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# Hindi-Urdu: Stress accent or non-stress accent?

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# HINDI-URDU: STRESS ACCENT OR NON-STRESS ACCENT?

by

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To Sarah and Josiah

## ABSTRACT

The Hindi-Urdu stress system has been a problematic topic for over a century. Hayes (1995) says, ‘ … this topic has its empirically dismaying aspects: the published descriptions almost all disagree with one another, and seldom mention the disagreement.’

The literature today divides languages between ‘stress accent’ languages and ‘non-stress accent’ languages. According to Beckman (1986), ‘stress accent’ languages are those that use phonetic attributes other than pitch to indicate a prominent syllable, while ‘non-stress accent’ languages are those that use only pitch to mark a prominent syllable.

In the past, several quantitative studies of phonetic correlates of stress in Hindi-Urdu have been carried out. The question I seek to answer in this study is whether there is evidence for stress accent (in Beckman's terminology) in Hindi-Urdu; that is, is word stress in Hindi-Urdu reflected in one or more acoustic properties, independent from the pitch fluctuations that are due to intonation? Most previous studies have not directly addressed this question.

I compared the acoustic properties of prominent and non-prominent syllables, controlling for the effects of intonation (especially the presence vs. absence of prominence-lending pitch movements), by recording words in both [+focus] and [-focus] contexts. Results showed a significant effect of stress on pitch as well as on duration. However, I also found that focus interacts with stress: for two minimal pairs in my data, stress showed a significant effect on both pitch and duration in the [+focus] condition, but on neither pitch nor duration in the [-focus] condition.

This result suggests that duration does not function independently from pitch as an acoustic correlate of stress in Hindi-Urdu, and that the language is more accurately classified as having non-stress accent instead of stress accent.

In a pilot perception experiment, listeners did not perform better than chance in identifying members of minimal stress pairs spoken in a [-focus] context, while they did perform better than chance for words spoken in a [+focus] context. This result corroborates the findings of the production experiments, viz. that for the words studied, acoustic correlates of stress disappear in the [-focus] context.

# CHAPTER 1

# INTRODUCTION

## 1.1. General Introduction to the Problem

Stress is an important aspect of the pronunciation of many languages. Despite its importance, it is often given little attention in language learning materials, leaving language learners to assume, often incorrectly, that stress is similar to their native language or other languages they know. In reference to speech perception, Cutler (1984: 79-80) inquires about what happens when a speaker uses incorrect stress patterns. She offers the following passage as an answer.

(R.K.) Bansal (1966) presented listeners with English spoken by Indian speakers, who often applied word stress in an unorthodox manner, and found that the listeners tended to interpret what they heard to conform with the stress pattern, often in conflict with the segmental information. For example, when words with initial stress were uttered with second-syllable stress, *atmosphere* was heard as *must fear*, *yesterday* as *or study*, *character* as *director*, and *written* as *retain*. Similarly, when two-syllable words with stress on the second syllable were uttered with initial stress, hearers perceived *prefer* as *fearful*, *correct* as *carried*, and *about* as *come out*.

Such errors are often made by non-native speakers of English, and the intelligibility problems that result show the importance of internalizing the stress patterns of a language during the language learning process.

Stress, tone, and intonation are described as part of the prosody of a language. Prosodic features of speech are those that are not predictable from the intrinsic properties of the consonants and vowels. Prosody is important to both phoneticians and phonologists. Phoneticians look for measurable properties of prosodic features, while phonologists traditionally try to explain prosody in an abstract framework. They have often ignored each other's work. However, it has been a growing trend to combine the two perspectives. Ohala and Jaeger (1986: 6) say, 'there is no more convincing way to show that experiments can help to answer questions in phonology than by answering phonological questions through experiments.' This study will investigate phonological predictions about stress in general, and specifically about stress in Hindi-Urdu, in light of phonetic evidence obtained in this research.

## 1.2. Hindi-Urdu Stress

### 1.2.1. Background on Hindi-Urdu

Hindi is the national language of India, and Urdu is the national language of Pakistan. Masica (1991: 27) says,

> Counted as different *languages* in sociocultural Sense B[1] (and officially), Urdu and Modern Standard Hindi are not even different dialects or subdialects in linguistic Sense A. They are different *literary styles* based on the *same* linguistically defined subdialect.

Hindi-Urdu is classified as Indo-Aryan, a major sub-branch of Indo-European. Since it covers such a large area, a number of dialects exist. I will further discuss dialect issues regarding speaker selection in Chapters 2 and 3.

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[1] Masica (1991: 23) defines Sense A as one where 'a *dialect* is a subvariety of a larger unit, which is typically a *language*', and Sense B as one where 'a *dialect* is unwritten, while a *language* possesses a **written "standard"** and a literature' (Emphasis in original).

A large number of speakers speak Hindi-Urdu mainly as a second language. It is commonly taught in primary schools of the Indian subcontinent and likely will continue to be taught in the future, meaning the number of speakers is likely to increase, depending on population growth. Hindi ranks among the largest of the world's languages with about three hundred sixty-six million people who speak it as their first language (Grimes 2001). About four hundred eighty-seven million people speak Hindi around the world including second language speakers. Over sixty million people, in all countries, speak Urdu. The estimate of the number of second language speakers of Urdu is one hundred four million. Based on these statistics, Hindi-Urdu is spoken by more than half a billion people around the world.

### 1.2.2. The Segments of Hindi-Urdu

Ohala (1999) gives the vowels and consonants of the language as found in Tables 1.1 and 1.2.

**Table 1.1. Hindi-Urdu vowels**

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| i | | | | | | | | | | u |
| | | ɪ | | | | | | | ʊ | |
| | e | | | | | | | | | o |
| | | | | | | ə | | | | |
| | | ɛ | | | | | | | | ɔ |
| | | | | (æ) | | | | ɑ | | |

Some additional remarks about vowels in Hindi-Urdu:

a. [ɪ], [ə], and [ʊ] are regarded as short.

b. [i], [e], [ɛ], [ɑ], [o], [ɔ], and [u] are regarded as long.

c. Short vowels do not occur word-finally.

d. Ohala includes [æ] in the inventory of Hindi vowels, but she notes it is only found in English loan words.

e. All of these vowels but [æ] have nasalized counterparts.

In Table 1.2, the sounds marked by parentheses are found in Urdu, but are not common in Hindi (Hussain 1997). Most of the words using these sounds are Arabic or Persian in origin. For the remainder of this paper, the following phonemic transcription will be used.

1. Retroflex consonants will have a dot beneath the consonant, e.g. /ṭ/, /ḍ/.
2. Post-alveolar fricatives and affricates will be written with /č/, /š/, and /ǰ/.
3. Aspiration will be written as 'h' following the consonant, e.g. /bh/, /gh/.
4. Long vowels will be written with two vowel symbols, e.g. /aa/, /ii/.
5. The short vowels are written with a single vowel symbol: /a/ [ə], /i/ [ɪ], and /u/ [ʊ].
6. The long vowels /e/ and /o/ do not have short counterparts, therefore they are written with a single vowel symbol.

**Table 1.2. Hindi-Urdu consonants**

| | Bilabial | Labio-Dental | Dental | Alveolar | Post-Alveolar | Retroflex | Palatal | Velar | Uvular | Glottal |
|---|---|---|---|---|---|---|---|---|---|---|
| Plosive | | | | | | | | | | |
| Unaspirated | p | | t̪ | | | ʈ | | k | (q) | (ʔ) |
| vl. Aspirated | pʰ | | t̪ʰ | | | ʈʰ | | kʰ | | |
| Voiced | b | | d̪ | | | ɖ | | g | | |
| Breathy vd. | bʱ | | d̪ʱ | | | ɖʱ | | gʱ | | |
| Affricate | | | | | | | | | | |
| vl. Unasp. | | | | | tʃ | | | | | |
| vl. Asp. | | | | | tʃʰ | | | | | |
| Voiced | | | | | dʒ | | | | | |
| Breathy vd. | | | | | dʒʱ | | | | | |
| Fricative | | | | | | | | | | |
| vl. | | f | | s | ʃ | | | (x) | | h |
| vd. | | | | z | (ʒ) | | | (ɣ) | | |
| Nasal | m | | n | | | | | ŋ | | |
| Approximant | ʋ | | | | | | j | | | |
| Tap/Flap | | | | | | | | | | |
| vd. | | | | ɾ | | ɽ | | | | |
| Breathy vd. | | | | | | ɽʱ | | | | |
| Lateral Approximant | | | | l | | | | | | |

7. [ɛ] and [ɔ]will be written as /ai/ and /au/, respectively, which is etymologically based and common in transliterations of Hindi-Urdu.
8. Nasalized vowels will be indicated by the vowel followed by the tilde: /o~/.

### 1.2.3. Hindi-Urdu Stress

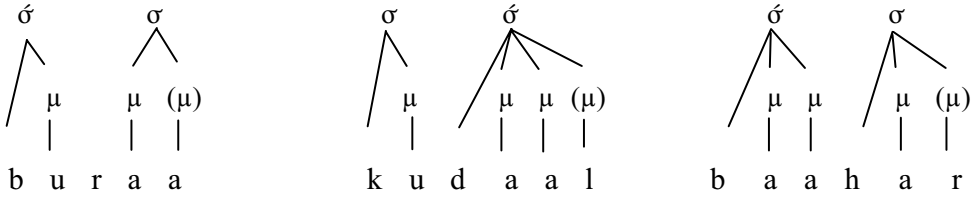
Hayes (1995: 162) says about Hindi-Urdu stress that, ‘ … this topic has its empirically dismaying aspects: the published descriptions almost all disagree with one another, and seldom mention the disagreement.’

Stress is relative prominence of syllables. Among the syllables of a word, one syllable usually stands out as more prominent than the other syllables. Some dictionaries of Hindi and/or Urdu indicate the location of word stress for each entry, e.g. S.W. Fallon (1879) and Qureshi (no date).

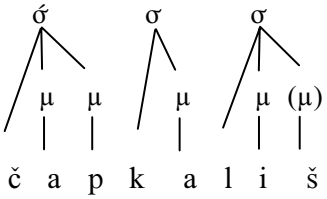
Over the years several accounts of Hindi-Urdu word stress have been published. Authors often agree on the location of stress in the words, although they may disagree about other issues, such as the way stress is manifested phonetically in Hindi-Urdu. Fairbanks (1981) studied the use of stress patterns in Hindi-Urdu verse. The literature strongly points to the view that speakers have intuitions with respect to the location of stress in Hindi-Urdu words.

Generally, the location of word stress in Hindi-Urdu is predictable on the basis of syllable weight. Probably the simplest account of stress placement in Hindi-Urdu comes from Hussain (1997). Based on the number of segments in the rhyme, Hindi-Urdu syllables can be classified as monomoraic or 'light' (V), bimoraic or 'heavy' (VV or VC), or trimoraic or 'superheavy' (VVC or VCC). Given these definitions, Hussain (1997) explains that the last heavy syllable is stressed, and if all syllables are light, the penultimate syllable is stressed. This account assumes a notion of extrametricality, which says the final mora of the word is invisible to the stress rule. Mohanan (1979, as cited by Pandey 1989: 41) first used extrametricality for describing stress in Hindi, and this notion has since been used in several other descriptions.

Some examples (μ = mora, σ = syllable, parentheses indicate extrametricality, stress indicated by acute accent mark):




'bad' 'pickaxe' 'outside'




'altercation'

Controversy surrounds the questions of whether word stress in Hindi-Urdu exists independently from intonation, and whether it is ever contrastive. The following is a summary of some of the ideas regarding these issues.

According to Trofimov and Jones (1923, as cited by Jain 1927: 315), 'the subject of stress is very closely connected with that of intonation. It is certain that much of the effect commonly ascribed to stress is really a matter of intonation.'

