Pattern of Prosodic Breakdown in Punjabi Speaking Aphasics

Dissertation submitted to Jawaharlal Nehru University in partial fulfillment of the requirements for the award of the Degree

MASTER OF PHILOSOPHY

By

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CERTIFICATE

This is to certify that the dissertation entitled " **Pattern of Prosodic Breakdown in Punjabi Speaking Aphasics** ", submitted by Chinar Dara, in partial fulfillment of the requirements of the award of the Degree of Master of Philosophy of the university, is to the best of my knowledge an original work and may be placed before the examiners for evaluation.

Prof. G.J.V. Prasad	Prof. Vaishna Narang	Dr.Madhuri Behari
(Acting Chairperson)	(Supervisor)	(Co-Supervisor)

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DECLARATION BY THE CANDIDATE

This dissertation entitled " **Pattern of Prosodic Breakdown in Punjabi Speaking Aphasics** " submitted by me for the award of the degree of Master of Philosophy is an original work and has not been submitted so far in part or in full, for any other degree or diploma of any university.

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....Mom and Dad....

Acknowledgements

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Table of Contents

List of Tables and Figures

List of Figures

Abbreviations

CMC	-	Christian Medical College
DMCH	-	Dayanand Medical College & Hospital
F0	-	Fundamental frequency
LHD	-	Left Hemisphere Damaged
MCA	-	Middle Cerebral Artery
RHD	-	Right Hemisphere Damaged

Chapter One

Introduction

> "I don't know, Yes, the bick, uh, yes I would say that the mick daysis nosis or chpickters. Course, I have also missed on the crafter teck. Do you know what that is? I've, uh, token to ingish. They have been toast sosilly. They'd have been put to myafa and made palis and, uh, myadakal senda you. That is me alordisdus. That makes anacronous senda."
>
> (Buckingham and Kertesz, 1976: 21)[1]

This is how a severely impaired patient with Wernicke's aphasia with neologisms, responds to an examiner's question "Who is running the store now?" (Buckingham and Kertesz, 1976:21), as reported by Buckingham and Kertesz. We can see how communication breaks down when the patient is unable to produce the response because of lack of the flow of information through appropriate channels. This disruption in a discourse is a result of not being able to comprehend the focus of the question and consequently not being able to monitor the output. The comprehension and production of an utterance are carried out in different anatomical locations of the brain; however, a successful discourse can only be carried out by a balanced involvement of both. So we can say that communication, a complex process, is processed at various levels, or rather, we could say human communication through the medium of language is a co-ordinated result of the interaction of various linguistic units at different levels. Broadly, the major constituents on the basis of which

[1] Cited from Obler, Loraine K. and Gjerlow, Kris, 1999, *Language and the brain,* p.59

communication is carried out are – lexicon, syntax, pragmatics, prosody and kinesics. The two levels are – firstly; the brain, where the stimulus is converted into a signal which accordingly activates the second level, the articulators, to give rise to a structured utterance, which then forms the discourse.

The focus of my study is to understand the breakdown of one of the major constituents, prosody, as a result of an injury to the brain. The aim is to try and formulate a pattern of how and to what extent the manipulated prosody affects language processing and to associate different areas in the brain to the corresponding prosodic units. The variables, comprehension and production of various aspects of prosody would be the parameters to test.

1.1 Introduction to Prosody

Prosody is a suprasegmental feature of language, which conveys information, apart from what is transmitted by the lexical units, in a sequence. As mentioned by Kenneth L. Pike (1945), every unit of speech, be it a sentence or a word or a syllable, has some kind of prosody when it is spoken. Even a sound on its own is produced by vibrations whose frequencies constitute its pitch, which is one of the main acoustic features of prosody. The changes in pitch, which occur within a unit of discourse, are not in a random manner. The patterns of variation and the rules of change are highly organized and structured. Their intricacy is so great that although one speaks his/her language with little effort, its analysis is extremely difficult and may induce one to conclude that no actual organization or rules are present, and that people use prosodic variation by whim and fancy. In each language, however, the use of prosody tends to become semi – standardized or formalized so that the speaker of the language uses the basic prosodic pattern in similar ways under similar circumstances.

Therefore, the analysis of prosodic pattern is as intricate as that of other speech sounds, and involves articulatory analysis, acoustic analysis and the analysis of the occurrence of speech sounds on the basis of the role it plays in forming the discourse. As stated by Robbins, "The aim of prosodic analysis in phonology is not that of transcription or unilinear representation of languages, but rather, a phonological analysis in terms which take account not only of paradigmatic relations and contrasts, but also of the equally important syntagmatic relations and functions which are operative in speech. These syntagmatic factors should be systemized and made explicit in phonology, no less than paradigmatic contrasts"(Robbins, 1957:191). Therefore, according to him, it makes use of two types of elements, "Prosodies and Phonematic Units"(Robbins, 1957:192). The latter refers to "those features or aspects of the phonic material which are best regarded as referable to minimal segments, having serial order in relation to each other in structures" (Robbins, 1957:192) That is, these units comprise of consonant and vowel elements or C and V units of a phonological structure. "Structures are not, however, completely stated in these terms; a great part, sometimes the greater part, of the phonic material is referable to prosodies, which are, by definition, of more than one segment in scope or domain of relevance, and may in fact belong to structures of any length, though in practice no prosodies have yet been stated as referring to structures longer than sentences"(Robbins, 1957:192). Consequently we can say that there are different domains over which prosody functions, which are, syllable, syllable groups or word, phrase structure and sentence. Also, a structure can be defined as a "syntagmatic entity comprising phonematic or segmental units and one or more prosodies belonging to the structure as a whole"(Robbins, 1957:192).

Therefore, we can say that phonological analysis of prosody is to identify the individual structure that could be anything from a syllable to a sentence with which the prosodic sound is attached. However, in most cases, as probably perceived by the native speakers, the phonic material of languages seems to belong to structures longer than single segments. This would be done in two possible ways. In the first case "a

feature may be spread or realized phonetically over a structure, such as a syllable, as a whole" (Robbins, 1957:193); examples could be stress, pitch, length, nasalization, palatalization and velarization.

In the second case, "features which are not realized phonetically over the whole or large part of a structure, but which nevertheless serve to delimit it, wholly or partly, from preceding and following structures thus [enter] into syntagmatic relations with what goes before or after in the stream of speech" (Robbins, 1957:193). Examples could be found in some languages of Southeast Asia, like the audible release of stop consonants being unexploded. In these languages, therefore, plosion serves as a syntagmatic signal of syllable initiality and helps delimit the syllable. So does aspiration, affrication etc. These are abstracted as prosodies of syllable initiality; though they may be realized phonetically at one place in the syllable, their relevance extends over the whole structure, which they serve to mark off and bind together as a functional unit.

The theory of prosodic analysis with respect to its acoustic features was introduced in a paper read to the Philological Society by Firth in 1948, and henceforth, the applications of the methods presented and the development of the theory has taken place with reference to various languages. Firth introduced the concept of pitch, which is a complete non-segmental character. Till then, prosodic analysis took into account the features that could be either spread over various phonetic segments or demarcate these segments from each other when produced in a sequence. Pitch is an acoustic feature of the speech sound and along with it are melody, cadence, loudness, timbre, tempo, stress, accent, and timing of pauses. In the present study only pitch is taken into consideration, including both categories of pitch, which are tone (as in the case of Punjabi, a tone language) at the lexical level and intonation at the sentence level. Because of its non-segmental character with the implied domain of a syllable, it is generally known as suprasegmental phoneme. However, Pike limits the term suprasegmental to "quantitative characteristics ...

some modifications of a sound which [do] not change the basic quality or shape of its sound waves"(Pike, 1945: 27).

Later, disregarding the point made by Firth, Palmer (1968:8) states " The starting point for prosody was essentially the complete rejection by Firth of the phoneme as a satisfactory basis for phonological analysis. There are two major characteristics of the prosodic approach. First, its elements are not confined to the narrow segments of the phoneme but might extend beyond these segments to parts of the syllable, the syllable, the word, or even the 'longer piece'. Secondly, it rejects the rigid division between morphology and phonology of American Linguistics which was, Firth said, 'to all intents and purposes Phonemics with an additive morphemics plus the supplementary amendments of morphophonemics.'"

