

Metrical stress theory brings forth that in a word some syllables are metrically weak while others are metrically strong. There are different theories which set different criteria for this relative prominence of syllables. Foot-based approach is commonly accepted by the lexical stress finders (Gordon, Carmen, & Noutaka, 2010). A word can be divided into different 'feet'. A foot contains a stressed and an unstressed syllable. Hayes (1995) presents the example of Maranungku language 'ja ŋar,æmata. The metrical presentation of this word appears thus;

Word Level (x . . .)
Foot Level (x .)(x .)
'ja ŋar,mata

The word 'ja ŋarmata' contains 4 syllables. The first two syllables form first foot and the other two form another foot. The sign (x) indicates prominence (stress) while (.) means no prominence. Similarly, the next two syllables present the second foot with first syllable prominent and the other unstressed. Putting these feet together in word form, first syllable appears to be the most prominent one and thus it bears primary stress.

A more convenient illustration of metrical stress theory appears in Kenstowicz (1997) and Hussain (1997). Here words have been presented in three lines; line 0, line 1 and line 2. Line 0 presents syllable level; line 1 presents foot level and line 2 presents word level. Asterisks represent number of syllables, feet and then word level stress. Line 0 indicates all possible syllables which could bear stress. Line 1 brings forth foot level stress. In the first word 'Apalachicola' first, third and fifth syllables bear stress at foot level. Line 2 highlights the most prominent syllable in each word.

Figure 2.1:**Metrical presentation of words**

The metrical representation of words into syllables and feet suggests that a multisyllabic word may have more degrees of stress depending on the relative prominence of the syllables.

2.2 Lexical Stress Cues

A stressed syllable is considered prominent on the basis of one or all of the following criteria;

a. It is longer than the other syllables
b. Its F0 may get affected
c. It is more intense than the other syllables
d. Its vowel may change its quality

These four criteria are basically four cues which may help in detecting stress in a word. Ladefoged and Johnson (2010) propose length of a syllable as the most authentic cue for a listener to detect a stressed syllable in a word. Lindblom (1963), Higgins (1972), Klatt (1973), Crystal and House (1988), Anderson and Port (1994), Jessam, Morton and Stephen-Batog (1968), Rigault (1962) and many others have used vowel duration as the main cue for detecting lexical stress in different languages. Their studies show that the stressed syllables have comparatively longer duration than that of the unstressed syllables. Nevertheless, the fact should be kept in mind that some languages take duration as the strongest cue for measuring stress while in other languages other cues like pitch or intensity may be stronger than duration. One such example is Finnish language where unstressed syllables are found with longer duration of vowel and stressed syllables with shorter vowel duration.

Fry's (1958) study detects pitch i.e. F0 as the strongest cue for measuring stress. But Fry's study receives criticism due to results extracted from Pierrehumbert's (1980) study. Fry (1958) relies only on high F0 for stressed syllable. Pierrehumbert (1980) associates stressed syllable with both the high and low F0. High and low tones, which form tunes, manipulate F0 of an utterance. These light or low tones fall on stressed syllables. Thus, a stressed syllable receives a low F0 value when a low tone relates to it and a high F0 value when a high tone falls on it. Moreover, if there are no tones linked to the stressed syllable then F0 cannot be a cue for stressed syllable. This concludes that high F0 cannot be made an independent tool for measuring stress, instead it should be measured with high and low tones.

Intensity or amplitude of a vowel can be a cue for a stressed syllable. In simple words a stressed syllable may appear louder (Lieberman, 1960; Ladefoged & Johnson, 2010). Other studies like Sluijter and van Heuven (1996) and Turk and Sawusch (1996) suggest otherwise. These studies propose that stressed vowels are not always louder than the unstressed and that increase in vowel amplitude does not always make it prominent for the listeners.

The studies on different languages like Swedish, Dutch and English show that vowel changes its quality when it is stressed and unstressed. A long vowel may get shorter when it is embedded in an unstressed syllable (Engstand, 1988; Sluijter and van Heuven, 1996). Thus, vowel quality can be counted on while measuring stress.