Dixit (1963: 124-5) discusses the relationship between stress and the 'rhythmic' properties of sentences. He says,

> Hindi is a highly rhythmic language. The arrangement of syllables in a word, of words in a phrase, and of phrases in a sentence gives a clue to the rhythmic pattern and to the placement of non-lexical stress on different levels. … In a word only one syllable and in a phrase only one word gets prominent stress; all other syllables and words are evenly

> stressed. Stress on these levels is non-lexical and predictable. On the sentence level 'sentence stress' or 'emphatic stress' plays a significant role.

Arun (1961: 21) claims, 'stress is not so prominent in Hindi as in English. However, it is sometimes phonemic'. By 'sometimes' it is meant that in certain environments, a word may be stressed differently, leading to a few examples of words that contrast in stress only. Arun provides four examples, which he claims are 'distinguished only by means of stress.'

/ˈgalaa/ 'throat'

/gaˈlaa/ 'melt something'

/ˈghaṭaa/ 'thick cloud'

/ghaˈṭaa/ 'decrease something'

Mehrotra (1965: 96) begins his work by saying,

> Stress plays a vital part in Hindi, although not as vital as in English, or Russian, or Greek. There is not a single syllable that does not bear some degree of stress, but the weak stress has been considered to be 'no stress phoneme' and the heavy stress has been regarded as 'stress phoneme'.

On the use of stress, he adds,

> Stress in Hindi is used mainly for 'emphasis' and for 'contrast.' It is found at the word level. A word may contain only one stress at some syllable of it at the most (and the rest of the syllables have no stresses), and it is not at all necessary that each word, or even any word in the whole sentence, should carry a stress. Sometimes only one word in a sentence is stressed… (96).

### 1.2.4. Previous Studies of Stress Correlates in Hindi-Urdu

Stress is realized in several ways in the languages of the world. The physical process for creating prominence on a syllable has many variables. Fundamental frequency ($F_0$), duration, and intensity are often common correlates of syllable prominence. In many languages, change in $F_0$ has been found to be an important phonetic correlate of accent. According to Van Heuven and Sluijter (1996; cited by Baart 1999: 5.4.1), relative duration of syllables, more specifically of the rhymes of syllables, is the most consistent correlate of accent in languages such as English and Dutch. Other correlates may include spectral balance (spectral tilt), and vowel reduction. Studies of the phonetic correlates of accent in other languages have shown that the most important correlates may differ from language to language.

Mehrotra (1965: 104-105), based on impressionistic observation, lists the following influences of stress on the sounds and sound-attributes of the language.

- stress makes a vowel tense and a consonant fortis
- stress causes some sounds to be longer than when they are in some unstressed syllables
- stress may double a consonant, e.g. /kaṭ/ may be pronounced /kaṭṭ/.
- stress may introduce aspiration in an initial stop
- contrarily, an unstressed syllable may show the loss of aspiration somewhere in it
- high and low vowels head towards the mid central vowel, if they are unstressed
- some rise in pitch of the sounds may also be an effect of the stress

- stress may also fall with increase in pitch

M. Ohala was the first to study the acoustic correlates of stress in Hindi. Her studies on this topic began in the 1970s. Ohala (1977) measured duration and pitch for a set of words used in the frame /aapne ____ kahaa/ 'you said _____'. She found no significant effects of stress on duration. In another experiment, she found some correlation of stress with pitch movement. In this part of the study, the target word was intentionally put in a context where it received 'sentence stress'. Results showed that the prominent syllable was marked by, 'a rising pitch on it and a falling pitch on the syllable following it.' Further discussion of this study is found in Section 1.2.5 below.

Ohala (1986) is a revision of the 1977 study, but also includes a study of target words said in isolation as well as in the frames /aapne ____ kahaa/ 'you said _____' and /aapne ____ dekhaa/ 'you saw _____'. The verbs, the final words in the utterances, were chosen since the first syllables contrast in syllable weight. In addition to five native speakers, the words were then spoken in the frames by the investigator with prominence placed on different syllables for the same words. Participants were asked to choose preferences. Results:

a. Stress varied between the words said in isolation and those said in a frame.

b. In words of VC(C)VCV, where the first V is short, i.e. [ɪ], [ə], and [ʊ], that vowel is never stressed.

c. The heaviest syllable does not always receive the stress.

d. In the sentence frame, if the final syllable is the heaviest, then it receives the stress.

In her conclusion, Ohala (1986: 87) states,

> One can therefore ask of the Hindi data: are there any habitual variations in the pitch contour that are not predictable from the over-all sentence intonation, or are there any characteristic variations in segmental duration that are not predictable from the segments themselves or the segmental environment they appear in? Furthermore if one does find such habitual or characteristic variations in these parameters is it the case that deviations from these patterns are unacceptable, unintelligible or foreign sounding?

She is willing to state that Hindi does have phonetic stress based on the pitch study results.

Ohala (1991) uses perception experiments to test Hindi speakers' acceptability ratings of stress variation. She found conflicting results in speakers' choices comparing words in isolation to those in a sentence frame.

Hussain (1997) uses the frame sentence /tumne ____ kahaa/ 'you said ____' in his study of Urdu stress correlates. He claims that (1997: 63) 'within the target word, the syllable with lexical stress would attract the phrasal stress, making lexical stress more prominent.' Hussain (1997: ii-iii) lists the following as effects of stress:

a. The results indicated a longer duration and lower $F_0$ (due to the alignment of a low tone) for stressed vowels.

b. Also, high vowels got less intense and low vowels got more intense with stress. However, individual speaker data on intensity showed a lot of variation.

c. Also, the quality of the vowels changed with stress as unstressed vowels underwent more contextual assimilation than stressed vowels.

d. Results from stops show that the closure, voicing during closure and aspiration of aspirated (and not voiceless and voiced) onset stops increased with stress.

e. The closure of voiceless, voiced and breathy coda stops and voicing during closure of voiced coda stops also increased with stress.

f. The duration of closure of aspirated coda stops decreased with stress.

Nair (1999), writing about Hindi, presumes that the prominence she hears as a native speaker is lexical stress. She uses a similar frame as Hussain for her recordings. Her frame is /kahaa ____ aapne/ and /bolaa ____ aapne/, both of which are translated 'you said ___.' The words /ˈbolaa/ and /kaˈhaa/ are stressed differently. In using two different verbs for 'say', she tried to control for the effects of a bordering stressed syllable on the target word.

Nair only looked at syllable and vowel duration, and frequencies of formants 1 and 2. Fundamental frequency and intensity were not measured. Based on the results, she concluded that the strongest acoustic cues of stress are syllable lengthening and more extreme vowel formants ($F_1$ and $F_2$). Regarding the formant differences, she explains that they are 'unreliable cues as compared to duration' (Nair 1999: 246). However, vowels in non-stressed syllables are more schwa-like than vowels in stressed syllables. Nair concludes, 'variations in vowel/syllable duration and formant values do indicate that Hindi has lexical stress, even though most of the time this stress is non-contrastive', and 'it would, therefore, seem reasonable to conclude that as reported earlier by other authors, Hindi does have lexical stress and it is expressed acoustically as syllable lengthening and, less significantly, as more extreme vowel formants' (pp. 246-247).

### 1.2.5. Hindi Intonation

There have been few works regarding intonation in Hindi-Urdu. Moore (1965) is probably the most complete work on the topic, while Harnsberger (1994, 1999) are among the most recent. Both Moore and Harnsberger studied the phonetic correlates of intonation by instrumental means.

Moore measured the fundamental frequency, duration, and intensity of syllables in order to learn about intonation. About stress he says, 'even though stress is not phonemic at the word level, stress (i.e. intensity) is a component of the prosodemes of emphasis, in combination with traits of pitch and quantity' (Moore 1965: 94).

Moore divides sentences into feet. Each foot bears one of three degrees of emphasis: weak, normal, and strong. He provides the following table to show the correlation of features with degrees of emphasis.

**Table 1.3. Moore's prosodemes of stress.**

| | **Melodic Range ($F_0$)** | **Dynamic Range (Intensity)** | **Quantity (Duration)** |
|---|---|---|---|
| **Weak emphasis** | Narrow | Narrow | Short |
| **Normal emphasis** | Medium | Medium | Medium |
| **Strong emphasis** | Wide | Wide | Long |

The foot is important to Moore's analysis. According to him, 'each foot is characterized by a trait of rising pitch throughout its duration', 'the neutral distribution of the foot is one foot per word. Some words may be divided into two feet; such words are compounds or derivatives', and 'a foot may be distributed on two words' (p. 124).

Moore (1965: 121) concludes,

> Intonation is defined as the level in language on which utterances are distinguished from one another by the prosodic features of pitch, intensity, and quantity. Such a definition is

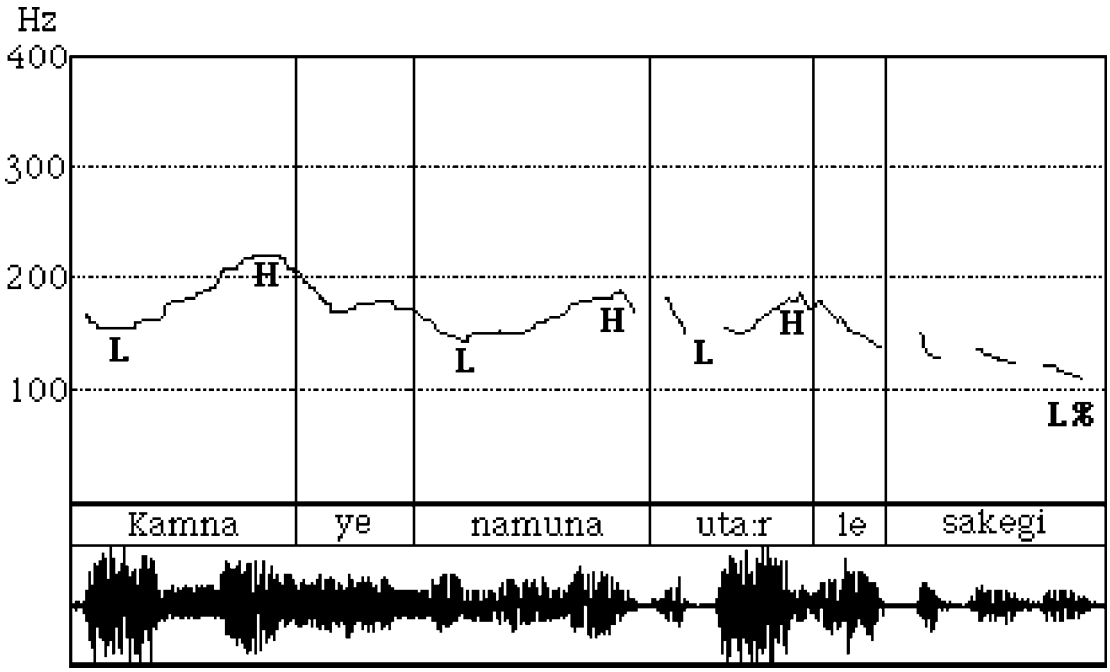
> necessary for Hindi, at least, because it is not by pitch alone that intonational meanings are conveyed. Some significant distinctions depend on intensity alone, and some on quantity alone.

Harnsberger (1994) found in his data that for content words, $F_0$ drops, then rises. Words longer than three syllables are parsed into multiple occurrences of low to high rises. These coincide with morphological boundaries. He also found a low intonational phrase boundary tone. Figure 1.1 is a pitch graph from a sentence in Hindi-Urdu that shows several instances of rising pitch:

Focus is also important when looking at intonation. Chafe (1994: 29) explains, 'manifested in brief spurts of language called intonation units, focus is the portion of consciousness which the speaker wishes the hearer's consciousness to be focused on.'

About focus, Harnsberger (1994: 55) says, 'Bengali, English, Korean, Hausa, and Hindi also follow a general strategy for marking a focused constituent – it receives a nuclear accent or pitch excursion of great degree while other (normally) accented constituents are made less prominent … '. Harnsberger (1999) additionally explains that the 'focused item has expanded register; following constituents have a compressed register.' Figure 1.2 shows $F_0$ for a focused constituent.