Also, Robbins defines – a syllable prosody as " an abstraction of a specific order in a separate dimension (the syntagmatic), taking its place in a system of prosodies intended to cover the analysis of syntagmatic relations generally, within linguistic structures" (Robbins, 1970:197). The same point that was highlighted was the importance of the syntagmatic and not the paradigmatic relation of the prosody with other elements of the structure for the prosodic analysis. Sprigg, emphasizing the same point says, "In prosodic analysis prominence is given to syntagmatically associated features as opposed to features in paradigmatic contrast" (Sprigg, 1972:547)[1] So we can say that prosody can be analyzed with respect to its domain of the language in consideration and the role it plays in modifying the utterance. This modification could be influenced by linguistic or non-linguistic functions of the prosody.

Joshi summarizes a phonological structure as "...a syntagmatic entity comprising phonematic units C and V, and one or more prosodies belonging to the structure as a

[1] As quoted in Joshi, S.S, *Phonology of the Punjabi Verb*, 1988, p.8

whole. Within such structures, elements can be replaced by, or substituted for, other elements at the same level of abstractions; systems of units or terms commute to give values for the elements of structure." (Joshi, 1988:10)

1.2 Role of Prosody in Punjabi

The state of Punjab is situated in the northern part of India, and the spoken language of this place is Punjabi. It is a highly developed and industrialized state with the highest per capita income in the country. It is also one with the highest literacy rates. All these factors, along with other languages like Hindi and English, have had a great influence on the speech community of Punjab. People more often tend to use words from these languages as they interact with people from other states in case of either possibility; when they go out or when other people come to their place as a result of easy accessibility of transportation. Because of this, Punjabi has undergone changes with respect to different linguistic functions. My study, however, tries to exclude as many diverting factors as possible, and tries to concentrate on core Punjabi.

Pitch, the acoustic feature of prosody, plays a significant role in Punjabi, and it is the level and contour of the pitch and its place of occurrence that is responsible for the difference in the semantics of the utterance. In Punjabi, pitch has two manifestations, tone and intonation. Tone distinguishes lexical units as it plays a role of contrastive feature in tonal languages. Two lexical units with the same features, except difference in tones, will have different meanings in a tonal language, whereas, intonation helps to make discourse more meaningful. The point of contention is the domain and the contour of the pitch. As Pike puts it, " a tone language may be defined as a language having lexically significant, contrastive but relative pitch on each syllable" and clarifies by adding that "significant pitch distinguishes the

meaning of an utterance and when pitch is lexical, it distinguishes the meaning of words" (1945: 3). This shows that, according to Pike, the domain of pitch is a syllable.

" Pitch fluctuation, in its linguistic function, may conveniently be called speech melody. Speech melody is part of the spoken form of the language, just as its segments" (Abercrombie, 1967: 104)[1]. While discussing speech melody he also says that it's linguistic functions vary and are of two fundamentally different kinds. In one case, "the function of the speech melody patterns is to be the part of the structure of sentences; in the other case, their function is to be part of the structure of words. In the former case, the patterns are called INTONATION and in the later case they are called TONE" (Abercrombie, 1967: 104)[2]. Therefore, according to Abercrombie, the domain of pitch is a word.

However, for Punjabi, Gill and Gleason tend to ignore Pike's definition and go by Abercrombie's. They put forth that "there is one tone onset on every word.... The occurrence of a tone may be taken to mark a phonologic word, generally equivalent to a morphologic word" (Gill and Gleason, 1963: 48). Also, Bahl at this point states that, the position of tone in Punjabi is significant in a word. He does not, however, mean that a word can contain more than one tone.

Later, Awan clarifies by stating that "whether a tone is a property of the syllable, the word, group of words depends on the language under study" (1974: 25)[3].

Another aspect of constant discussion is the contours of the tone in Punjabi. Different researchers have stated different contours and levels of pitch variation in this tone language. In this dissertation, I have cited the study of Joshi, Gill and

[1] As quoted in Joshi, S.S, *Phonology of the Punjabi Verb*, 1988, p.51
[2] As quoted in Joshi, S.S, *Phonology of the Punjabi Verb*, 1988, p.51
[3] As quoted in Joshi, S.S, *Phonology of the Punjabi Verb*, 1988, p.52

Gleason and Narang. All of them have stated different terms for each tone of the language and the characteristics corresponding to each tone. Punjabi has three tones as accepted by the researchers (Gill & Gleason, 1963; Awan, 1974; Joshi, 1978, Narang, 1989).

According to Joshi, a three–term tonal system exists in Punjabi. The phonetic exponents of each term may be classified on the basis of their pitch features, phonation features, word–initial features and word–final features. For the present study only pitch features are taken into account. The three terms of the tonal system are: -

1) Tone 1

> "A fall in pitch followed by a rise is the most characteristic feature of the clause – final verb words ...The fall in pitch starts a little above the mid level, falls to low, where it may remain level for sometime, and then rises to about mid level again. The rise in all the cases does not necessarily reach the same level as that of the beginning point." (Joshi, 1988:54). Therefore, according to Joshi it is a low falling tone, which again rises at the end of the syllable.

2) Tone 2

> "A level pitch is the most common feature of the pitch exponents of this tone." (Joshi, 1988: 56). The pitch of this tone is at mid level when compared to Tone 1 and Tone 3. However, this tone may rise or fall in case of certain clauses, that is, units bigger than words.

3) Tone 3

> "A rise in pitch followed by a fall is the most common feature of the various pitch exponents of Tone 3 non-causative verbs" (Joshi, 1988: 59). In case of causative verbs forms there is a fall and a rise in the pitch.

According to Gill and Gleason (1963) Punjabi has three tones, high, medium and low. In the production of these tones there is neither friction nor stoppage of air in the mouth. They are pronounced always concurrently with a syllable.

"In the production of low tone, there is a considerable amount of constriction in the larynx along with some creakiness. Sometimes fall of the larynx is accompanied by the lowest possible pitch" (Gill and Gleason, 1963:28), as can be said about the articulatory features of the low tone. In terms of acoustic features, the fall in pitch is followed by a rise though not to the same level in all cases. The level of pitch is lower than the other two tones, which falls further and then rises in the end of the syllable.

"In high tone, pitch of the voice is raised and falls down in the same syllable in a monosyllabic word but in polysyllabic words the fall is realized in the tail syllable, which follows the onset syllable"(Gill and Gleason, 1963: 30). High tone has a higher level of pitch than the other two and the syllable with this tone is also shorter than those of the other two tones. It occurs in initial, medial and final positions.

In the mid tone words, the pitch remains fairly level which may rise towards the end. The rise is not necessarily realized in all the cases. The level of pitch is in between the other two tones.

The low tone is lowest of all and the pitch tends to fall. The syllable is of intermediate height in this case.

In case of phonemic disorder of prosody, all three tones will have to be studied with effect to their contrastive functions, i.e. different tones associated with the same syllable bringing out the lexical differences. Therefore, according to them, the level of pitch variation is also an important characteristic feature along with the contours of the tones at lexical level.

1.3 Introduction to Neurology of Prosody

The onset of the twentieth century brought with it a whole lot of new dimensions of research and an array of unanswered questions. Language is being investigated with a new interest, which has led to new perspectives and approaches of investigation. The increasingly new behavioral and neuroscientific tools like structural neuroimaging, computational modelling, precise behavioral probes of distinct psycholinguistic process, and methods to examine evoked electrophysiological responses, cerebral asymmetries and task -dependent shifts in regional brain activation, are being used to assess the normal as well as disordered brain, which further helps us understand neural substrate of language.

However, the studies about language and brain are usually supposed to have begun in 1861 when the French surgeon and anatomist Paul Broca announced that he had discovered an association between language loss and damage to a determinate portion of the cerebral cortex: the first of the third frontal convolution. Further, in 1865, he proposed the concept of cerebral dominance and said, "the language center of the brain resided in the dominant hemisphere of the brain i.e. the faculty of articulate language was located in the posterior portion of the left third frontal convolution" (Caplan, 1987: 49). Later in 1874, Carl Wernicke, then a 26 year old physician training in neuropsychiatry, discovered "that there were several sub types of aphasic syndromes, each of which resulted from lesions in different areas of the brain." (Caplan, 1987: 49, 50). Just as Broca's paper produced the important hypothesis that linguistic and psycholinguistic functions were localized in cerebral gyri, Wernicke's paper introduced the notion of information flow into our concepts of the representation and processing of language by the brain. These are called " faculty" models (Caplan, 1987: 62). The work of Wernicke, Lichtheim and many other late nineteenth century investigators dealt mainly with various parts of what may be termed the "faculty for language" (Caplan, 1987: 65). The identification of elementary components of this faculty, the delineation of interactions of components,

and the search for the neural loci of these components and their connecting pathways were other aspects that were taken into consideration by them.