The above discussion shows that different cues work for different languages in measuring lexical stress; however, we find less criticism on vowel-duration cue. As Urdu is a syllable or mora-timed language, its stress assignment is sensitive to its syllabic weight. Mora-timed languages are

quantity-sensitive which means duration can serve a central cue for measuring their lexical stress (Gordon, Nash, & Takara, 2010).

2.3 Moraic Account of Urdu Syllables

Hussain (1997) gives moraic account of Urdu syllables. He divides syllables into three categories; light, heavy and super heavy. Light syllable is mono-moraic, heavy syllable is bi-moraic and super-heavy syllable is tri-moraic. A consonant or a short vowel is equal to one mora (light), long vowel or a short vowel with a consonant is equal to two morae (heavy) and a long vowel with one consonant or one short vowel with two consonants is equal to three morae (super heavy). Hussain (1997) studied stress in two and three syllable words and came up with the following algorithm

- Urdu is sensitive to the length of vowel.
- There is one stress in one word.
- Placement of stress is not fixed to word edge which means stress is not always placed on first, last or penultimate syllable of a word.
- Short vowels and coda consonants are equal to one mora and no mora is assigned to onsets.
- Last mora of the last syllable is considered extra-metrical which means it will not be counted in the syllable weight.
- If the final syllable is super-heavy only then it will be stressed and if it is light or even heavy it will not be stressed.
- If final syllable is not super-heavy then the heavy or super-heavy syllable, which is closest to the final syllable, will be stressed.
- In case there is no super-heavy final syllable or heavy or super-heavy syllable closest to it then penultimate syllable will be stressed (p. 45-50).

Thus, Urdu also has lexical stress and it follows certain rules for its placement. However, we need to know how consistently these rules are followed.

3. Research Methodology

3.1 Speakers

Seven female speakers (approximate ages between 20-30 years) were selected. The variable of L1 was considered central here because Urdu is spoken with different accents. This is because the real Urdu accent is influenced by other regional languages like Punjabi, Siraiki, Pushto, Pahari, etc. Initially, the target population was those Urdu speaking individuals whose mother tongue can be any regional language but they speak Urdu as their major language in all situations. Our preliminary investigations brought forth wavering results on the data collected from the different accents of Urdu. Later, data was recollected keeping in view the following variables; 1) Urdu speakers with Punjabi mother tongue 2) they were born and grew up in Lahore 3) their parents (mother and father) match on the same accent of Punjabi. Precisely, our target population was Urdu speakers with Punjabi background which means they can understand Punjabi but will always respond in Urdu because their fluency will be halted when they code-switch to Punjabi. Thus, the following definition of Urdu speakers is used in this study: 'The speakers who can understand Punjabi but speak Urdu in all situations and when asked to speak Punjabi, they will not be able to speak a normal size paragraph fluently'. Easiest criterion for the selection of such speakers was to

confirm whether they speak Urdu with their previous generation i.e. with their parents and other elders. Seven female speakers fulfilling these criteria of the definition were selected.

3.2 Materials

Two bi-syllabic and three tri-syllabic words carrying back-low vowel /a:/ in each syllable have been selected for the study. This careful selection of the same vowel in all the syllables facilitated the analysis of primarily stressed, secondarily stressed and unstressed syllables within the same word. Moreover, the occurrence of the same vowel in all the syllables allowed good control on other extraneous variables like speech rate which could bring difference across utterances. Syllabic-templates and syllabic-weight of the target words have been presented in the following table:

Table 3.1: **Target words with syllabic-templates and syllabic-weight**

Urdu words with English transliteration	**IPA Transcription**	**Meaning in English**	**Syllabic-templates**	**Syllabic-weight**
نامہ(nama)	/na:ma:/	Letter	CVV.CVV	H.H
دانہ(dana)	/d̪a:na:/	Grain	CVV.CVV	H.H
ناکارہ (nakara)	/na:ka:ra:/	Useless/futile	CVV.CVV.CVV	H.H.H
کارنامہ(karnama)	/ka:rna:ma:/	Extraordinary achievement	CVVC.CVV.CVV	SH.H.H
شالامار(shalamar)	/ ʃa:la:ma:r/	A historical garden in Lahore	CVV.CVV.CVVC	H.H.SH

All these words are nouns grammatically except ‘nakara’ which is an adjective. Bi-syllabic and tri-syllabic words have been selected purposefully to see what stress patterns they follow according to the number of syllables. In tri-syllabic words different syllabic-templates carrying different syllabic-weight have been selected to see the impact of close and open or heavy and super-heavy syllables (like ka:r and na: respectively) on stress assignment.