Of the few studies done on the correlates of stress in Hindi-Urdu, none has intentionally accounted for the effects of intonational focus. Only one of the studies of the correlates of stress accounts for the effects of intonation (Ohala 1977). Ohala reports on one study where she placed the target word at the end of the sentence frame. Her intention was to remove the effects of imperative intonation on the target words to see if the words could be distinguished when the effects of imperative intonation were removed. In her experiment, she played the sentences to one listener who tried to distinguish between one minimal pair. The participant could not tell the difference between the words. Based on the results, Ohala concluded that these words cannot be distinguished apart from the effects of imperative intonation.



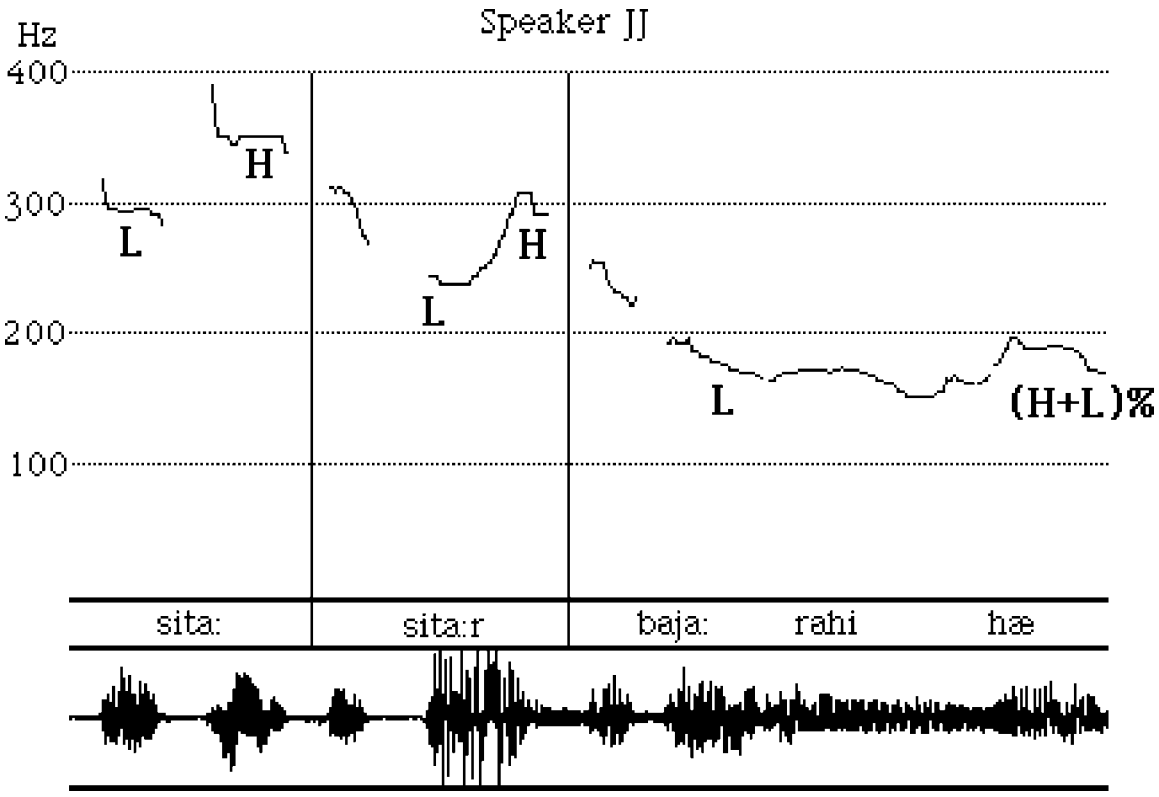

**LH LH LH L%**

Kamna ye namuna uta:r le sakegi

Kamna this model copy do can

Kamna can copy this model

**Figure 1.1. Sample pitch graph showing multiple rises (From Harnsberger (1994))**




**LH LH (H+L%)**

sita: **sita:r** baja: rahi hœ

Sita sitar play -ing is

Sita is playing the sitar

**Figure 1.2. Example of a sentence with a focused constituent (/sita:r/) (From Harnsberger (1994))**

### 1.2.6. Stress Accent and Non-stress Accent

One way to classify languages is to describe them as either 'stress accent' languages or 'non-stress accent' languages. Beckman (1986: ix) defines 'stress accent' languages as those that use phonetic attributes other than pitch to indicate a prominent syllable while 'non-stress accent' languages do not.

Ladd (1996: 156) makes the following claim:

> …we ought to be able to find languages that have lexically specified pitch features with stress accent, and languages that have only intonational pitch features and non-stress accent. I believe this can be done: Swedish (like most of the European 'pitch accent languages') is an example of a language combining lexically specified pitch features with stress accent, while Bengali (and probably most of the languages of India) is an example of a language with non-stress accent and no lexical specification of pitch.

Based on Ladd's comments, Hindi-Urdu would fall into the same category as Bengali in the schema in Table 1.4. The current study seeks to investigate whether that is indeed the case.

**Table 1.4. Ladd's typological conjecture**

| | | Phonetic Typology | |
|---|---|---|---|
| | | **Stress accent** | **Non-stress accent** |
| **Lexical typology** | **Lexical pitch** | Example: Swedish | Example: Japanese |
| | **Postlexical Pitch only** | Example: English | Example: Bengali |

## 1.3. Overview of the Study

Now that we know about past research and some of the major typological claims, we can begin looking for the answer to our main research question, which is: Does Hindi-Urdu have acoustic manifestations of stress apart from the features of intonation?

Thus far, there have been no systematic quantitative studies examining the acoustic correlates of word stress on words spoken without a conspicuous pitch movement. This paper is a first attempt to do that.

The study is structured around two experiments, a production experiment (Chapter 2) and a perception experiment (Chapter 3). Chapter 4 presents conclusions and includes suggestions for further research.

# CHAPTER 2

# THE PRODUCTION EXPERIMENT

## 2.0. Rationale

In order to be able to study the effects of sentence intonation on the acoustic manifestations of word stress in Hindi-Urdu, I decided to record words in environments where they are pragmatically focused and receive the main emphasis of the sentence, and also in environments where they are not focused and do not receive a major emphasis.

Moore (1965) observed that the stronger the intonational emphasis on a certain word in Hindi-Urdu, the wider the range of pitch is on that word (the difference between high and low pitch). He also described a wider range for intensity and an increase in duration for the same words. Harnsberger (1994:4.3) explains that in his data 'all content words (i.e. nouns, verbs, adjectives, and adverbs) not in a sentence-final phrase showed a characteristic rising contour'. He further explains that a focused word has expanded register, while constituents that follow have a compressed register.

Sluijter (1995) describes the effects of focus distribution, pitch accent and lexical stress on syllables in Dutch. The aim of her study was to see to what extent they are independent from one another in the language. Using specially constructed dialogues, Sluijter elicited target words in both [-focus] and [+focus] environments. Several aspects of her methodology were adopted for the current study.

## 2.1. Method

### 2.1.1. Stimulus materials

The words chosen for this study all contain simple syllable structures, viz. CV.CVV, CV.CVVC, or CVV.CVC. The list includes Arun's 1961 minimal pairs supplemented with a number of other common words. The total number of words used in this study was 14 (see Table 2.1).

In order to control for focus, the target words were embedded in different types of dialogues. In each dialogue, the first character tells her friend something. The friend then asks a question, and the first speaker answers that question. In one type of dialogue, the target word is the focus of the question and the answer. Example (1) shows the basic structure of a dialogue where the target word, /galaa/, is the focus of the question and the answer.

(1)

Context: My throat is sore.

Q: /tumne galaa kahaa yaa peṭ kahaa/

you throat say or stomach say

Did you say THROAT or did you say STOMACH?

A: /mai~ne galaa kahaa/

I throat said

I said THROAT.

**Table 2.1. Words used in the study**

| | **CVCVV** | **CVCVVC** | **CVVCVC** |
|---|---|---|---|
| ˈσσ | /ˈgalaa/ ‘throat’ | | /ˈbaadal/ ‘a cloud’ |
| | /ˈghaṭaa/ ‘thick cloud’ | | /ˈsaabun/ ‘soap’ |
| | /ˈburaa/ ‘bad’ | | /ˈbaahar/ ‘outside’ |
| | /ˈpakaa/ ‘cooked’ | | |
| σˈσ | /khuˈdaa/ ‘god’ | /kiˈtaab/ ‘book’ | |
| | /gaˈlaa/ ‘melt something’ | /kuˈdaal/ ‘axe’ | |
| | /ghaˈṭaa/ ‘decrease something’ | /paˈṭhaan/ ‘Afghan’ | |
| | /paˈkaa/ ‘cook something’ | | |

Example (2) shows a dialogue where the verb (underlined) is the focus of the question and the answer. The target word /galaa/ is out of focus.

(2)

Context: Today our teacher taught us words for the parts of the body. He told us about the word /galaa/.

Q: /unho~ne galaa <u>kahaa</u> yaa galaa <u>likhaa</u>/

they throat said or throat wrote

Did he SAY ‘throat’ or did he WRITE ‘throat?’

A: /unho~ne galaa <u>kahaa</u>/

they throat said

He SAID ‘throat.’

It was originally planned that only data from the last sentence of each dialogue (the ‘Answer’ line) would be used for further analysis. However, after the texts were recorded, it was decided to also include the second clause of the ‘Question’ part for those dialogues where the target word is out of focus. See Section 2.1.3.

One Hindi speaker translated the sentences from English into Hindi and wrote them in the Devanagari script. Since she was not a mother-tongue Hindi speaker, the written dialogues were checked with a native speaker. Because of a miscommunication, however, the words /gaˈlaa/ ‘melt something’ and /paˈkaa/ ‘cook something’ were changed to /galaa-o/ and /pakaa-ne/ respectively (alternate verb forms) in the written texts of the [+focus] dialogues. See Appendix 1, 6b and 8b.

Each individual dialogue was repeated once, non-consecutively. The whole set was ordered randomly with the restriction that members of minimal pairs were placed with at least one differing dialogue separating them. Each speaker read a total of 56 dialogues.

### 2.1.2. Speakers

The Hindi speakers that participated in the production experiment (see Table 2.2) were all university students either attending Southern Illinois University Carbondale (SIUC) or visiting friends there. Speakers were found by asking Indian students about their Hindi-speaking abilities. Those who were willing to participate were asked to tell their friends about the project. All of the participants claimed to be native Hindi speakers, although a couple also indicated another native language. Since all of the participants were students at English-speaking universities, there was no need for Hindi translations of instructions or consent forms.

**Table 2.2. Speaker information for participants in the production experiment**

| Speaker | Age | Sex | Dialect | Hindi w/ fam & friends | Native language | Home city & state | Formal Hindi training |
|---|---|---|---|---|---|---|---|
| R | 24 | M | Bombaya Hindi | yes | Hindi | Poona, Maharashtra | 10 years |
| K | 21 | M | | yes | Hindi | Baroda, Gujarat | some |
| C | 21 | M | | yes | Hindi, Marathi | Poona, Maharashtra | 5 years |
| A | 22 | M | | yes | Hindi | Poona, Maharashtra | 8 years |
| Bi | 24 | M | | yes | Hindi, Oriya | Berhampur, Orissa | none |
| Bh | 23 | M | Bombaya Hindi | yes | Hindi | Bombay, Maharashtra | |

### 2.1.3. Procedures

Participants were recorded with an Aiwa AM-F70 Digital MiniDisc Player/Recorder with a Shure SM10A Professional Unidirectional Head-worn Dynamic Microphone. By using a headset microphone, the microphone element was kept at a constant distance from the speaker's mouth. It is possible to have amplitude fluctuations due to effects from speakers turning their heads away from a microphone while recording. The recordings were all made in a sound-treated studio at SIUC.