Later in 1948, Pierre Marrie and Kurt Goldstein developed Global Models of aphasia in which a disturbance of a single functional capacity was the predominant cause of all the signs and types of aphasia. Both accepted the existence of several aphasic syndromes and neither claimed that a sole factor was adequate to describe all the various manifestations of aphasia. This further gave rise to Process Model, which was developed by the Russian neuropsychologist A. R. Luria, and has changed the insight into the nature of aphasic symptoms. The underlying principle is that the usual functions of language – speech, comprehension, reading, and writing – are processes, which can further be divided into constituent parts. This model extends the processing account of language use to all tasks. They consider all the activities, which involve language, to be the result of several identifiable processing components. This helps in discussing the qualitative nature of language breakdown. Another important feature is that, when language is impaired, it will usually be impaired in a number of functions. This result is concluded from the view that sub-components of language functioning are each involved in a variety of different tasks, which explains the interactive nature of the "language system" (Caplan, 1987: 120). Though Luria viewed the psychology of language as an outgrowth of mechanisms regulating sensory motor function, and extended this analysis to the level of the neural basis for language, he also conceived of language as a particular intellectual capacity, which played a special role in human psychology. This role was in part to facilitate "abstract thinking, categorization, drawing inferences and other intellectual functions" (Caplan, 1987:127). Another role that language played in human psychology, according to Luria was to regulate behavior. He held views similar to those of Jackson and Goldstein, to the extent that he believed that human behavior consisted of primitive actions, which were regulated by higher functional abilities.

This development instigated further research, and a broader category of "interactionists" (Caplan, 1987:130) have emerged, who argue that while localizing language phenomena in the brain, which is the ultimate aim of neurolinguistics, it is no longer expected that there are language areas entirely "responsible" (Caplan, 1987:130) for language, or even "dominant" (Caplan, 1987:130) for language to be contrasted with areas that have nothing to do with it. Rather, the whole brain contributes to the broad range of language abilities. This can be clearly explained further as it has been propounded on the basis of linguistic investigations that grammatical functions are discreetly represented. The programming of the articulatory–motor units and the selective processing of syntacto–morphological units (auxillaries, verbal conjugations, inflections and articles) are mediated in the frontal language cortex. The posterior temporo–parietal cortex is involved with language formulation, semantic arrangement, lexical selection and comprehension of language. "This commonly accepted tenet of two neurolinguistic loci continues to be limited lacunae in our knowledge of the neurological underpinnings related to the grammatical functions... Thereby the site of a lesion has been conjectured based on the clinical symptomology based on the assumption that a lesion of another location than a presumed one would not have produced such a clinical picture of grammatical breakdown"(Bhatnagar, Mandybur, et al, 2000). Further research is required to locate regions in brain responsible for other language functions, like phonological processing et al.

The first systematic inquiry into the neurology of prosody was initiated by Monrad-Krohn in 1945 and is widely referred till date. He divided prosody into four basic types as reported in Ross, Elliot D., 1999. *Intrinsic (linguistic) prosody* is used to clarify the meaning of a sentence by the proper distribution of intonation, stresses and pauses, which are equivalent to the application of commas, colons, semicolons, periods and question marks in written language. Examples include, raising instead of lowering the intonation contour at the end of a sentence to indicate a question and

changing the stress and pausal pattern to clarify potentially ambiguous semantic or syntactic information. For instance "The **Red**coats have arrived" (British regulars) versus "The red... **coats** have arrived" (red-colored coats) as "A man... and **a woman** dressed in formal attire ...came to party" (only woman was wearing formal clothes) versus "A **man and woman**... dressed in formal attire...came to the party" (both were dressed in formal clothes). Dialectal and idiosyncratic prosody are also to some degree subsumed by the term intrinsic prosody and refer to regional and individual differences in enunciation, pronunciation and the stresses and pausal patterns of speech. *Intellectual prosody* imparts attitudinal information to discourse and may drastically influence meaning. For example, if the sentence, "He is clever" is emphatically stressed on "is" it becomes a resounding acknowledgement of the person's ability whereas if the emphatic stress resides on "clever" with a marked rise in intonation, sarcasm becomes apparent. *Emotional prosody* inserts moods and emotions, such as happiness, sadness, fear and anger, into speech. The term *affective prosody* refers to the combination of attitudinal and emotional prosody. When coupled with gestures, affective prosody imparts vitality to discourse and greatly influences the content and impact of a message. If a statement contains an affective-prosody intent that is at variance with its literal meaning, the former usually takes precedence in the interpretation of the message both in adults and to a lesser degree in children. For example, if the sentence "I had a really great day' is spoken with an ironic tone of voice, it will be understood as communicating an intent opposite to its linguistic meaning. The paralinguistic feature of language, as exemplified by affective prosody, may thus play an even more important role in human communication than the exact choice of words. *Inarticulate prosody* refers to the use of certain paralinguistic elements, such as grunts and sighs, to embellish discourse.

Though Monrad – Krohn discovered the impairments in which the lack of correct prosody caused problems, yet there was not enough evidence at that time. As stated by Goodglass and Kaplan that a patient with Wernicke's aphasia may "sound

like a normal speaker at a distance, because of his fluency and normal melodic contour of his speech" (Ross, 1999). Hughlings Jackson also recognized that even patients with severe aphasic disturbances could produce prosodic intonation to convey the affective or pragmatic intention of a communicative message. Therefore, there has been a debate ever since on the existence of disturbances as a result of brain injury and also between the role of left and right hemisphere in the functioning of various components of prosody.

However, there has been evidence from dichotic listening studies conducted by Blumstein and Cooper (1974) where results from two experiments suggest that the right hemisphere is directly involved in the perception of intonation contours and that normal language perception involves the active participation of both cerebral hemispheres. Just before that, Zurif and his workers (1970,72) had demonstrated right ear superiority for prosodic perception in contrast to Blumstein and Cooper's left ear advantage in the perception of intonation contours. That is probably because of the difference in the nature of the tasks used by them. In the Blumstein and Cooper study, the subjects were required to make a rather gross distinction based solely on the melodic component of intonation contours (statement vs. question vs. imperative), whereas, Zurif et al required subjects to remember the grammatical structure of sentences in which grammatical constituents were cued by prosodic features. Thus, the more linguistic oriented tasks used by Zurif et al may have preferentially engaged the left hemisphere. Also, the study in case of a tone language, Thai, conducted by Lancker and Fromkin (1973), concluded that the pitch discrimination is lateralized to the left hemisphere when the pitch differences are linguistically preferred. Later, in 1981, Weintraub et al, carried out a research on the right hemisphere contribution to the language. Their study demonstrated " that patients with right hemisphere lesions perform poorly on tests of non–affective prosody. The patients made errors on all aspects of prosodic control tested, namely, discrimination, repetition and elicited production...[and]...this raised the possibility that right hemisphere damage leads to a more generalized impairment of prosody than was hitherto supposed." They also

stated that right hemisphere of dextrals may have a specialized role in the overall modulation of speech prosody independent of its additional specialization for affective behavior. In 1982, Kent and Rosenbeck(1982) illustrated the hypothesis based on the then existing literature and their own studies with the help of the following diagram: -

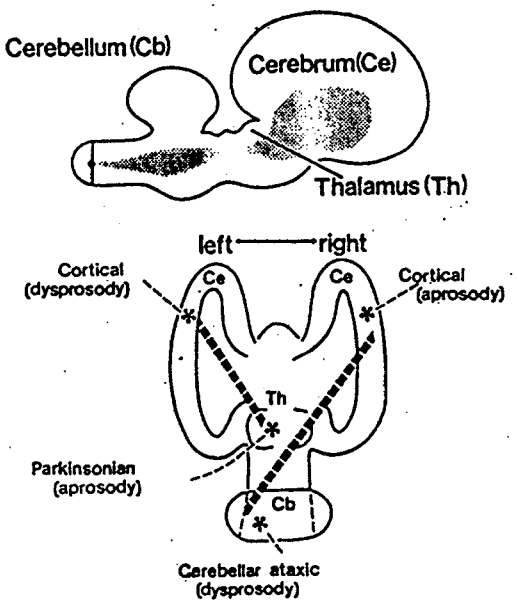


Fig 1.1 Relation between prosodic disorders and neurologic lesion

They summarized it as " (1) the right cerebral hemisphere, which appears to have a privileged role in the processing of prosodic and affective information; (2) contralateral cerebellocerebral connections, which allows the cerebellum access to the prosodic line presumably contained in the right cerebral hemisphere; (3) ipsilateral thalamocortical pathways which may conduct essential affective and motivational information from the basal ganglia; (4) the thalamus, which seems to regulate information flow to the cortex; (5) the cerebellum which in addition to its general chores of motor regulation may be involved in integrating the prosodic and segmental – phonetic components of speech." (Kent and Rosenbek, 1982).