3.3 Procedure

The carefully selected five words were written in Urdu orthography and embedded in a carrier phrase ‘میں نے ----- کہا' i.e. ‘I said _____.’ The word list appears thus;

میں نے نامہ کہا (I said nama)
میں نے دانہ کہا (I said dana)
میں نے ناکارہ کہا (I said nakara)
میں نےکارنامہ کہا (I said karnama)
میں نے شالامار کہا (I said shalamar)

Each individual repeated each phrase three times and as there were five phrases in total so 15 utterances were collected from each individual and 105 overall.

The recordings were done in an anechoic room of the Center for Language Engineering (CLE). Each speaker was asked to speak in a comfortably natural way and speed (neither too slow nor too

fast) in order to ensure natural stress patterns of each word. The recordings were made using PRAAT software on mono-channel at a sampling rate of 8000 HZ. All these recorded files were saved using unique code for each file like 'sp1nama1', 'sp1dana1', 'sp1nakara1', and so on. In all wave files, text grids were generated for segmentation and further analyses. For marking the boundaries of vowels, the beginning and end of the clear second formant was taken in account. A sample tagged file can be viewed below;

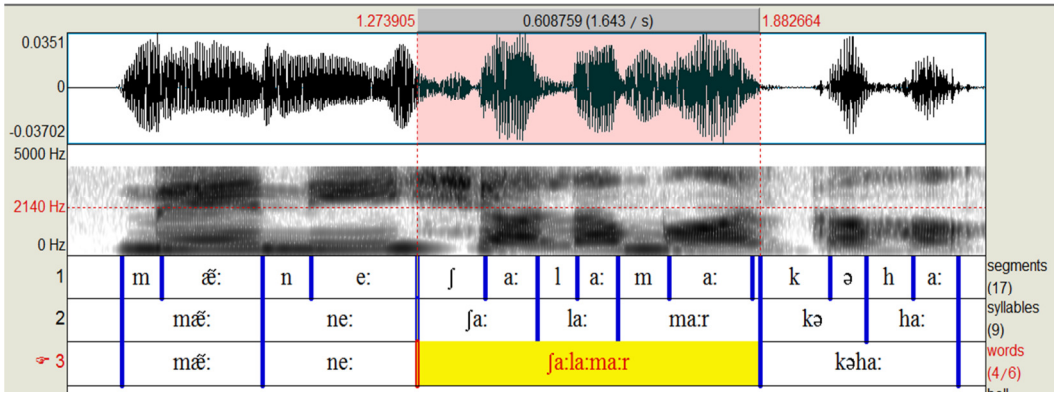

Figure 3.1:**A sample tagged file**

In the above file, the yellow highlighted area presents the target word and pink colour highlights its waveform. Top most text grid presents segments while second and third text grids present syllables and words respectively.

In this preliminary research on the secondary stress of Urdu words, only 'durational cue' has been utilized considering its importance and suitability for Urdu lexical stress. Hussain (1997, 2005), Dyrud (2001) and Mumtaz (2014) have highlighted the importance of 'vowel duration' in detecting word stress of Urdu. Mumtaz' research, particularly, proves durational cue as the most helpful one (73%) for stress determination. Therefore, durational cue has been utilized in the present study to see its workability in detecting secondary stress.

To ensure researcher triangulation, a few randomly picked files were marked by two other expert linguists. No major differences could be noticed in the marked files. Difference of one or two peaks of the waveform was accepted by the researchers; nevertheless, more than 2 peaks difference had been taken seriously and resolved mutually.