Before recording the dialogues, a short story taken from McGregor (1995) was read aloud by each participant. The rationale for including the story was to adjust recording levels during continuous speech, hear the participants' voices in a longer context, and informally test participants' reading skills. The participants were asked to read the short story and all of the dialogues from note cards. The dialogue situations were explained to them, and before the actual recording began, they were asked to read through one example from each of the different dialogues to become familiar with the contexts of the sentences they were reading. They were

asked to read the sentences normally, without worrying about making mistakes. They were also asked to place the completed cards quietly in front of the cards to be read. The order of the cards was reversed for each speaker to offset the possible effects of fatigue.

The author and another trained linguist evaluated the recordings. Three speakers were chosen based on the evaluators' subjective judgments of their reading ability. Particular attention was paid to the question and answer lines of the dialogue, and whether or not subjects read the dialogues in a way that showed they were thinking about what they were reading. For reading ability, the best readers were the ones that did not pause or appear to have difficulty understanding what they read, emphasizing the words that were focused. When readers are not thinking about what they are reading, they may use list intonation after reading similar sentences several times in a row. The dialogues were constructed in a way that would eliminate list intonation, but it was clear that some speakers were thinking more about the content of the dialogues than others.

Speakers A, Bi, and Bh performed much better than the other speakers overall. The recordings of these three speakers were also presented to a linguist who has worked for several years doing language survey in many parts of India. He stated as his opinion that the recordings did not contain noticeable characteristic qualities of regional dialects from the speakers' respective home areas.

All recordings were digitized and measured using SIL International's Speech Analyzer version 1.5 Test 15.3 on a Dell Inspiron 8000. Segment boundaries were placed based on information from the waveform, the spectrogram, and listening to individual segments. Guidelines for placing segment boundaries were taken from Baart (1999). Boundaries were placed at positive zero crossings.

Target words for measurement were taken from the answer, or final sentence, of each dialogue, and from the question in the [-focus] dialogues. Although this was not originally planned, target words taken from the second clause of the question part of the dialogue were included in the study so as to enlarge the size of the database for statistical processing. Unfortunately, the [+focus] dialogue does not provide an additional equivalent environment in the Question line for the target word because there the target word does not occur in a sentence-final clause. As a result, there are many more cases of words in the measured data that are taken from [-focus] environments as compared to words taken from [+focus] environments.

For this study, $F_0$ was measured in hertz at the zero crossing closest to the temporal mid-point of the vowel in the 'auto pitch' graph window in Speech Analyzer. For each vowel in the target words, peak intensity was recorded in decibels[2]. Measurements were taken and recorded manually in a spreadsheet for each of these variables. A total of two hundred thirty-one word tokens were measured. This spreadsheet was then used for further statistical processing.

Among the two hundred thirty-one cases, some measurements were not taken. For example, the first vowel (V1) in a word like /kiˈtaab/ is sometimes shortened to the point that no voicing can be measured for pitch. In these situations, measurements were only taken where possible. Cells were left blank when information was not available. In one instance, the word /ˈbaadal/ was pronounced [ ˈbɑɑdl̩ ]. In this case, measurements for pitch and intensity were taken from

[2] The intensity measurements calculated by SA are displayed in the magnitude graph. Magnitude is calculated as the average intensity over a period of 13.6 milliseconds. SA expresses intensity in decibels (dB). Since this is a relative (logarithmic) scale, there was no need to adjust the values in order to compare several speakers.

the center of the syllabic lateral. There were also some problems with breathy voiced stops. Breathy voice sometimes spreads through much of the following vowel. In some cases, which are marked in the data, interpolated $F_0$ values were used, the interpolations being between the end of the $F_0$ curve on the preceding syllable and the start of the $F_0$ curve on the following syllable. Some phrases in the recordings contained pauses. If the pause interfered with the measurements being analyzed, the word was excluded from any measurements. Included in the data were cases of words 6 and 8 where the target word contains additional morphemes: /galaa-o/ and /pakaa-ne/. After it was verified that the segment boundaries between /aa/ and /o/, and between /aa/ and /n/, could be determined in the waveform with acceptable precision, I decided to include the stems /galaa/ and /pakaa/ in this study.

## 2.2. Results

### 2.2.1. $F_0$

In this section, I present the most salient patterns observed in the fundamental frequency ($F_0$) data.

Table 2.3 is a summary of the means of the $F_0$ measurements taken in the first vowel ($V_1$) and second vowel ($V_2$) of each target word. The last column contains the means of the $F_0$ differences between the two vowels ($V_2$-$V_1$). Measurements are in hertz and are rounded to the nearest tenth. Standard deviation is also rounded to the nearest tenth.

Lexical stress (as given in Qureshi n.d.) is on the first syllable for words of types 1 and 3, and on the second syllable for types 2 and 4.

**Table 2.3. Mean $F_0$ (in Hz)**

| | $V_1$ | | $V_2$ | | $V_2$-$V_1$ | |
|---|---|---|---|---|---|---|
| **Speaker** | | | | | | |
| A | 112.0 | (6.6) | 115.5 | (5.5) | 3.8 | (6.2) |
| Bh | 97.0 | (3.8) | 97.9 | (2.3) | 0.9 | (4.1) |
| Bi | 119.8 | (8.5) | 123.1 | (6.3) | 3.4 | (9.6) |
| **Word Type** | | | | | | |
| 1) 'CVCVV | 109.4 | (11.1) | 111.9 | (12.6) | 2.8 | (4.0) |
| 2) CV'CVV | 112.7 | (11.6) | 112.5 | (10.7) | 0.2 | (6.4) |
| 3) 'CVVCVC | 105.0 | (8.6) | 113.9 | (12.5) | 9.4 | (7.1) |
| 4) CV'CVVC | 119.7 | (9.9) | 111.3 | (10.5) | -3.7 | (6.8) |
| **Focus** | | | | | | |
| [-focus] | 110.4 | (11.5) | 112.0 | (11.9) | 2.6 | (6.9) |
| [+focus] | 110.8 | (11.4) | 113.3 | (11.1) | 3.3 | (8.0) |

Note: Vowel 1 pitch ($V_1$), Vowel 2 pitch ($V_2$), and pitch difference[3] ($V_2$-$V_1$). Standard deviation in parentheses.

[3] Pitch difference ($V_2$-$V_1$) in the table is not the actual difference of the columns in the table, because the number of cases for each mean may be different for $V_1$ and $V_2$. The reason that this is so is that in a few cases, $V_1$ pitch could not be determined, while $V_2$ pitch could be determined.

$F_0$ averages for $V_1$ and $V_2$ are significantly different between speakers [$F(2,197)=185.1$, $p<0.001$]. Speaker Bh is the lowest, then Speaker A, followed by the highest average for Speaker Bi. There is also a difference in pitch range. Judging from the means for $V_2$-$V_1$, speakers A and Bi have similar pitch ranges, and speaker Bh has a narrower range.

Table 2.3 also shows that the stressed syllable has lower average $F_0$ as compared to the other syllable in the word. There is a significant effect of word type on $V_1$ pitch [$F(3,196)=12.5$, $p<0.001$], and on $V_2$-$V_1$ [$F(3,195)=34.2$, $p<0.001$]. For word types 1 and 3, the first syllable has lower pitch, and on word types 2 and 4, the second syllable has lower pitch. The effect is greatest for word types 3 and 4.

There is an overall tendency for $F_0$ difference to be greater for words that are [+focus] as compared to words that are [-focus]. However, this tendency is not statistically significant.

Word types 3 and 4 show the greatest $F_0$ difference and the largest effect of stress on $F_0$. For these word types there is a significant effect of stress on Vowel 1 pitch [$F(1,74)=45.1$, $p<0.001$] and on pitch difference [$F(1,73)=58.8$, $p<0.001$]. An example of a type 3 word is presented in Figure 2.1, and an example of a type 4 word in Figure 2.2.

Since words of types 3 and 4 show the clearest effect of stress on mean $F_0$, I will first look at these words to study how the focus condition interacts with the effect of stress.

Table 2.4 presents mean $F_0$ measurements broken down by stress and focus.

The effect of stress on $V_1$ pitch and $V_2$-$V_1$ is significant in the [-focus] condition [$F(1,44)=24.7$, $p<0.001$ and $F(1,44)=30.9$, $p<0.001$, respectively] as well as in the [+focus] condition [$F(1,26)=16.4$, $p<0.001$ and $F(1,26)=28.8$, $p<0.001$, respectively]. As can be seen in Table 2.4, there is a greater pitch difference ($V_2$-$V_1$) in a [+focus] environment than in a [-focus] environment.

Figure 2.3 presents a graphical representation of the interaction of stress and focus in Table 2.4.

**Table 2.4. Mean $F_0$ for word types 3 and 4 broken down by focus and stress**

| | **$V_1$** | **$V_2$** | **$V_2$-$V_1$** |
|---|---|---|---|
| **[-focus]** | | | |
| 3) 'CVVCVC | 106.1 (8.3) | 115.5 (12.4) | 9.5 (7.2) |
| 4) CV'CVVC | 120.1 (10.5) | 117.8 (8.2) | -2.3 (6.0) |
| | | | |
| **[+focus]** | | | |
| 3) 'CVVCVC | 104.7 (8.9) | 114.6 (12.2) | 9.9 (7.4) |
| 4) CV'CVVC | 119.1 (9.6) | 113.4 (8.3) | -5.7 (7.7) |

Table 2.5 presents mean $F_0$ data for those words that are members of minimal pairs.