It was Susan J. Behrens (1983) who emphasized that a left hemisphere mechanism may be engaged for prosodic features when those features are linguistically significant, and a right hemisphere mechanism for prosody separate from linguistic component. This was supported by Heilman et al in 1984 that the right hemisphere is dominant for comprehension of emotional prosody and not propositional (linguistic) prosody. However, Silberman and Weingartner came out with another perspective of the hemispheric lateralization of emotions. According to them, the right hemisphere plays a major role in the processing of "emotional aspects of information" in regulating " states of subjective emotional feeling and associated behaviors"(Silberman and Weingartner, 1986). They also demonstrated that the right hemisphere is "involved in handling of negative emotions" and the left hemisphere is "associated with processing of positive emotions" (Silberman and Weingartner, 1986). Even Emmorey (1987), indicated that " comprehension of lexical/phrasal stress contrasts is preserved with damage to the right hemisphere but impaired with damage to the left hemisphere".

Other interesting features were brought into light by the study of Mahoney and Sainsbury (1987) and Hassler (1990). Mahoney and Sainsbury included another factor, attention, which influences lateralization. The results of their study suggested that "attention influences the rate of the laterality effect but not the direction of the effect" (Mahoney and Sainsbury, 1987). Later, Hassler used Witelson's Dichaptic Test to assess the relative participation of the two hemispheres in spatial processing. Their study hypothesized that, " in males, functions of the right hemisphere were more strongly involved than functions of the left hemisphere. In females, functions of both hemispheres should be nearly equally involved in spatial processing" (Hassler, 1990). Cancelliere and Kertesz carried out another interesting study, which investigated the relationship between intrahemispheric location of lesion and disturbances of emotional expression and comprehension. The results, "for lesions in either hemisphere, indicated involvement of the basal gangalia most frequently in aprosodic syndromes followed by anterior temporal lobe and insula lesions. Basal

Gangalia damage was also seen most frequently in patients with impaired comprehension of emotional facial expressions and situations. The anterior temporal lobe was also frequently involved in patients with such deficits. The basal gangalia emerged as a structure of particular importance in the mediation of emotional expression and comprehension" (Cancelliere and Kertesz, 1990). This shows that prosody is not limited to one hemisphere and is rather a function of different regions in the brain. Again in 1991, Bradvik et al contested the hypothesis that right hemisphere is superior for emotional prosody as well as expression of intonation contours and left for ability to distinguish and express prosodic features providing "phonemic" (lexical) or "emphatic" (Bradvik, 1991) information. They concluded that the right hemisphere is of importance for "identification and production of several linguistic prosodic qualities of speech, as well as for identification of emotions. It was also demonstrated that speech prosody may be disturbed by cortical as well as purely sub-cortical lesions" (Bradvik, 1991).

However, later studies emphasized on the dominant and lateralized function of the right hemisphere for affective prosody. Like Ross (1997,1999) after doing a series of clinical studies clearly shows that "focal damage to the right hemisphere" is the cause of disruption in the flow of comprehension, production and repetition of affective prosody and does not influence the linguistic prosody. The conflict over dominance of the hemisphere was heightened when Baum and Pell (1997) and Pell (1999) did not support the previous theories. The results of Baum and Pell's (1997) test demonstrated that both the right and left hemisphere damaged patients "were able to appropriately utilize the acoustic parameters examined (duration, fundamental frequency (F0), amplitude) to differentiate both linguistic and affective sentence types in a manner comparable to NC speakers".

As a result of these conflicting views on the basis of the respective studies a clear-cut analysis is yet to be formulated. **Therefore, this has led to the formulation of a few hypotheses for lesion sites and their corresponding functions related to**

processing of prosody. First one can be that all the different components of prosody are processed in the right hemisphere, which are integrated with linguistic information via callosal connections (Klouda et al. 1988). The **second** suggests that affective (emotional) prosody is taken care of by the right hemisphere and linguistic prosody by the left – the functional lateralization hypothesis (Van Lancker 1980). The **third** one claims that prosody is not a function of one hemisphere and it is the different anatomical regions, which are responsible for different aspects of prosody. Like comprehension and production of prosody are not lateralized to one hemisphere but are processed by subcortical regions (Cancelliere and Kertesz 1990). **Lastly,** studies suggest that individual acoustic cues to prosody can be independently lateralized (Van Lancker and Sidtis 1992).

Most of these studies have been carried out in non-tone languages except in the case of Thai, Mandarin Chinese and Taiwanese. In these languages prosodic features serve a more basic linguistic function in addition to their use as cues to syntactic structure and emotional meaning. Because of the fundamental linguistic importance of tone in these language systems, one might predict a different pattern of prosodic control than is found in speakers of non-tone languages.

In 1986, Packard conducted a study of nonfluent left hemisphere-damaged aphasic speakers in Mandarin Chinese. As compared to normal speakers, left hemisphere-damaged speakers made more mistakes in the tasks focusing on phonemic nature of tones. This led to the claim that left hemisphere controls phonemic tone. In the same year Ryalls and Reinvang hypothesized on similar lines that the left hemisphere is involved with tone production after making a comparison between left and right hemisphere damaged speakers of Norwegian which is another tone language. Later in 1992, Gandour and his colleagues also reached the same conclusion after carrying out a study in Thai. They took into account acoustic and conceptual analyses to understand the control of fundamental frequency (F0) in lexical items with tone contrasts. Their tests showed that left hemisphere damaged

speakers did not perceive the tonal contrasts very well as compared to normal and right hemisphere damaged speakers. Thus, the authors suggested that the left hemisphere has a major role in this manifestation of prosody. However, it has been more or less concluded, with respect to the functioning of word level stress bringing out phonemic tone contrasts, that it is controlled by the left hemisphere (Pell 1999a,b).

1.4 A Brief Description of further Chapters

Therefore, in this study we proceed with the hypothesis, that linguistic prosody is stimulated in the left hemisphere and emotive prosody in the right hemisphere. All the analyses will be compared with this hypothesis. Also, an attempt has been made to find out to what extent the manifestation of prosody is affected. For this, both the correct and incorrect responses are analyzed along with the fundamental frequency of the pitch to study the acoustic cue of these tonal contrasts. My dissertation is based on these theories and I have tried to find out what principle lies beneath the functioning of prosody in the case of Punjabi language. For this I have tried to formulate an hypothesis of how brain-damaged Punjabi speakers perceive their language and then if they are able to produce it with the same distinctions or not.

This dissertation is divided into four more chapters. The next chapter is on research methodology and will explain the basis of the empirical part of the study and how the study was conducted. In the third chapter there is a detailed report of all the cases individually, and is followed by the fourth chapter analyzes the results, which are being discussed at length. The last chapter summarizes and then concludes the findings of the present study.

Chapter Two

Research Methodology

2.1 Aim of the research

The aim of my research is to formulate a pattern of prosodic breakdown on the basis of linguistic and affective parameters in case of Punjabi speaking patients with right as well as left hemisphere lesions.

Linguistic analysis includes both "emic" and "etic" disorder of prosody (Ruth Lesser, 1978: 182). Emic refers to the system and distribution of contrastive linguistic units. This contrast is made with respect to different aspects of prosodic elements like stress, tone, intonation, etc. But this varies in all languages. For example, stress occurs in most languages to perform the distinctive linguistc functions. However, features like tone, and vowel length may not be present in all languages as an emic parameter. Languages in which tone is present as a distinctive phonemic unit are called tone languages, like, Punjabi. Etic refers to description of physical phenomena in speech and writing without explicit reference to their emic function. The disorders that are attributable to etic are articulatory difficulties, and emic when there are grammatical restrictions.