4. Data Analysis

In Urdu, the stressed syllables' vowels have greater duration than that of the same unstressed ones. In the present study, the words have been selected very carefully to match on the same vowel in all syllables i.e. /a:/. In bi-syllabic words, first syllable is stressed in both the words. The average values for /da:na:/ are 140ms and 111ms respectively for penultimate and final syllables. In the word /na:ma:/ penultimate syllable is primarily stressed with an average of 112 ms and final syllable is unstressed because of shorter duration i.e. 96ms. The following graphs vividly present the data:

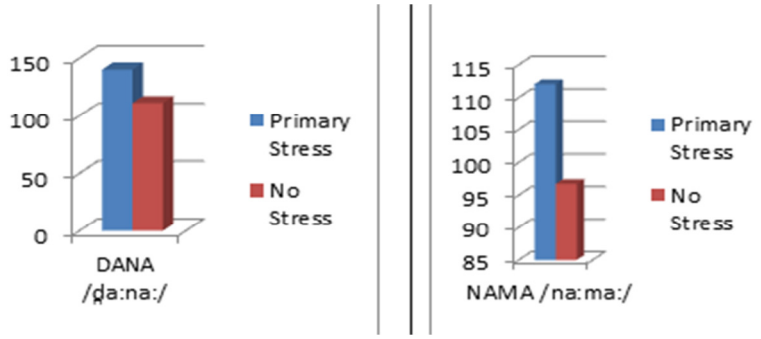

Figure 4.1:**Average vowel duration in ms in bi-syllabic Urdu words**

Multiple stresses have been observed in tri-syllabic Urdu words. In the word /na:ka:ra:/ penultimate syllable carries primary stress with a mean value of 164ms while secondary stress falls on final syllable with 135ms mean value and antepenultimate syllable carries no stress with 115ms mean. The second word /ka:rna:ma:/ has primary stress on its antepenultimate syllable /ka:r/ (closed syllable) with an average value of 163ms while secondary stress falls on the final syllable, the average value for which is 122ms and penultimate syllable carries no stress with a mean value of 108ms. In the word / ʃa:la:ma:r/, primary stress falls on the final syllable /ma:r/ (closed syllable) with an average value of 155ms while secondary stress is on the antepenultimate syllable with 112ms mean value and penultimate syllable carries no stress.

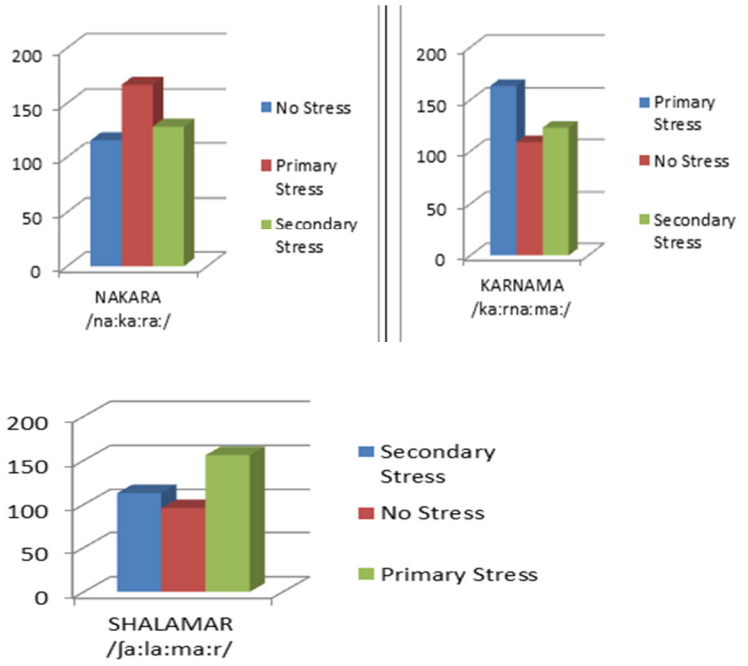

Figure 4.2:**Average vowel duration in ms in tri-syllabic Urdu words**

4.1 Statistical Analysis

Table 2 highlights the mean durations of the vowels in bi-syllabic words. The vowels of primarily stressed syllables are significantly longer in duration than their unstressed counterparts. Independent sample t-test has been performed on the data to statistically analyse and prove the significance of the difference between the two levels of stress. The results clearly show two levels of stress i.e. primary stress and no stress in the bi-syllabic Urdu words 'dana' (t=4.63, p=.000) and 'nama' (t=3.29, .002).