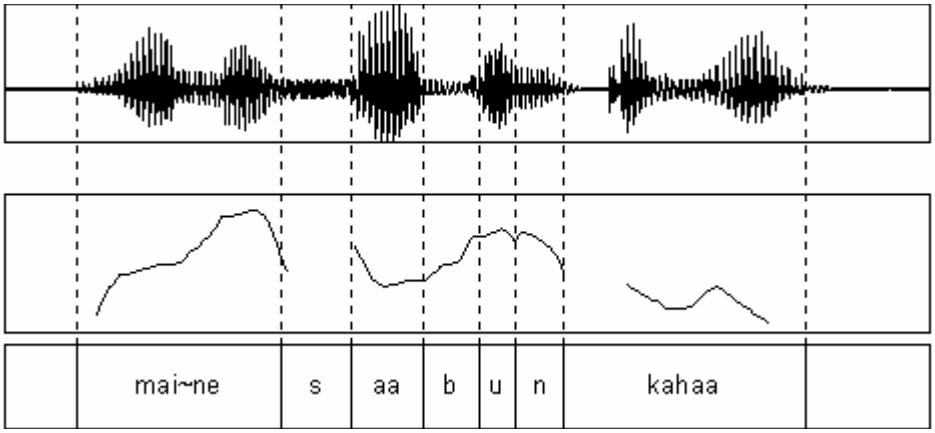



**Figure 2.1. Waveform and $F_0$ graph for word type 3 /'saabun/**

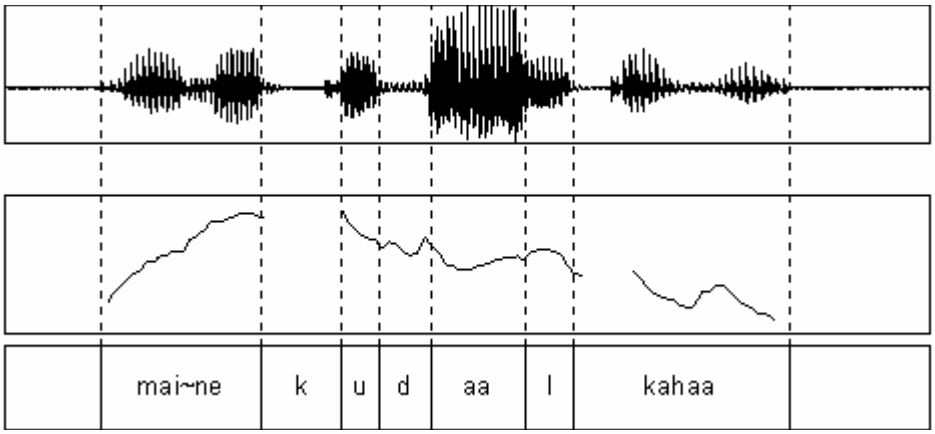



**Figure 2.2. Waveform and $F_0$ graph for word type 4 /ku'daal/**

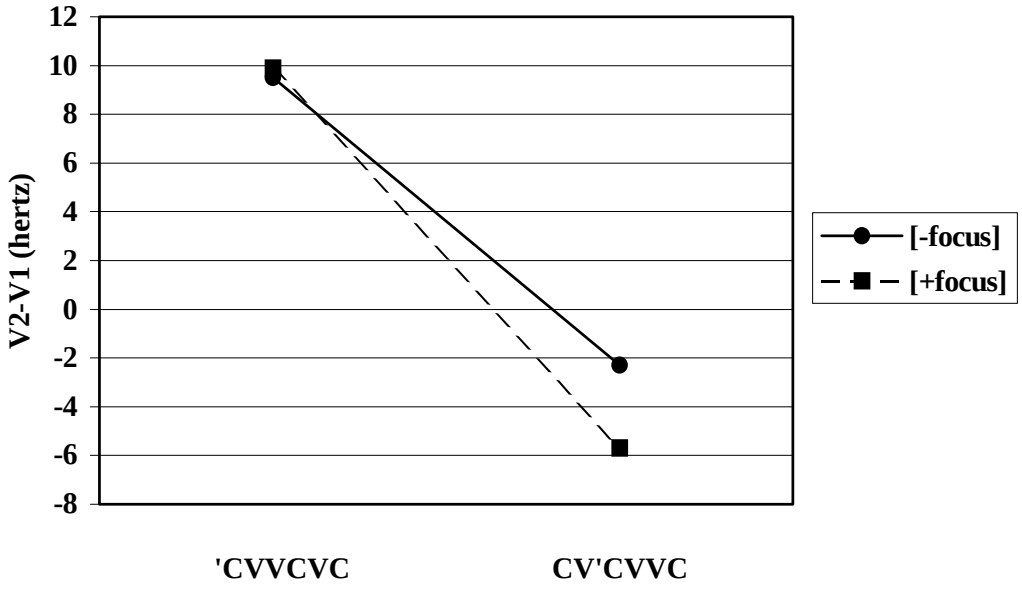



**Figure 2.3. Mean $F_0$ differences for word types 3 and 4**

**Table 2.5. $F_0$ means for minimal pairs**

| | $V_1$ | | $V_2$ | | $V_2$-$V_1$ | |
|---|---|---|---|---|---|---|
| Word | | | | | | |
| /ˈgalaa/ | 106.3 | (9.1) | 109.8 | (11.3) | 3.5 | (4.6) |
| /gaˈlaa/ | 111.8 | (10.6) | 111.6 | (9.7) | -0.3 | (6.3) |
| /ˈghaṭaa/ | 108.5 | (10.9) | 110.5 | (12.2) | 2.0 | (3.6) |
| /ghaˈṭaa/ | 108.7 | (10.8) | 113.5 | (12.5) | 3.5 | (3.9) |
| /ˈpakaa/ | 110.2 | (10.6) | 112.8 | (13.2) | 3.6 | (4.6) |
| /paˈkaa/ | 114.0 | (10.2) | 112.8 | (10.4) | 1.3 | (4.9) |

The words /ˈpakaa/ and /paˈkaa/, and /ˈgalaa/ and /gaˈlaa/ conform to the general pattern seen elsewhere in the data. That is, pitch is lower on a stressed syllable and higher on an unstressed syllable. On the other hand, the pattern seen for the minimal pair /ˈghaṭaa/ and /ghaˈṭaa/ is different in that pitch is higher, not lower, on the stressed syllable in /ghaˈṭaa/. I will now look at /ˈpakaa/ and /paˈkaa/, and /ˈgalaa/ and /gaˈlaa/ to study how focus interacts with the effect of stress on pitch in these words.

Table 2.6 presents mean $F_0$ measurements for /ˈpakaa/ and /paˈkaa/, and /ˈgalaa/ and /gaˈlaa/, broken down by stress and focus.

**Table 2.6. Mean $F_0$ broken down by stress and focus for the words /ˈpakaa/ and /paˈkaa/, and /ˈgalaa/ and /gaˈlaa/**

| | Vowel 1 | Vowel 2 | $V_2$-$V_1$ |
|---|---|---|---|
| **[-focus]** | | | |
| ˈσσ | 108.6 (10.8) | 111.1 (12.6) | 2.4 (3.4) |
| σˈσ | 110.3 (10.5) | 112.4 (10.4) | 2.1 (3.5) |
| **[+focus]** | | | |
| ˈσσ | 107.5 (8.1) | 113.3 (11.7) | 5.8 (5.8) |
| σˈσ | 116.5 (5.4) | 117.0 (4.3) | 0.6 (3.4) |

The effect of stress on $V_1$ pitch is significant in the [+focus] condition [F(1,15)=5.9, p=0.028]. The effect of stress on $V_2$-$V_1$ is significant at the 10 percent level in the [+focus] condition [F(1,15)=4.1, p=0.060]. There is no significant effect of stress on $F_0$ in the [-focus] condition.

Figure 2.4 presents a graphical representation of the interaction of the effects of stress and focus on pitch difference in Table 2.6.

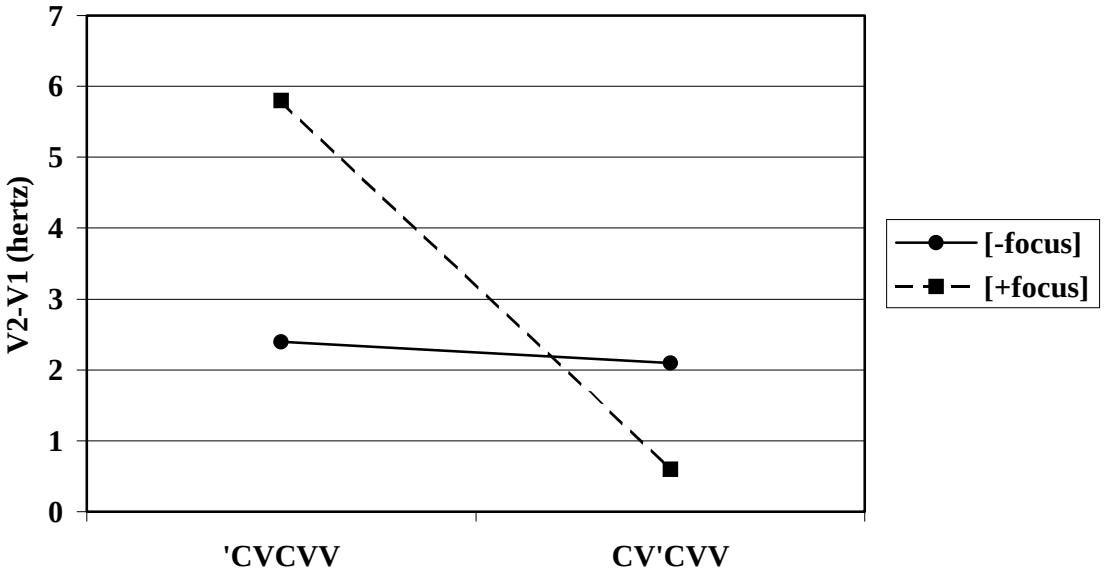



**Figure 2.4. Mean $F_0$ differences for selected minimal pairs**

### 2.2.2. Duration

Durations of words, syllables, and segments were measured in milliseconds. In order to be able to compare syllable and segment durations across speakers and utterances, the durations of syllables and segments are expressed as percentages of word duration in the tables that follow. Percentages and standard deviations were rounded to the nearest tenth.

**Table 2.7. Mean durations (word durations in ms., other durations in percentage of word duration)**

| | Word dur | | S1Per | | C1Per | | V1Per | | C2Per | | V2Per | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Speaker** | | | | | | | | | | | | |
| A | 325 | (45) | 46.4 | (6.5) | 26.8 | (7.4) | 19.0 | (8.5) | 20.5 | (6.5) | 27.0 | (8.7) |
| Bh | 301 | (41) | 44.8 | (7.0) | 27.9 | (6.3) | 18.3 | (13.9) | 21.9 | (7.4) | 26.4 | (7.7) |
| Bi | 378 | (47) | 47.2 | (7.6) | 29.0 | (7.3) | 18.3 | (7.3) | 19.7 | (5.4) | 26.9 | (6.9) |
| **Word Type** | | | | | | | | | | | | |
| 1) 'CVCVV | 304 | (48) | 47.9 | (5.6) | 29.3 | (6.5) | 18.6 | (4.9) | 21.0 | (8.2) | 31.0 | (5.5) |
| 2) CV'CVV | 319 | (46) | 47.3 | (4.6) | 31.4 | (8.3) | 15.9 | (5.9) | 22.7 | (5.5) | 30.1 | (4.3) |
| 3) 'CVVCVC | 359 | (45) | 51.1 | (4.3) | 23.7 | (3.7) | 27.5 | (4.9) | 18.4 | (4.7) | 14.5 | (5.1) |
| 4) CV'CVVC | 378 | (48) | 35.4 | (3.6) | 26.0 | (3.9) | 9.4 | (3.0) | 20.4 | (5.5) | 28.6 | (3.9) |
| **Focus** | | | | | | | | | | | | |
| [-focus] | 328 | (55) | 45.9 | (7.1) | 27.9 | (6.9) | 18.0 | (7.7) | 21.0 | (6.7) | 26.6 | (8.2) |
| [+focus] | 347 | (52) | 46.4 | (7.1) | 28.2 | (6.7) | 18.2 | (7.9) | 20.4 | (5.8) | 26.4 | (8.0) |

Note: Word duration (Word dur), syllable 1 duration (S1Per), consonant 1 duration (C1Per), vowel 1 duration (V1Per), consonant 2 duration (C2Per), and vowel 2 duration (V2Per). Standard deviation is in parentheses.

Table 2.7 presents a summary of mean durations for the entire word, the first syllable of the word (S1), the first consonant of the word (C1), the first vowel (V1), the second consonant (C2), and the second vowel (V2).

The differences in word durations across speakers are significant [$F(2,26)=60.8$, $p<0.001$]. However, the differences in relative durations of syllables and segments across speakers are not significant. This indicates that while the different speakers may have been speaking at different average speech rates, the relative durations of syllables and segments within the words are similar for all speakers.

Table 2.7 also shows that words spoken in [+focus] environments have a longer average duration than words spoken in [-focus] environments. The effect of focus on word duration is significant [$F(1,227)=6.7$, $p=0.010$].

Table 2.8 presents mean durations of the first syllable ($S_1$) for /ˈpakaa/ and /paˈkaa/, and /ˈgalaa/ and /gaˈlaa/, broken down by stress and focus.

**Table 2.8. Mean duration for Syllable 1 ($S_1$) broken down by stress and focus**

| | $S_1$ | |
|---|---|---|
| **[-focus]** | | |
| ˈσσ | 46.9 | (5.6) |
| σˈσ | 46.7 | (4.0) |
| **[+focus]** | | |
| ˈσσ | 48.5 | (2.6) |
| σˈσ | 44.2 | (2.8) |

In the [-focus] condition there is no significant effect of stress on syllable duration. However, in the [+focus] condition the effect of stress on syllable duration is significant [$F(1,15)=9.9$, $p=0.007$]. Even though the average duration of the first syllable is always shorter than the average duration of the second syllable (percentage duration of $S_1$ is always less than 50), the presence of stress on a syllable does result in increased relative duration for that syllable.

Figure 2.5 gives a graphical presentation of the interaction of the effects of focus and stress on the relative duration of the first syllable.