Therefore, the objective of my research is to find out how brain damaged people comprehend and produce these tones, which have different functions in Punjabi, and to what extent they deviate from the normal control subjects. To achieve this aim, four tasks have been prepared to examine the subjects' responses to each variation of prosody. As a result of the paucity of time and limited resources only few aspects of prosody were taken into account. They are tonal contrasts at lexical level, that is, when tone acts as a phoneme, difference in the linguistic meaning of a non-committal utterance because of variation in the intonation of the utterance and the difference in the meaning of a non-committal utterance with respect to the emotions of the speaker

involved. In my present study I've taken into consideration only one of the acoustic features, pitch, to know the deviation in case of the phonemic tone. To know this, the fundamental frequency of the vowel sound is being calculated, which bears the pitch that brings out the contrast.

This research is based on the criteria like comprehension of the tones by recognition through word contrasts and production of these tones with or without the same variations. These are confirmed with the help of different tasks like picture naming, repetition, and decoding of correct and incorrect tones and intonation.

2.2 Subjects

A total of 12 subjects participated in this experiment. Out of which four were unilateral left hemisphere damaged patients with mean age of 57.5 years, four unilateral right hemisphere damaged patients with mean age 39 years and four normal control subjects with mean age 41.5 years. All the subjects were native speakers of Punjabi, though, their dialects were different, as all of them belonged to various parts of Punjab.

The brain-damaged subjects were outpatients in Dayanand Medical College and Christian Medical College, Ludhiana. The normal control subjects were from Punjab Agricultural University, Ludhiana. All the brain-damaged speakers had suffered a cerebrovascular stroke except one whose damage was as a result of an accident. Their lesions were confirmed either by a CT scan or an MRI scan and this information was procured from the patients' medical records. An aphasia-screening test was performed on each one of them to determine their aphasia quotient. The aphasia-screening test was prepared by Dr. Bhatnagar (see appendix 2, p.162). This test was procured from the Department of Speech Pathology and Audiology, All India Institute of Medical Science (AIIMS), New Delhi, where it is commonly used to

assess the type of aphasia of a patient. This test was carried out in Hindi because of the unavailability of the corresponding test in Punjabi. The Aphasia Severity Scale and the Rating Scale Profile of speech characteristics of the test are adapted from BDAE (Goodglass and Kaplan, 1983). These tests and the tasks were performed atleast one-month post onset of the stroke.

A detailed personal as well as medical history of each subject was taken into consideration. Demographic details like age, sex, education, mother tongue, language preference in different aspects of life, and preference of handedness were considered along with medical factors like time and circumstances of the stroke, familial history, presence of any other ailment and psychological factors. A detailed description of each patient is provided in the Appendix 1 (p.138). A summary of the basic information of all the subjects is tabulated in the following table:

3.3 Stimuli and Procedure

Four tasks were specifically developed to test the comprehension and production of various aspects of prosody in an utterance that is the phonemic as well as phonetic aspect. The stimuli for each one is different as each task is designed to check a specific linguistic or non-linguistic function of prosody. The linguistic category of the first two tasks is at the lexical level where tone plays a phonemic role. As there are three tones- low, mid and high- in Punjabi, the tasks are prepared to see how the subjects perceive and produce all the three tones. The linguistic category of the third and fourth task is the sentence level. The aim of the third task is to check if the subject can perceive and produce the correct tones, which distinguishes the different kinds of statements that are declarative, imperative and interrogative. However, the fourth task is to see how subjects comprehend and produce the tones, which are affective in nature. The three emotions that have been taken into consideration are happiness, anger and sadness.

The experiment on the subjects was carried out individually in quiet examination rooms of both the hospitals. The duration of the entire experiment was 90 minutes. The first 45 minutes were devoted to knowing the medical history of the person and on the aphasia battery to find out the aphasia quotient (AQ). During the next 45 minutes the tasks prepared on prosody were carried out. The entire test was done in one session only. The responses for these tasks on tones were recorded in an M - 450 Sony Microcassette Recorder. The subject's responses were recorded by placing the recorder at a distance of around 10 inches from the speaker's mouth.

A detailed description of each task is as follows: -

1. **Picture Naming Task:** In this task the subject had to provide the correct lexical unit corresponding to that picture. The test variable was 'production of tone'

sentence was tested. The test variables were again comprehension (which includes identification) and production of tones at sentential level. Three different emotions (happiness, anger and sadness) were taken into consideration. In this case also there were a total of ten sentences, out of which three signified happiness, three sadness and four anger. These were again non-committal sentences. The same procedure was carried out as in the case of the third task.

We can divide these four tasks on the following parameters: -

Task No.	Linguistic Category	Function	Test Variables
1	Lexical Level	Linguistic – producing three tones of Punjabi	Production
2	Lexical Level	Linguistic – Tonal Contrasts in Punjabi	Production
3	Sentential Level	Linguistic – Variations in intonation	Comprehension Production
4	Sentential Level	Affective – Variations in emotions	Comprehension Production

Table 2.2 Description of tasks

iv) Numbers

18. Do (two)

19. P̃əj (five)

20. əṭh (eight)

TASK 2 – Repetition

1. ɔkirki nu cànda-e

   (He is peeping through the window.)

2. ɔ apne bəchəya-nu bahut cɑndɑ-e

   (He is very fond of his children)

3. uzi tì, tí sa:l di-he

   (His daughter is thirty years old)

4. us kə̀ṛi ich sɑ:f pani-e

   (That pitcher has clean water)

5. ɔchaval nal kə́ṛi kha riya-e

   (He is having rice with curry.)

6. une pɑ:ni dól dit-ta

   (He spilled the water)

7. ɔdol giya-e

   (He has gone crazy)

8. ɔde pɑ̀i ne nəve kəpṛe pɑ́i-e

   (His brother is wearing new clothes.)

TASK 3 – Repetition

1. o ja rəhi-e
   (She is going.)
2. onu cá chəngi ləgdi he?
   (He likes to have tea?)
3. o sɔṇi-e!
   (She is Beautiful!)
4. o Chandigarh jɑ rəi-ne.
   (They are going to Chandigarh.)
5. o kəm nəhi kər ria-e!
   (He is not working!)
6. odi kuṛi da vyɑ ho ria-e?
   (His daughter is getting married?)
7. onu gɑnɑ g nɑ chəŋgɑ ləgda-e!
   (She likes to sing!)

8. o kə́r giya-e?
   (He has gone home?)
9. čhor phərya giya?
   (The thief got caught?)
10. udi tŏr piṛ kər rəi-e.
    (His neck is hurting.)

TASK 4 – Repetition

1. o bɑ:r ja rai-e
   (She is going abroad – Happy)
2. jədo kəm tɛ ja rəi si təd mein uno mili
   (I met him yesterday when he was going for work – Happy)
3. ɔda result əj aya si.
   (His result came out today – Sad)
4. une əpne puttr nu kəl datiya.
   (He scolded his son yesterday – Angry)
5. o kəlli rəh rəhi he
   (She is living alone – Sad)
6. tu ki kər riyɑ -e
   (What are you doing – Angry)
7. ɔda result əj aya si.
   (His result came out today – Happy)
8. o bɑ:r jɑ ri-e
   (She is going abroad – Sad)
9. o khéd riya-e.
   (He is playing – Angry)
10. kəl rətti uze uncle ne phone kita si.
    (Her uncle called up last night – Angry)

3.5 Parameters of calculation

There were three groups of subjects, left hemisphere damaged (LHD), right hemisphere damaged (RHD) and normal control subjects (NC) and four in each set. Their aphasia quotient (AQ) was computed by calculating the scores of the three categories of the test on the basis of the guidelines given in the battery. The three

categories are auditory comprehension, production and praxic movements (for details of the test refer appendix 3, p.162).

For the four tasks each correct response recorded for each of the test variables was given one mark. Given specified time duration, if the response from the subject was within that time limitation, it was taken into consideration, else it was marked as wrong. In the first two tasks, scores were given only to production responses, but for the other two tasks the scores were marked for comprehension as well as production. To compare the three sets for each variable of all the tasks, the analysis of variance (ANOVA) statistical tool was used to confirm our hypothesis (refer literature review p. 19). The calculated value of the variants is compared to the table value which is $F_{(2,9)} = 19.385$.