Table 4.1: **Mean duration (in ms) of vowels in stressed and unstressed syllables of bi-syllabic Urdu words (standard deviation is given in parentheses)**

Words	Primary stress	No stress	t-value	p-value
/ɖa:na:/	140.24 (22.31)	111.24 (17.99)	4.63	.000
/na:ma:/	112.05 (16.05)	96.71 (14.06)	3.29	.002

Table 3 displays the mean values of the vowel durations in tri-syllabic words of Urdu. The differences between the three levels have been proved significant by implementation of the ANOVA test on the data. The test results vividly display three distinct levels of stress in multisyllabic words of Urdu 'nakara' (f=51.87, p=.000), 'karnama' (f=40.42, p=.000) and 'shalamar' (f=153.28, p=.000).

Table 4.2: **Mean duration (in ms) of vowels in stressed and unstressed syllables of bi-syllabic Urdu words (standard deviation is given in parentheses)**

Words	Primary Stress	Secondary Stress	No Stress	f-value	p-value
/na:ka:ra:/	164.66	135.95	115.09	51.87	.000
/ka:rna:ma:/	163.09	122.19	108.42	40.42	.000
/ ʃa:la:ma:r/	155.95	112.85	95.85	153.28	.000

To see the differences among the three levels minutely 'multiple comparisons test' has been performed on the data. The test results indicate that the mean difference is significant at .05 level. Multiple comparisons test compares each level with the other two levels of each word. In the table given below, we can see that 'no stress' level of the word 'nakara' has been compared with the other two levels and a mean difference has been extracted from each comparison to see its significance. In the first word 'nakara' the multiple comparisons show that 'no stress' has significant difference from primary and secondary levels (-49.57 and -20.87 respectively) with a significance of .000. Similarly, primary stress has significant difference from no stress and secondary stress i.e. 49.57 and 28.71 respectively with a .000 level of significance. Then, secondary stress has a considerable difference from no stress and primary stress i.e. 20.85 and -28.71 respectively with p=.000.

Table 4.3: **Multiple comparisons of the three levels of stress in tri-syllabic words**

Words	Level for comparison	Compared with	Mean difference	Significance
Nakara	No stress	Primary stress	-49.571	.000
		Secondary stress	-20.857	.000
	Primary stress	No stress	49.571	.000
		Secondary stress	28.714	.000
	Secondary stress	No stress	20.857	.000
		Primary stress	-28.714	.000
Karnama	No stress	Primary stress	-54.667	.000
		Secondary stress	-13.762	.034
	Primary stress	No stress	54.667	.000
		Secondary stress	40.905	.000
	Secondary stress	No stress	13.762	.034
		Primary stress	-40.905	.000
Shalamar	No stress	Primary stress	-60.095	.000
		Secondary stress	-17.000	.000
	Primary stress	No stress	60.095	.000
		Secondary stress	43.095	.000
	Secondary stress	No stress	17.000	.000
		Primary stress	-43.095	.000

The second word 'karnama' also exhibits three distinct levels of stress. The level 'no stress' is significantly different in vowel duration from primary and secondary stress (-54.66 and -13.76 respectively). The level 'primary stress' has a mean difference of 54.66 and 40.90 from no stress and secondary stress respectively. Then, secondary stress has considerable difference from no stress and primary stress (13.76 and -40.90 respectively).

In the word 'shalamar' the results highlight three vivid levels of stress. The level 'no stress' is significant different from primary and secondary level with a difference of -60.09 and -17.00 respectively. The primary stress level is different from no stress and secondary stress with a significant difference of 60.09 and 43.09 respectively. Similarly, secondary stress is different from no stress and primary stress with a mean difference of 17.00 and -43.09 respectively.