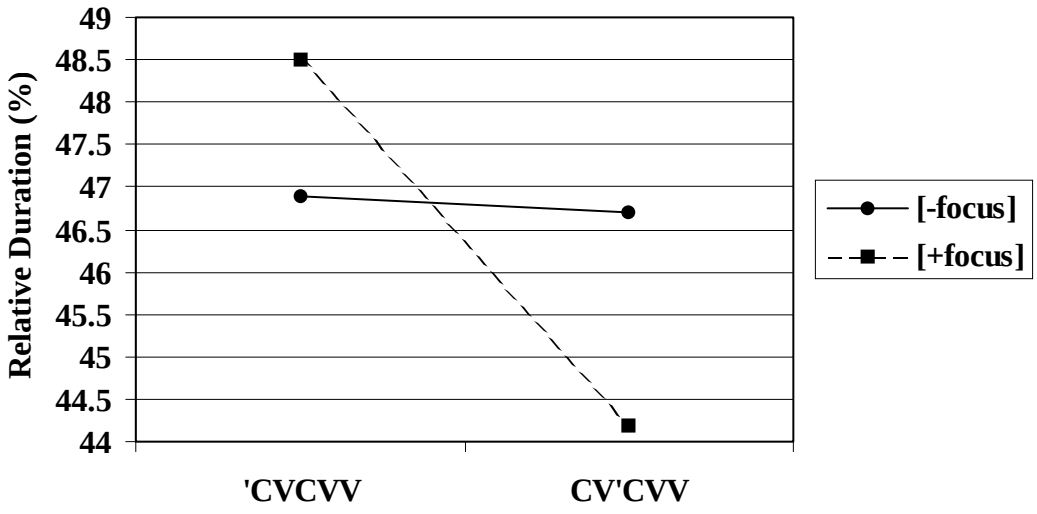



**Figure 2.5. Mean durations for minimal pair members**

### 2.2.3. Intensity

Table 2.9 presents a summary of mean peak intensity measured in the first vowel of the word (V1) and the second vowel of the word ($V_2$). The last column presents the means of the intensity differences between the two vowels ($V_2$-$V_1$). Mean intensities and standard deviations are recorded in decibels and rounded to the nearest tenth.

**Table 2.9. Mean intensity (magnitude) in decibels (dB)**

| | $V_1$ | $V_2$ | $V_2$-$V_1$ |
|---|---|---|---|
| **Speaker** | | | |
| A | -6.4 (2.9) | -3.6 (2.3) | 2.8 (3.6) |
| Bh | -4.0 (3.7) | -4.0 (2.4) | 0.0 (4.1) |
| Bi | -6.5 (3.7) | -3.5 (2.5) | 3.0 (3.9) |
| **Word type** | | | |
| 1) 'CVCVV | -5.2 (3.4) | -3.1 (2.0) | 2.1 (3.7) |
| 2) CV'CVV | -6.3 (3.5) | -3.6 (2.4) | 2.7 (3.8) |
| 3) 'CVVCVC | -3.9 (2.5) | -5.1 (2.6) | -1.1 (2.4) |
| 4) CV'CVVC | -7.5 (4.3) | -3.0 (2.3) | 4.5 (4.7) |
| **Focus** | | | |
| [-focus] | -5.5 (3.5) | -3.5 (2.4) | 2.0 (4.1) |
| [+focus] | -5.9 (3.9) | -4.0 (2.4) | 1.9 (4.1) |

Note: Mean peak intensity of vowel one ($V_1$) and vowel two ($V_2$), and mean intensity difference ($V_2$-$V_1$). Standard deviations are in parentheses.

The effect of word type on the intensities of the first and second vowel and on the intensity differences is highly significant. However, this effect is easily explained on the basis of the differences in segmental make-up between words of type 3 and type 4. No other significant effects or interactions were found in the intensity data.

## 2.3. Discussion

The data in this study confirmed that pitch is a correlate of stress in Hindi-Urdu. Stress tends to correlate with relatively low pitch on the stressed syllable (see Section 2.2.1). The strongest evidence of this is found in Table 2.4 where lower pitch is found on a stressed syllable even in the [-focus] condition. The data of this study also confirmed that duration is a correlate of stress in Hindi-Urdu: stress tends to correlate with increased syllable duration (see Section 2.2.2). The data suggest furthermore that the effect of stress on duration is not independent from the effect on pitch. When we look at the minimal pairs /ˈgalaa/, /gaˈlaa/, /ˈpakaa/, and /paˈkaa/, and take the distinction between [+focus] and [-focus] into account, we see that pitch correlates with stress in the [+focus] condition, while in the [-focus] condition, no significant effect of stress was found. Similarly, for the [+focus] environment there is a significant effect of stress on duration and in the [-focus] environment there is no significant effect of stress on duration.

If Hindi-Urdu is a ‘stress accent’ language, we would expect to see an effect of stress on duration even for the [-focus] words. However, durational differences disappear for the [-focus] condition. Therefore the results of this data suggest that Hindi-Urdu is a non-stress accent language according to the typology of Beckman (1986). That is, there are no other features, independent of pitch, that correlate with stress.

This study is admittedly based on a very limited set of data. The data furthermore did not show a fully consistent pattern. In particular, the words /ˈghaṭaa/ and /ghaˈṭaa/ did not pattern like the other minimal pairs. This may mean that they are not minimal pairs after all, but homophones. Alternatively, it could mean that speakers were not paying attention to the meaning of the word.

Further research is needed to confirm the conclusions. A larger corpus of words and more speakers are needed.

# CHAPTER 3

# THE PERCEPTION EXPERIMENT

## 3.0. Rationale

In several previous studies, suspected minimal pairs for stress have been used as evidence for various views on stress in Hindi-Urdu. Some say these prove that stress is contrastive, therefore phonemic (Arun 1961), while Ohala (1977) claims that the differences between the concerned words are a side effect of intonation and that there is no lexical contrast.

When there are two different words in a language that are homophonous except for lexical stress, a native speaker of that language should be able to identify the meaning of each word without context. In English, we can tell the difference in meaning between '**per**mit' and 'per**mit**' based on the acoustic correlates of stress in English. We do not need to rely on context. If Arun's (1961) words do indeed contrast by stress, we would predict that native speakers are able to identify those words without needing a context. In the perception experiment described in this chapter, the listeners were asked to do exactly that.

If Hindi-Urdu is a non-stress accent language in the terms of the typology of Beckman (1986), then the acoustic manifestations of stress depend on the presence of an intonational pitch accent on the word in question. If a word is spoken without a pitch accent, there will be no acoustic marking of stress. Listeners should not be able to consistently identify the correct member of a minimal pair unless they can rely on context. The purpose of the perception experiment was to see if this is indeed the case.

## 3.1. Method

### 3.1.1. Stimulus materials

For the perception experiment, recordings of minimal pairs from the production experiment were selected. Because the speech of speaker Bh was rather monotonous, only the recordings of A and Bi were used in the perception experiment. The final sentence, or Answer, from the dialogues were cut out and played to mother-tongue listeners. These sentences were taken out of their original contexts so there was no way of telling the meaning of the words except by prosodic features alone. Another pair of words was added to the data that differed by non-prosodic features for a control. The minimal pairs used in the perception experiment are given in Table 3.1.

As can be seen in Table 3.1, and as explained in Section 2.1.1, in the [+focus] contexts, the words /gaˈlaa/ and /paˈkaa/ (with second syllable stress) were not recorded as such in the production experiment. Rather, they were recorded using an inflected form of these words. For this reason these items could not be used in the perception experiment, because they are not minimally contrasting with their counterparts. Consequently, items with 4 cases each in Table 3.1 were presented as pairs, while the words /gaˈlaa/ and /paˈkaa/ in the [+focus] environment were presented individually.

### 3.1.2. Subjects

I found native Hindi speakers at North Dakota State University by sending a message to a publicly posted e-mail list for the Association of Students from India. I met and tested two mother-tongue Hindi speakers. Table 3.2 shows some background information for each of the two listeners.

**Table 3.1. Words used in the perception experiment and number of cases for each environment**

| | | [+focus] | [-focus] |
|---|---|---|---|
| /ˈgalaa/ | 'throat' | 4 | 4 |
| /gaˈlaa/ | 'melt something' | 0 | 4 |
| /ˈghaṭaa/ | 'thick cloud' | 4 | 4 |
| /ghaˈṭaa/ | 'decrease something' | 4 | 4 |
| /ˈpakaa/ | 'cooked' | 4 | 4 |
| /paˈkaa/ | 'cook something' | 0 | 4 |
| /khuˈdaa/ | 'god' | 4 | 4 |
| /kuˈdaal/ | 'axe' | 4 | 4 |

**Table 3.2. Listener information for participants in the perception experiment**

| | Native Lang. | Other Lang. | Hindi w/ fam & Friends | Home city & state | How long in US | Formal Hindi training |
|---|---|---|---|---|---|---|
| A | Hindi | English | Yes | Delhi | 2 years | Up to 10th grade |
| S | Hindi | English | Yes | New Delhi | 3 years | Up to 5th grade |

Since there were only two participants in this experiment, this should only be considered a pilot study for further research.

### 3.1.3. Procedure

The experiment was divided into two parts. In Part 1 the items with counterparts were presented to the listeners in pairs. Following that, the items without counterparts were presented individually in Part 2.

Each stimulus item was played three times over amplified speakers. The recordings were replayed as many times as the subjects requested. For Part 1, speakers were told that they were hearing both members of a minimal pair and they were asked to indicate the order in which the items were presented. The listeners were asked to write down the meaning of the target word on an answer sheet (Appendix 4). For Part 2 subjects were told that they were hearing either one or the other member of a minimal pair and were asked to indicate which member of the minimal pair they were hearing.

## 3.2. Results

Both listeners scored 100% correct for the control words. However, for the members of the minimal pairs, scores were considerably lower. Table 3.3 shows the scores for each listener in both [+focus] and [-focus] conditions.

**Table 3.3. Results of the perception experiment (a pilot study)**

| | [+focus] | [-focus] | Total |
|---|---|---|---|
| **Part 1** | | | |
| Subject A | 4 (50%) | 10 (42%) | 14 (44%) |
| Subject S | 6 (75%) | 16 (67%) | 22 (69%) |
| Total Part 1 | 10 (63%) | 26 (54%) | 36 (56%) |
| **Part 2** | | | |
| Subject A | 4 (50%) | | 4 (50%) |
| Subject S | 5 (63%) | | 5 (63%) |
| Total Part 2 | 9 (56%) | | 9 (56%) |
| **Total** | 19 (59%) | 26 (54%) | 45 (56%) |

The overall score (56%) was only slightly higher than chance. Subject S scored higher than Subject A in every category. Additionally, the means show that listeners scored better in recognizing words in the [+focus] environment than words in the [-focus] environment.

## 3.3. Discussion

Since there were only two speakers, we cannot make any strong generalizations based on the results presented in Section 3.2. However, the data suggest that there is a small effect of stress on subjects' responses among the members of the minimal pairs presented in this experiment. The data also suggest that this effect is stronger for words in the [+focus] environment. This is consistent with the results of the previous production experiment in that for these minimal pairs there are only minimal effects of stress in the [-focus] environment.

# CHAPTER 4

# CONCLUSIONS AND SUGGESTIONS FOR FURTHER RESEARCH

Before I present the conclusion of this study, I will first discuss some of the difficulties encountered during this research, and give suggestions regarding how they can be avoided in future research.

In the course of this study, I encountered a number of obstacles. Some of these problems were due to the fact that I did not know the language. As a result, the speakers could not always be assisted with questions about the text, or be monitored for correct usage during recording. Additionally, two inaccuracies in the translations of the written dialogues were not noticed until after the recordings were made. For further research, it is very important to either have a native speaker lead or at least help with the research. This person must understand the purpose of the study and the methodology involved.

Mother-tongue Hindi speakers were also difficult to find. In the course of this research, it was not difficult to find sizable Indian populations, but a majority of individuals I encountered were either from southern India or other areas where Hindi is not spoken as a native language. The study was also limited to men since I found no female mother-tongue Hindi speakers.