To study the pitch variation for the phonetic and phonemic function of tone, fundamental frequency (F0) was calculated for all the significant vowel sounds, which was computed by using the 4.1.21 version of PRAAT, a computer program. Paul Boersma and David Weenink of the Institute of Phonetic Sciences of the University of Amsterdam maintain this program. The F0 at initial, medial and final positions of the twenty sounds, that is, all sounds of the first two tasks of all the subjects were calculated. However, only four sounds, / ə/, / o /, / ɑ/, and / i / have been taken into account for the present study as only these sounds are in contrast for all the three tones. Firstly the averages of these sounds in each tone is computed and then to study the level of pitch for the three tones a combined average of all the sounds of a tone is calculated. Then these averages of all the three groups, LHD, RHD and NC are compared to study the pattern of deviation in case of the responses of brain damaged subjects.

To study the responses of the brain damaged subjects in detail, this dissertation is divided into three more chapters. In the next chapter of Case Observation, each case

is studied individually as their scores for each task are tabulated. The fourth chapter deals with the analysis of the scores of each task and the fundamental frequency of the tones at the lexical level. On the basis of the analysis, the results are obtained and an attempt has been made to discuss those results. The last chapter is the concluding chapter and all the findings are concluded to form a hypothesis for further extensive research in Ph.D.

Chapter Three

Case Observation

In this chapter a detailed description of all the subjects along with their scores in each task is being presented (for further details about subjects refer appendix 1, p.138). This includes the aphasia quotient (AQ), kind of aphasia on the basis of "Aphasia Severity Scale" (refer appendix 3, p.163) of the test battery, scores of all the four tasks (for details refer Tasks, p.27) with respect to each parameter (for details refer Stimuli and Procedure, p.24) along with the anatomical location of the injury of each subject.

3.1 Subject 1

The first subject is a 70 year old bilingual male. His mother tongue and most often used language is Punjabi but has a good working knowledge of Hindi as well. Though his education is till primary level, he can speak, comprehend and read both these languages very well but is unable to write comprehensively. He also knows Urdu but has a very basic knowledge of the language. This subject had a stroke in August'03 due to which he has brain damage on left hemisphere of the brain. The anatomical location of the injury is Anterior-Cerebral Artery, frontal lobe. A mild attack of paralysis on the right side (upper) of the body had been reported during the first few days of the stroke but there was a fast recovery of the same. No other problems like hemianopia and sensory loss had been observed.

The percentage test scores of the aphasia battery that was done on 10th October'03, that is, one-month post onset, of this subject are – 91% in auditory comprehension, 98% in production and 97.33% in praxic movements. His aphasia test scores reveal that he has **Minimal Aphasia** according to the *"Aphasia Severity Scale"* provided with the test. This shows that he has 'minimal discernible aphasic

manifestations, the subject may have subjective difficulties that are not apparent to the listener'.

Score Sheet of Tonal Tasks

Task 1: Picture Naming Task (production of tones)

(1 for each correct response)

	Level of tone	Score
1	Low	1
2	Low	1
3	Mid	1
4	Low	0
5	Mid	0
6	High	1
7	High	1
8	Mid	1
9	High	0
10	High	0
11	Mid	1
12	Mid	0
13	Mid	1
14	Mid	1
15	Mid	1
16	Mid	0
17	Mid	1
18	Mid	0
19	Mid	1
20	Mid	1

Table 3.1 Scores of Subject 1 Task 1

Total:

Low Tone Words : 2 / 3
Mid Tone Words : 9 / 13
High Tone Words : 2 / 4

Task 2: **Repetition Task (production of tone)**

(1 for each correct response)

	Level of Tone	Score
1	Low	1
2	Mid	0
3	Low	0
4	High	1
5	Low	1
6	High	1
7	High	0
8	Mid	1
9	Low	0
10	High	1

Table 3.2 Scores of Subject 1 Task 2

Total:

Low Tone Words	:	2 / 4
Mid Tone Words	:	1 / 2
High Tone Words	:	3 / 4

Task 3: **Repetition Task (comprehension & production of the tones)**

(1 for each correct response)

	Kind of Statement	Score	
		Comprehension	Production
1	Declarative	1	1
2	Interrogative	1	1
3	Imperative	0	0
4	Declarative	1	0
5	Imperative	1	1
6	Interrogative	1	1
7	Imperative	1	0
8	Interrogative	1	0
9	Interrogative	0	0
10	Declarative	1	1

Table 3.3 Scores of Subject 1 Task 3

Total:

Declarative : 3 (comprehension)/ 3, 2 (production) / 3
Interrogative : 3 (comprehension)/ 4, 2 (production) / 4
Imperative : 2 (comprehension)/ 3, 1 (production) / 3

Task: 4 **Repetition Task (comprehension & production of tones)**

(1 for each correct response)

	Kind of Emotion	Score	
		Comprehension	Production
1	Happy	1	1
2	Happy	1	1
3	Sad	1	0
4	Angry	1	1
5	Sad	0	0
6	Angry	1	1
7	Happy	1	1
8	Sad	1	1
9	Angry	1	0
10	Angry	1	1

Table 3.4 Scores of Subject 1 Task 4

Total:

Happy : 3 (comprehension)/ 3, 3 (production) / 3
Sad : 2 (comprehension)/ 3, 1 (production) / 3
Angry : 4 (comprehension)/ 4, 3 (production) / 4

3.2 Subject 2

The second subject is a 74 year old multilingual male. His mother tongue and the language used for most activities is Punjabi. He has a moderate knowledge of Hindi as well though prefers to use Punjabi, since he can comprehend, speak and read the language very well. He has some knowledge of English, too, which he learnt in school. He had a stroke in April'03 and as a result has an infarct in the temporo-parietal region of the left hemisphere of the brain. He had a sudden onset of weakness in the right (both upper and lower part) side of the body along with some speech difficulty. His condition had improved considerably over a few hours. Along with this he also had a sensory loss in the lower part of the right side of the body, which also improved during that recovery period. He was suffering from asthma for three years prior to the stroke.

These tests were conducted four months after the stroke and the percentage test scores for aphasia battery are – 55% in auditory comprehension, 72.5% in production and 66% in praxic movements. These scores indicate that he is on the third level of *'Aphasia Severity Scale'* provided with the test, which means that the subject can carry out **Unassisted Communication**. According to this scale 'the patient discusses almost all everyday problems with little or no assistance. Limited expressive and/or receptive competence makes conversation about complex and abstract material difficult or impossible'.

Score Sheet of Tonal Tasks

Task 1: **Picture Naming Task (production of tones)**

(1 for each correct response)

	Level of tone	Score
1	Low	1
2	Low	1
3	Mid	1
4	Low	0
5	Mid	1
6	High	1
7	High	1
8	Mid	0
9	High	1
10	High	1
11	Mid	0
12	Mid	1
13	Mid	0
14	Mid	0
15	Mid	0
16	Mid	1
17	Mid	1
18	Mid	1
19	Mid	1
20	Mid	1

Table 3.5 Scores of Subject 2 Task 1

Total:

Low Tone Words	:	2 / 3
Mid Tone Words	:	8 / 13
High Tone Words	:	4 / 4

Task 2: **Repetition Task (production of tone)**

(1 for each correct response)

	Level of Tone	Score
1	Low	0
2	Mid	0
3	Low	1
4	High	1
5	Low	0
6	High	1
7	High	0
8	Mid	0
9	Low	0
10	High	1

Table 3.6 Scores of Subject 2 Task 2

Total:

Low Tone Words	:	1 / 4
Mid Tone Words	:	0 / 2
High Tone Words	:	3 / 4

Task 3: **Repetition Task (comprehension & production of the tones)**

(1 for each correct response)

	Kind of Statement	Score	
		Comprehension	Production
1	Declarative	1	0
2	Interrogative	1	0
3	Imperative	1	1
4	Declarative	1	1
5	Imperative	1	0
6	Interrogative	0	0
7	Imperative	1	1
8	Interrogative	0	0
9	Interrogative	1	1
10	Declarative	0	0

Table 3.7 Scores of Subject 2 Task 3

Total:

Declarative : 2 (comprehension)/ 3, 1 (production) / 3
Interrogative : 2 (comprehension)/ 4, 1 (production) / 4
Imperative : 3 (comprehension)/ 3, 2 (production) / 3

Task4: Repetition Task (comprehension & production of tones)

(1 for each correct response)

	Kind of Emotion	Score	
		Comprehension	Production
1	Happy	1	1
2	Happy	1	1
3	Sad	1	0
4	Angry	1	1
5	Sad	0	0
6	Angry	1	0
7	Happy	1	1
8	Sad	1	1
9	Angry	0	0
10	Angry	1	1

Table 3.8 Scores of Subject 2 Task 4

Total:

Happy : 3 (comprehension)/ 3, 3 (production) / 3
Sad : 2 (comprehension)/ 3, 1 (production) / 3
Angry : 3 (comprehension)/ 4, 1 (production) / 4

3.3 Subject 3

The third subject is a 60 year old multilingual female, a native of Bhatinda, Punjab. She is fluent in Punjabi and Hindi and has some basic knowledge of English. Punjabi is her mother tongue and she can understand, speak, read and write it very well. However, in case of Hindi she can only comprehend and speak and is unable to read and write. She had a stroke in August'03 as a result of excessive mental stress. Consequently, there was an infarct in the sub-cortical region, frontal lobe of the left hemisphere. For some time after the stroke she had a tendency of being hypertensive and had high BP. She even had a right hemiparesis and right hemianopia. However, she recovered fairly well.