4.2 Metrical Structure of the Target Words

The following figure presents the metrical structure of the target words. The 'μ' sign is used for 'mora'. So, one 'μ' means one mora. The 'σ' sign is used for syllable. 'L' means 'light syllable' and 'H' means 'heavy syllable' and SH means 'super heavy syllable. The 'x' sign without parenthesis shows the possibility of stress where all the syllables can bear stress. The 'x' sign with parenthesis shows that only the heavy syllables have the likelihood of bearing stress. The top line represents the only syllable which bears stress. In 'mora line' the square brackets show extra-metricality. According to metrical stress theory, the final mora of the final syllable is not counted (Hayes, 1995).

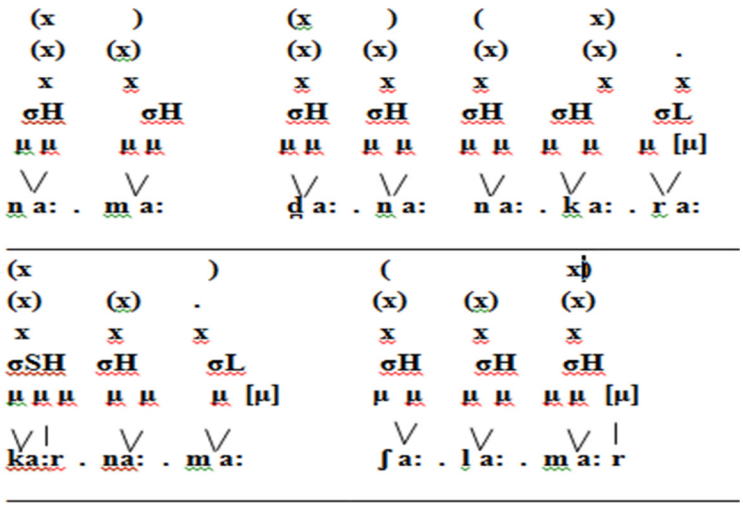

Figure 4.3:**Metrical structure of the Urdu words**

In Urdu, short vowels and coda consonants are mono-moraic and long vowels are bi-moraic. Consonant clusters at coda position are also bi-moraic. Mono-moraic syllables are called light syllables, bi-moraic syllables are heavy and tri-moraic syllables are super-heavy.

5. Findings and Discussion

The 'vowel length' data clearly shows three distinct degrees of stress in tri-syllabic words of Urdu. Two bi-syllabic and three tri-syllabic words were selected for analyses. The words were unique because all used same vowel /a:/ in all the syllables. Variables of same vowel in all syllables of the target words, same mother tongue of the speakers, same city of residence, etc. were strictly matched. Researcher triangulation was also ensured with two expert linguists and the researcher herself.

The syllables of the bi-syllabic Urdu words matched on syllabic-weight as both have 'HH' and syllabic-templates 'CVV'. The results indicate that the speakers showed clear tendency towards penultimate syllable for stress assignment.

In tri-syllabic words, different syllabic-templates were chosen. In the first word 'nakara', all syllables matched on syllabic weight and templates; HHH and CVV comparatively. In the second word 'karnama', ultimate syllable is super-heavy and the penultimate and the final syllables are heavy. In the third word 'shalamar', the final syllable is super-heavy and the penultimate and the ultimate syllables are heavy. The purpose of selecting different syllabic templates was to determine primary and secondary stress patterns of these words and the change in patterns with the change in templates.

The findings indicate that all the super-heavy syllables bear primary stress as in 'kar.na.ma.' and 'sha.la.mar.' In the word 'na.ka.ra.', where all syllables are heavy with no super-heavy syllable, the penultimate syllable bears primary stress.

The secondary-stress-assignment also follows certain rules. In the present data, it strictly follows foot-based approach as presented in (Hayes, 1995). According to this approach a word is divided into different feet and each foot contains two syllables where two strong or two weak syllables cannot be grouped together. The present study also favoures the theory as stress falls on every alternate syllable showing perfect examples of strong and weak syllables.

The study has certain limitations too as it has not tested other designs of templates. Similarly, the number of speakers can also be increased to bring more authenticity in the results. Last but not the least, the phenomenon of 'word final lengthening' has not been studied in the present research which may be considered in the potential works.

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