In further studies of Hindi-Urdu stress, more male and female speakers need to be tested in several perception experiments in order to see if the recent descriptions of the acoustic correlates of stress are crucial for the perception of stress. Other strategies for separating the effects of intonation from a sentence could also prove helpful. As Ohala (1977) suggests, perhaps synthesis (or re-synthesis) may be used effectively to control for factors tested for in perception experiments.

Even though there were setbacks, there are significant results from the current study. The results of the production experiment (Section 2) showed that pitch is a correlate of stress in Hindi-Urdu. Stress tends to correlate with low pitch on the stressed syllable (see Section 2.2.1). This is a similar outcome as Hussain (1997) (see Section 1.2.4).

The data of this study also confirmed that duration is a correlate of stress in Hindi-Urdu: stress tends to correlate with increased syllable duration (see section 2.2.2). Duration was found to be a correlate of stress in both Hussain (1997), and Nair (1999).

The data suggest furthermore that the effect of stress on duration is not independent from the effect on pitch (Section 2.2.2). This is evidence that Hindi-Urdu is a non-stress accent language. However, it does not rule out other potentially independent correlates like spectral balance (spectral tilt), or vowel reduction. The latter two were not studied in this project.

The production experiment results also support Moore (1965) and Harnsberger's (1994) claims about intonation, specifically regarding a focused constituent. A word in a [+focus] environment receives greater pitch movement as compared to a word in a [-focus] environment.

In relation to Ladd's typological conjecture, this study supports his hypothesis that Hindi-Urdu, like Bengali, falls into the category of non-stress accent. However, classifying Hindi-Urdu as having either lexically assigned pitch or postlexical pitch is not made easier by the results of this study. Hindi-Urdu intonational studies show rises for content words, and the data here do not disagree. There do not seem to be lexically contrastive types of pitch movement on content words. There also do not seem to be intonationally contrastive pitch movements on content words. Therefore, it is difficult to decide whether the pitch rises that are found should be described as lexical or as intonational.

The pilot perception experiment results suggest that there is a slight effect of stress that makes the members of the minimal pairs contrastive. This effect is greater for words in the [+focus] environments than for words in the [-focus] environment. However, since there were only two participants, these suggestions cannot be taken as strong generalizations.

The effects of stress found in this study on the production as well as the perception of the members of minimal pairs was relatively small, even in the [+focus] contexts. This may perhaps be due to the shortness of the first vowel in the minimal pairs /ˈgaɭaa/ - /gaˈlaa/, /ˈghaṭaa/ - /ghaˈṭaa/, and /ˈpakaa/ - /paˈkaa/.

The current study suggests that prominence-lending pitch movements consist of low pitch on a stressed syllable followed by a rise. If the first vowel is short, most of the rise may be executed on the second syllable, even if the first syllable is stressed. As a result, the difference between initial and final stress is reflected in a relatively small difference in the timing of the pitch rise. The data does not fully reflect this difference since I took measurements at only one point in each vowel. Measuring pitch at more points in each vowel would show this difference in greater detail. This conjecture needs to be verified against the data in more detail since it is outside the scope of the current study.

In answer to our main research question, the data here show that Hindi-Urdu does have acoustic correlates for prominent syllables apart from pitch. Both pitch and duration show statistically significant correlation with a prominent syllable. However, duration was not shown to be independent of pitch, suggesting that duration is an acoustic correlate of intonational pitch accent, not of word stress. Therefore, it is appropriate to describe Hindi-Urdu as a non-stress accent language.

# APPENDIX 1

# TEXT OF THE DIALOGUES

The following is the data for the production experiment. It was presented with the English immediately followed by the Hindi Devanagari translation. Each mini-dialogue was attached to a five by seven note card.

## Dialogue situation one

The following sentences are dialogues between two people: Radha and Jaya. Radha spends a lot of time learning about new words in school. Jaya wants to know how to spell words, but Radha never knows how to spell them because her teacher never writes them on the blackboard. Jaya doesn't give up, and continues to ask Radha if her teacher wrote the new words down, or only spoke them aloud.

(1a)

Radha: Today our teacher taught us words for the parts of the body. He told us about the word /galaa/.

Jaya: /unho~ne galaa kahaa yaa galaa likhaa?/
they throat said or throat wrote
Did he SAY 'throat' or did he WRITE 'throat'?

Radha: /unho~ne galaa kahaa/
they throat said
He SAID 'throat'.

(2a)

Radha: Today our teacher discussed the weather. He told us about the word /ghaṭaa/.

Jaya: /unho~ne ghaṭaa kahaa yaa ghaṭaa likhaa?/
they thick.cloud said or thick.cloud wrote
Did he SAY 'thick cloud' or did he WRITE 'thick cloud'?

Radha: /unho~ne ghaṭaa kahaa/
they thick.cloud said
He SAID 'thick cloud'.

(3a)

Radha: Today our teacher talked about good and bad things. He told us about the word /buraa/.

Jaya: /unho~ne buraa kahaa yaa buraa likhaa?/
they bad said or bad wrote
Did he SAY 'bad' or did he WRITE 'bad'?

Radha: /unho~ne buraa kahaa/
they bad said
He SAID 'bad'.

(4a)

Radha: Today our teacher discussed cooking. He told us about the word /pakaa/.

Jaya: /unho~ne pakaa kahaa yaa pakaa likhaa?/
they cooked said or cooked wrote
Did he SAY ‘cooked’ or did he WRITE ‘cooked’?

Radha: /unho~ne pakaa kahaa/
they cooked said
He SAID ‘cooked’.

(5a)

Radha: Today our teacher talked about religious words. He told us about the word /khudaa/.

Jaya: /unho~ne khudaa kahaa yaa khudaa likhaa?/
they god said or god wrote
Did he SAY ‘god’ or did he WRITE ‘god’?

Radha: /unho~ne khudaa kahaa/
they god said
He SAID ‘god’.

(6a)

Radha: Today our teacher talked about verbs. He told us about the verb /galaanaa/ and the command /galaa/.

Jaya: /unho~ne galaa kahaa yaa galaa likhaa?/
they melt.it said or melt.it wrote
Did he SAY ‘melt it!’ or did he WRITE ‘melt it!’?

Radha: /unho~ne galaa kahaa/
they melt.it said
He SAID ‘melt it!’.

(7a)

Radha: Today our teacher talked about words that indicate measure. He told us about the word /ghaṭaa/.

Jaya: /unho~ne ghaṭaa kahaa yaa ghaṭaa likhaa?/
they decreased said or decreased wrote
Did he SAY ‘decreased’ or did he WRITE ‘decreased’?

Radha: /unho~ne ghaṭaa kahaa/
they decreased said
He SAID ‘decreased’.

(8a)

Radha: Today our teacher discussed commands. He told us about the word /pakaa/.

Jaya: /unho~ne pakaa kahaa yaa pakaa likhaa?/
they cook.it said or cook.it wrote
Did he SAY ‘cook it!’ or did he WRITE ‘cook it!’?

Radha: /unho~ne pakaa kahaa/
they cook.it said
He SAID ‘cook it!’.

(9a)

Radha: Today our teacher talked about things we see in the sky. He told us about the word /baadal/.

Jaya: /unho~ne baadal kahaa yaa baadal likhaa?/
they a.cloud said or a.cloud wrote
Did he SAY ‘a cloud’ or did he WRITE ‘a cloud’?

Radha: /unho~ne baadal kahaa/
they a.cloud said
He SAID ‘a cloud’.

(10a)

Radha: Today our teacher discussed washing clothes. He told us about the word /saabun/.

Jaya: /unho~ne saabun kahaa yaa saabun likhaa?/
they throat said or throat wrote
Did he SAY ‘soap’ or did he WRITE ‘soap’?

Radha: /unho~ne saabun kahaa/
they soap said
He SAID ‘soap’.

(11a)

Radha: Today our teacher discussed going in and out. He told us about the word /baahar/.

Jaya: /unho~ne baahar kahaa yaa baahar likhaa?/
they outside said or outside wrote
Did he SAY ‘outside’ or did he WRITE ‘outside’?

Radha: /unho~ne baahar kahaa/
they outside said
He SAID ‘outside’.

(12a)

Radha: Today our teacher took us to the library. He told us about the word /kitaab/.

Jaya: /unho~ne kitaab kahaa yaa kitaab likhaa?/
they book said or book wrote
Did he SAY ‘book’ or did he WRITE ‘book’?

Radha: /unho~ne kitaab kahaa/
they book said
He SAID ‘book’.

(13a)

Radha: Today our teacher talked about chopping down trees. He talked about the word /kudaal/.

Jaya: /unho~ne kudaal kahaa yaa kudaal likhaa?/
they axe said or axe wrote
Did he SAY ‘axe’ or did he WRITE ‘axe’?

Radha: /unho~ne kudaal kahaa/
they axe said
He SAID ‘axe’.

(14a)

Radha: Today our teacher told us about different ethnic groups of the area. He told us about the word /paṭhaan/.

Jaya: /unho~ne paṭhaan kahaa yaa paṭhaan likhaa?/
they Afghan said or Afghan wrote
Did he SAY ‘Afghan’ or did he WRITE ‘Afghan’?

Radha: /unho~ne paṭhaan kahaa/
they Afghan said
He SAID ‘Afghan’.

## Dialogue Situation Two

Radha and Jaya also experience difficulty understanding each other. Jaya often thinks she has heard correctly, but is not always sure. She asks Radha to repeat the word she missed.

(1b)

Radha: My throat is sore.

Jaya: /tumne galaa kahaa yaa peṭ kahaa?/
you throat say or stomach say
Did you say ‘THROAT’ or did you say ‘STOMACH’?

Radha: /mai~ne galaa kahaa/
I throat said
I said ‘THROAT’.

(2b)

Radha: I just saw a thick cloud outside. The weather is very bad.

Jaya: /tumne ghaṭaa kahaa yaa bijlii kahaa?/
you thick.cloud say or lightning say
Did you say ‘THICK CLOUD’ or did you say ‘LIGHTNING’?

Radha: /mai~ne ghaṭaa kahaa/
I thick.cloud said
I said ‘THICK CLOUD’.

(3b)

Radha: Jaya, didn’t you know that stealing is a bad thing to do?

Jaya: /tumne buraa kahaa yaa baṛaa kahaa?/
you bad say or big say
Did you say ‘BAD’ or did you say ‘BIG’?

Radha: /mai~ne buraa kahaa/
I bad said
I said ‘BAD’.

(4b)

Radha: The dal cooked this morning.

Jaya: /tumne pakaa kahaa yaa giraa kahaa?/
you it.cooked say or it.spilled say
Did you say ‘IT COOKED’ or did you say ‘IT SPILLED’?

Radha: /mai~ne pakaa kahaa/
I it.cooked said
I said ‘IT COOKED’.

(5b)

Radha: God will help us through this difficult time.

Jaya: /tumne khudaa kahaa yaa allah kahaa?/
you god say or Allah say
Did you say ‘GOD’ or did you say ‘ALLAH’?

Radha: /mai~ne khudaa kahaa/
I god said
I said ‘GOD’.

(6b)

Radha: Melt this ghee!

Jaya: /tumne galaane ko kahaa yaa pakaane ko kahaa?/
you melt.it to say or cook.it to say
Did you say ‘MELT IT!’ or did you say ‘COOK IT!’?

Radha: /mai~ne galaao kahaa/
I melt.it said
I said ‘MELT IT!’.

(7b)

Radha: Our profits from the shop might decrease this year.

Jaya: /tumne ghaṭaa kahaa yaa baṛhaa kahaa?/
you decrease say or increase say
Did you say ‘DECREASE’ or did you say ‘INCREASE’?

Radha: /mai~ne ghaṭaa kahaa/
I decrease said
I said ‘DECREASE’.

(8b)

Radha: When you get the dal from the bazaar, cook it!