The tests were conducted fourteen months post onset. The percentage scores of the aphasia test battery are – 89% in auditory comprehension, 94% in production, and 76% in praxic movements. On the basis of *'Aphasia Severity Scale'* she can be rated as having **Moderate Aphasia**, which means, 'a noticeable loss of fluency in speech or facility of comprehension interferes with communication, but it does not pose a significant limitation on the content and/ or the form of expression'.

Score Sheet of Tonal Tasks

Task 1: **Picture Naming Task (production of tones)**

(1 for each correct response)

	Level of tone	Score
1	Low	1
2	Low	1
3	Mid	1
4	Low	1
5	Mid	1
6	High	1
7	High	1
8	Mid	1
9	High	0
10	High	1
11	Mid	1
12	Mid	1
13	Mid	0
14	Mid	1
15	Mid	1
16	Mid	1
17	Mid	1
18	Mid	1
19	Mid	0
20	Mid	1

Table 3.9 Scores of Subject 3 Task 1

Total:

Low Tone Words	:	3 / 3
Mid Tone Words	:	11 / 13
High Tone Words	:	3 / 4

Task 2: **Repetition Task (production of tone)**

(1 for each correct response)

	Level of Tone	Score
1	Low	1
2	Mid	1
3	Low	1
4	High	1
5	Low	0
6	High	0
7	High	0
8	Mid	1
9	Low	0
10	High	1

Table 3.10 Scores of Subject 3 Task 2

Total:

Low Tone Words	:	2 / 4
Mid Tone Words	:	2 / 2
High Tone Words	:	2 / 4

Task 3: Repetition Task (comprehension & production of the tones)

(1 for each correct response)

	Kind of Statement	Score	
		Comprehension	Production
1	Declarative	1	1
2	Interrogative	1	1
3	Imperative	0	1
4	Declarative	0	0
5	Imperative	1	1
6	Interrogative	0	0
7	Imperative	0	0
8	Interrogative	1	0
9	Interrogative	1	1
10	Declarative	1	1

Table 3.11 Scores of Subject 3 Task 3

Total:

Declarative : 2 (comprehension)/ 3, 2 (production) / 3
Interrogative : 3 (comprehension)/ 4, 2 (production) / 4
Imperative : 1 (comprehension)/ 3, 2 (production) / 3

Task4: **Repetition Task (comprehension & production of tones)**

(1 for each correct response)

	Kind of Emotion	Score	
		Comprehension	Production
1	Happy	0	0
2	Happy	1	1
3	Sad	1	1
4	Angry	1	1
5	Sad	1	1
6	Angry	1	1
7	Happy	1	1
8	Sad	1	1
9	Angry	1	0
10	Angry	1	1

Table 3.12 Scores of Subject 3 Task 4

Total:

Happy : 2 (comprehension)/ 3, 2 (production) / 3
Sad : 3 (comprehension)/ 3, 3 (production) / 3
Angry : 4 (comprehension)/ 4, 3 (production) / 4

3.4 Subject 4

The fourth subject is a 25 year old bilingual male, a native of Ludhiana, Punjab. He has fairly good linguistic skills in two languages, Punjabi, his mother tongue and Hindi. He can carry out all the basic functions of comprehension, production, reading and writing in case of both languages. He had an occlusive stroke as a result of an RSA c head injury in August'03. Consequently, he had right-sided hemiparesis. Decreased sleep and appetite along with blockage in the blood vessels were also observed. The anatomical location of the stroke was thrombus mid and distal LICA had an infarct in the Middle Cerebral Artery, frontal– parietal lobe.

The percentage scores of the aphasia test battery, which was carried out on 13th Oct'03 are – 84% in auditory comprehension, 88% in production and 60% in praxic movements. According to the *'Aphasia Severity Scale'* these scores indicate that he has **Moderate Aphasia**, which means, 'a noticeable loss of fluency in speech or facility of comprehension interferes with communication, but it does not pose a significant limitation on the content and/ or the form of expression'.

Score Sheet of Tonal Tasks

Task 1: **Picture Naming Task (production of tones)**

(1 for each correct response)

	Level of tone	Score
1	Low	1
2	Low	1
3	Mid	1
4	Low	1
5	Mid	1
6	High	1
7	High	1
8	Mid	1
9	High	0
10	High	1
11	Mid	1
12	Mid	1
13	Mid	0
14	Mid	1
15	Mid	1
16	Mid	0
17	Mid	1
18	Mid	0
19	Mid	1
20	Mid	1

Table 3.13 Scores of Subject 4 Task 1

Total:

Low Tone Words	:	3 / 3
Mid Tone Words	:	10 / 13
High Tone Words	:	3 / 4

Task 2: **Repetition Task (production of tone)**

(1 for each correct response)

	Level of Tone	Score
1	Low	1
2	Mid	0
3	Low	0
4	High	0
5	Low	1
6	High	0
7	High	0
8	Mid	1
9	Low	0
10	High	1

Table 3.14 Scores of Subject 4 Task 2

Total:

Low Tone Words	:	2 / 4
Mid Tone Words	:	1 / 2
High Tone Words	:	1 / 4

Task 3: **Repetition Task (comprehension & production of the tones)**

(1 for each correct response)

	Kind of Statement	Score	
		Comprehension	Production
1	Declarative	1	1
2	Interrogative	1	1
3	Imperative	0	0
4	Declarative	1	1
5	Imperative	1	1
6	Interrogative	0	0
7	Imperative	1	0
8	Interrogative	1	1
9	Interrogative	1	1
10	Declarative	0	1

Table 3.15 Scores of Subject 4 Task 3

Total:

Declarative : 2 (comprehension)/ 3, 3 (production) / 3
Interrogative : 3 (comprehension)/ 4, 3 (production) / 4
Imperative : 2 (comprehension)/ 3, 1 (production) / 3

Task4: Repetition Task (comprehension & production of tones)

(1 for each correct response)

	Kind of Emotion	Score	
		Comprehension	Production
1	Happy	1	1
2	Happy	1	1
3	Sad	1	1
4	Angry	1	1
5	Sad	0	0
6	Angry	0	0
7	Happy	1	1
8	Sad	1	1
9	Angry	1	0
10	Angry	1	1

Table 3.16 Scores of Subject 4 Task 4

Total:

Happy : 3 (comprehension)/ 3, 3 (production) / 3
Sad : 2 (comprehension)/ 3, 2 (production) / 3
Angry : 3 (comprehension)/ 4, 2 (production) / 4

3.5 Subject 5

This subject is a 65 year old multilingual male, a resident of Ludhiana, Punjab. His education till high school and a multicultural society enabled him to learn four languages. He has got good proficiency in Hindi, Urdu and Punjabi. Hindi is his mother tongue and the language used for most activities of everyday life; Punjabi is spoken in the immediate environment and Urdu was learnt in school but pursued because of his personal interest and environment. He has a fairly good knowledge of English as well. The subject had a stroke in July'03 because of which he sustained hemiparesis on the left side (upper) of his body and the anatomical location of the injury was in the parietal occipital lobe but he recovered fast.

The percentage scores of the aphasia test battery carried out on 15th Oct'03 are – 100 % in auditory comprehension, 92% in production and 94.7% in praxic movements. This score tells us that he had **Minimal Aphasia** according to the *'Aphasia Severity Scale'* provided with the test. This shows that he has 'minimal discernible aphasic manifestations, the subject may have subjective difficulties that are not apparent to the listener'.