Jaya: /tumne use pakaane ko kahaa yaa use andar rakhne ko kahaa?/
you him cook.it to say or him inside put to say
Did you say ‘COOK IT’ or did you say ‘STORE IT’?

Radha: /mai~ne pakaane ko kahaa/
I cook.it said
I said ‘COOK IT!’.

(9b)

Radha: Did you see that cloud up in the sky?

Jaya: /tumne baadal kahaa yaa hawaaii ǰahaaz kahaa?/
you a.cloud say or an.airplane say
Did you say ‘A CLOUD’ or did you say ‘AN AIRPLANE’?

Radha: /mai~ne baadal kahaa/
I a.cloud said
I said ‘A CLOUD’.

(10b)

Radha: Did you use enough soap when you washed the clothes this morning?

Jaya: /tumne saabun kahaa yaa paanii kahaa?/
you soap say or water say
Did you say ‘SOAP’ or did you say ‘WATER’?

Radha: /mai~ne saabun kahaa/
I soap said
I said ‘SOAP’.

(11b)

Radha: I was outside when the earthquake hit.

Jaya: /tumne baahar kahaa yaa andar kahaa?/
you outside say or inside say
Did you say ‘OUTSIDE’ or did you say ‘INSIDE’?

Radha: /mai~ne baahar kahaa/
I outside said
I said ‘OUTSIDE’.

(12b)

Radha: Will you bring my book to me?

Jaya: /tumne kitaab kahaa yaa patrikaa kahaa?/
you book say or magazine say
Did you say ‘BOOK’ or did you say ‘MAGAZINE’?

Radha: /mai~ne kitaab kahaa/
I book said
I said ‘BOOK’.

(13b)

Radha: Will you go to the bazaar and buy an axe?

Jaya: /tumne kudaal kahaa yaa aaraa kahaa?/
you axe say or hoe say
Did you say ‘AXE’ or did you say ‘HOE’?

Radha: /mai~ne kudaal kahaa/
I axe said
I said ‘AXE’.

(14b)

Radha: I noticed a new Afghan family moved into our neighborhood last week.

Jaya: /tumne paṭhaan kahaa thaa yaa panǰaabii kahaa?/
you Afghan say PAST or Panjabi say
Did you say ‘AFGHAN’ or did you say ‘PANJABI’?

Radha: /mai~ne paṭhaan kahaa/
I Afghan said
I said ‘AFGHAN’.

## APPENDIX 2

## PRODUCTION EXPERIMENT DATA MAP

'all' = $F_0$, intensity, and duration measurements were taken

'n/a' = no word was available to measure

'pause' = a pause interfered with measurements (no measurements taken)

'(i)' = interpolated pitch

'(p)' = one or more pitch measurements not taken

'khud' = speaker uttered /khud/ instead of /khudaa/

'lagaao' = speaker uttered /lagaa-o/ instead of /galaa-o/

'poor' = utterance mumbled (too poor for measurements)

| | | Speaker | | | | | |
|---|---|---|---|---|---|---|---|
| Word | | A | | Bi | | Bh | |
| **[+focus] in bold** | | Ques. | Ans. | Ques. | Ans. | Ques. | Ans. |
| throat /ˈgalaa/ | 1a1 | All | all | all | pause | all | all |
| throat /ˈgalaa/ | 1a2 | All | all | all | all | all | all |
| **throat /ˈgalaa/** | **1b1** | n/a | all | n/a | all | n/a | all |
| **throat /ˈgalaa/** | **1b2** | n/a | all | n/a | all | n/a | all |
| thick cloud /ˈghaṭaa/ | 2a1 | All | all | all | pause | all | all |
| thick cloud /ˈghaṭaa/ | 2a2 | All | all | all | all | all | all |
| **thick cloud /ˈghaṭaa/** | **2b1** | n/a | all | n/a | all | n/a | all |
| **thick cloud /ˈghaṭaa/** | **2b2** | n/a | all | n/a | all | n/a | all |
| bad /ˈburaa/ | 3a1 | All | all | all | all | all | all |
| bad /ˈburaa/ | 3a2 | All | all | all | all | all | all |
| **bad /ˈburaa/** | **3b1** | n/a | all | n/a | all | n/a | all |
| **bad /ˈburaa/** | **3b2** | n/a | all | n/a | all | n/a | all |
| cooked /ˈpakaa/ | 4a1 | all (i) | all (i) | all | all | all (i) | all (i) |
| cooked /ˈpakaa/ | 4a2 | All | all | all | all | all (i) | all (i) |
| **cooked /ˈpakaa/** | **4b1** | n/a | all | n/a | all | n/a | all |
| **cooked /ˈpakaa/** | **4b2** | n/a | all | n/a | all | n/a | all (p) |
| god /khuˈdaa/ | 5a1 | All | all (p) | all | all | poor | all |
| god /khuˈdaa/ | 5a2 | all (p) | all | all | all | all | all |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **god /khuˈdaa/** | **5b1** | n/a | all | n/a | all | n/a | all (p) |
| **god /khuˈdaa/** | **5b2** | n/a | ‘khud’ | n/a | all | n/a | all |
| melt something /gaˈlaa/ | 6a1 | pause | all | all | all | all | all |
| melt something /gaˈlaa/ | 6a2 | All | all | All | all | all | all |
| **/gaˈlaa-o/** | 6b1 | n/a | all | n/a | all | n/a | ‘lagaao’ |
| **/gaˈlaa-o/** | 6b2 | n/a | pause | n/a | all | n/a | ‘lagaao’ |
| decrease something /ghaˈṭaa/ | 7a1 | all | all | All | all | all | All |
| decrease something /ghaˈṭaa/ | 7a2 | all | all | all (p) | all | all | All |
| **decrease something /ghaˈṭaa/** | **7b1** | n/a | all | n/a | all | n/a | All |
| **decrease something /ghaˈṭaa/** | **7b2** | n/a | all | n/a | all | n/a | All |
| cook something /paˈkaa/ | 8a1 | all | all | All | all | all (p) | All |
| cook something /paˈkaa/ | 8a2 | all | all | All | all | all (p) | all (p) |
| **/paˈkaa-ne/** | 8b1 | n/a | all | n/a | all | n/a | all (p) |
| **/paˈkaa-ne/** | 8b2 | n/a | all | n/a | all | n/a | pause |
| a cloud /ˈbaadal/ | 9a1 | all | all | All | all | all | All |
| a cloud /ˈbaadal/ | 9a2 | all | all | All | all | all (p) | All |
| **a cloud /ˈbaadal/** | **9b1** | n/a | all | n/a | all | n/a | All |
| **a cloud /ˈbaadal/** | **9b2** | n/a | all | n/a | all | n/a | All |
| soap /ˈsaabun/ | 10a1 | all | all | All | all | all | All |
| soap /ˈsaabun/ | 10a2 | all | all | All | all | all (p) | All |
| **soap /ˈsaabun/** | **10b1** | n/a | all | n/a | all | n/a | All |
| **soap /ˈsaabun/** | **10b2** | n/a | all | n/a | all | n/a | all |
| outside /ˈbaahar/ | 11a1 | all | all | pause | all | all (p) | all |
| outside /ˈbaahar/ | 11a2 | all | all | pause | all | all | all |
| **outside /ˈbaahar/** | **11b1** | n/a | all | n/a | all | n/a | all |
| **outside /ˈbaahar/** | **11b2** | n/a | all | n/a | all | n/a | all |
| book /kiˈtaab/ | 12a1 | all | all | All | all | all (p) | all (p) |
| book /kiˈtaab/ | 12a2 | all | all (p) | all (p) | pause | all (p) | all (p) |
| **book /kiˈtaab/** | **12b1** | n/a | all (p) | n/a | all | n/a | poor |
| **book /kiˈtaab/** | **12b2** | n/a | all (p) | n/a | all | n/a | all (p) |
| axe /kuˈdaal/ | 13a1 | all | all | All | all | pause | all (p) |
| axe /kuˈdaal/ | 13a2 | all | all (d) | pause | all | all | all (p) |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **axe /kuˈdaal/** | **13b1** | n/a | all | n/a | all | n/a | all |
| **axe /kuˈdaal/** | **13b2** | n/a | all | n/a | all | n/a | all (p) |
| Afghan /paˈṭhaan/ | 14a1 | pause | all | All | all | pause | pause |
| Afghan /paˈṭhaan/ | 14a2 | pause | all (p) | pause | pause | all (p) | all (p) |
| **Afghan /paˈṭhaan/** | **14b1** | n/a | all | n/a | all | n/a | all |
| **Afghan /paˈṭhaan/** | **14b2** | n/a | all (p) | n/a | all | n/a | all (p) |

## APPENDIX 3

## PERCEPTION TEST ANSWER SHEET

Name:_____

### Part 1

| | | |
|---|---|---|
| 1 | _____ | गला ‘throat’ |
| 2 | _____ | गला ‘melt it’ |
| 3 | _____ | घटा ‘thick cloud’ |
| 4 | _____ | घटा ‘decrease’ |
| 5 | _____ | खुदा ‘god’ |
| 6 | _____ | कुदाल ‘pickaxe’ |
| 7 | _____ | पका ‘cooked’ |
| 8 | _____ | पका ‘cook it!’ |
| 9 | _____ | घटा ‘thick cloud’ |
| 10 | _____ | घटा ‘decrease’ |

| | | |
|---|---|---|
| 11 | _____ | खुदा ‘god’ |
| 12 | _____ | कुदाल ‘pickaxe’ |
| 13 | _____ | घटा ‘thick cloud’ |
| 14 | _____ | घटा ‘decrease’ |
| 15 | _____ | पका ‘cooked’ |
| 16 | _____ | पका ‘cook it!’ |
| 17 | _____ | गला ‘throat’ |
| 18 | _____ | गला ‘melt it’ |
| 19 | _____ | खुदा ‘god’ |
| 20 | _____ | कुदाल ‘pickaxe’ |
| 21 | _____ | खुदा ‘god’ |
| 22 | _____ | कुदाल ‘pickaxe’ |
| 23 | _____ | घटा ‘thick cloud’ |

| | | |
|---|---|---|
| 24 | _____ | घटा ‘decrease’ |
| 25 | _____ | घटा ‘thick cloud’ |
| 26 | _____ | घटा ‘decrease’ |
| 27 | _____ | खुदा ‘god’ |
| 28 | _____ | कुदाल ‘pickaxe’ |
| 29 | _____ | खुदा ‘god’ |
| 30 | _____ | कुदाल ‘pickaxe’ |
| 31 | _____ | गला ‘throat’ |
| 32 | _____ | गला ‘melt it’ |
| 33 | _____ | पका ‘cooked’ |
| 34 | _____ | पका ‘cook it!’ |
| 35 | _____ | घटा ‘thick cloud’ |
| 36 | _____ | घटा ‘decrease’ |
| 37 | _____ | खुदा ‘god’ |

38 _____ कुदाल ‘pickaxe’

39 _____ घटा ‘thick cloud’

40 _____ घटा ‘decrease’

41 _____ गला ‘throat’

42 _____ गला ‘melt it’

43 _____ खुदा ‘god’

44 _____ कुदाल ‘pickaxe’

45 _____ घटा ‘thick cloud’

46 _____ घटा ‘decrease’

47 _____ पका ‘cooked’

48 _____ पका ‘cook it!’

**Part 2**

1 _____ गला ‘throat’

गला ‘melt it’

2 _____ पका ‘cooked’

| | | |
|---|---|---|
| | | पका ‘cook it!’ |
| 3 | _____ | पका ‘cooked’<br>पका ‘cook it!’ |
| 4 | _____ | गला ‘throat’<br>गला ‘melt it’ |
| 5 | _____ | गला ‘throat’<br>गला ‘melt it’ |
| 6 | _____ | पका ‘cooked’<br>पका ‘cook it!’ |
| 7 | _____ | पका ‘cooked’<br>पका ‘cook it!’ |
| 8 | _____ | गला ‘throat’<br>गला ‘melt it’ |

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