Score Sheet of Tonal Tasks

Task 1: Picture Naming Task (production of tones)

(1 for each correct response)

	Level of tone	Score
1	Low	1
2	Low	1
3	Mid	1
4	Low	1
5	Mid	1
6	High	1
7	High	1
8	Mid	1
9	High	1
10	High	1
11	Mid	1
12	Mid	1
13	Mid	1
14	Mid	1
15	Mid	1
16	Mid	1
17	Mid	1
18	Mid	1
19	Mid	1
20	Mid	1

Table 3.17 Scores of Subject 5 Task 1

Total:

Low Tone Words	:	3 / 3
Mid Tone Words	:	13 / 13
High Tone Words	:	4 / 4

Task 2: **Repetition Task (production of tone)**

(1 for each correct response)

	Level of Tone	Score
1	Low	1
2	Mid	0
3	Low	1
4	High	1
5	Low	0
6	High	1
7	High	0
8	Mid	1
9	Low	1
10	High	1

Table 3.18 Scores of Subject 5 Task 2

Total:

Low Tone Words	:	3 / 4
Mid Tone Words	:	1 / 2
High Tone Words	:	3 / 4

Task 3: **Repetition Task (comprehension & production of the tones)**

(1 for each correct response)

	Kind of Statement	Score	
		Comprehension	Production
1	Declarative	1	1
2	Interrogative	1	1
3	Imperative	1	0
4	Declarative	1	1
5	Imperative	0	0
6	Interrogative	1	1
7	Imperative	1	1
8	Interrogative	0	0
9	Interrogative	1	1
10	Declarative	0	0

Table 3.19 Scores of Subject 5 Task 3

Total:

Declarative: 2 (comprehension)/ 3, 2 (production) / 3
Interrogative: 3 (comprehension)/ 4, 3 (production) / 4
Imperative: 2 (comprehension)/ 3, 1 (production) / 3

Task4: **Repetition Task (comprehension & production of tones)**

(1 for each correct response)

	Kind of Emotion	Score	
		Comprehension	Production
1	Happy	1	1
2	Happy	0	0
3	Sad	0	0
4	Angry	1	0
5	Sad	1	1
6	Angry	0	0
7	Happy	1	1
8	Sad	0	0
9	Angry	1	1
10	Angry	0	0

Table 3.20 Scores of Subject 5 Task 4

Total:

Happy : 2 (comprehension)/ 3, 2 (production) / 3
Sad : 1 (comprehension)/ 3, 1 (production) / 3
Angry : 2 (comprehension)/ 4, 1 (production) / 4

3.6 Subject 6

The sixth subject is a young 19-year-old bilingual boy. He has a fairly good proficiency in Punjabi and Hindi. Punjabi is his mother tongue and the one used for day-to-day chores; he can understand and use it very well for all communicative purposes. Hindi was learnt in school and is not very frequently used. He had acute seizure in September'03 in the frontal parietal part of right hemisphere in early September. As a result he had a complete paralysis on the left side of the body along with slight sensory loss.

His aphasia test percentage scores one-month post onset is – 78% in auditory comprehension, 79.5% in production and 50% in praxic movements. These scores indicate that he has **Moderate Aphasia**, according to the *'Aphasia Severity Scale'*, which means, 'a noticeable loss of fluency in speech or facility of comprehension interferes with communication, but it does not pose a significant limitation on the content and/ or the form of expression'.

Score Sheet of Tonal Tasks

Task 1: Picture Naming Task (production of tones)

(1 for each correct response)

	Level of tone	Score
1	Low	1
2	Low	1
3	Mid	1
4	Low	1
5	Mid	1
6	High	1
7	High	1
8	Mid	0
9	High	1
10	High	1
11	Mid	1
12	Mid	1
13	Mid	1
14	Mid	1
15	Mid	1
16	Mid	1
17	Mid	1
18	Mid	0
19	Mid	0
20	Mid	1

Table 3.21 Scores of Subject 6 Task 1

Total:

Low Tone Words	:	3 / 3
Mid Tone Words	:	10 / 13
High Tone Words	:	4 / 4

Task 2: **Repetition Task (production of tone)**

(1 for each correct response)

	Level of Tone	Score
1	Low	1
2	Mid	1
3	Low	1
4	High	0
5	Low	0
6	High	1
7	High	1
8	Mid	1
9	Low	1
10	High	1

Table 3.22 Scores of Subject 6 Task 2

Total:

Low Tone Words	:	3 / 4
Mid Tone Words	:	2 / 2
High Tone Words	:	3 / 4

Task 3: **Repetition Task (comprehension & production of the tones)**

(1 for each correct response)

	Kind of Statement	Score	
		Comprehension	Production
1	Declarative	1	1
2	Interrogative	1	1
3	Imperative	1	1
4	Declarative	1	0
5	Imperative	0	0
6	Interrogative	1	0
7	Imperative	1	1
8	Interrogative	1	1
9	Interrogative	0	0
10	Declarative	1	1

Table 3.23 Scores of Subject 6 Task 3

Total:

Declarative : 3 (comprehension)/ 3, 2 (production) / 3
Interrogative : 3 (comprehension)/ 4, 2 (production) / 4
Imperative : 2 (comprehension)/ 3, 2 (production) / 3

Task4: **Repetition Task (comprehension & production of tones)**

(1 for each correct response)

	Kind of Emotion	Score	
		Comprehension	Production
1	Happy	1	1
2	Happy	0	0
3	Sad	1	1
4	Angry	1	0
5	Sad	1	0
6	Angry	1	1
7	Happy	0	0
8	Sad	0	0
9	Angry	0	0
10	Angry	0	0

Table 3.24 Scores of Subject 6 Task 4

Total:

Happy : 1 (comprehension)/ 3, 1 (production) / 3
Sad : 2 (comprehension)/ 3, 1 (production) / 3
Angry : 2 (comprehension)/ 4, 1 (production) / 4

3.7 Subject 7

This subject is a 40-year-old bilingual female, a native of Ludhiana, Punjab. She has good proficiency in Punjabi and Hindi and can carry out all linguistic functions except writing very well. Her mother tongue is Punjabi. She uses this language for most day-to-day activities. She had an acute stroke in May'03 and as a result the posterior cerebral artery of right hemisphere of the brain got affected. She also had a mild paralysis attack on the left (upper and lower) side of the body.

Her percentage scores in the aphasia test battery five months post onset are – 82% in auditory comprehension, 81% in production and 86% in praxic movements. These scores indicate that she has **Moderate Aphasia** according to the *'Aphasia Severity scale'*, which means, 'a noticeable loss of fluency in speech or facility of comprehension interferes with communication, but it does not pose a significant limitation on the content and/ or the form of expression'.

Score Sheet of Tonal Tasks

Task 1: **Picture Naming Task (production of tones)**

(1 for each correct response)

	Level of tone	Score
1	Low	1
2	Low	0
3	Mid	1
4	Low	1
5	Mid	1
6	High	1
7	High	1
8	Mid	0
9	High	1
10	High	0
11	Mid	0
12	Mid	1
13	Mid	1
14	Mid	1
15	Mid	1
16	Mid	1
17	Mid	1
18	Mid	1
19	Mid	1
20	Mid	1

Table 3.25 Scores of Subject 7 Task 1

Total:

Low Tone Words	:	2 / 3
Mid Tone Words	:	11 / 13
High Tone Words	:	3 / 4

Task 2: **Repetition Task (production of tone)**

(1 for each correct response)

	Level of Tone	Score
1	Low	0
2	Mid	0
3	Low	1
4	High	1
5	Low	0
6	High	0
7	High	1
8	Mid	1
9	Low	1
10	High	0

Table 3.26 Scores of Subject 7 Task 2

Total:

Low Tone Words	:	2 / 4
Mid Tone Words	:	1 / 2
High Tone Words	:	2 / 4

Task 3: Repetition Task (comprehension & production of the tones)

(1 for each correct response)

	Kind of Statement	Score	
		Comprehension	Production
1	Declarative	1	1
2	Interrogative	1	1
3	Imperative	1	1
4	Declarative	1	1
5	Imperative	0	0
6	Interrogative	1	1
7	Imperative	1	1
8	Interrogative	1	0
9	Interrogative	0	0
10	Declarative	1	1

Table 3.27 Scores of Subject 7 Task 3

Total:

Declarative : 3 (comprehension)/ 3, 3 (production) / 3
Interrogative : 3 (comprehension)/ 4, 2 (production) / 4
Imperative : 2 (comprehension)/ 3, 2 (production) / 3

Task4: **Repetition Task (comprehension & production of tones)**

(1 for each correct response)

	Kind of Emotion	Score	
		Comprehension	Production
1	Happy	1	1
2	Happy	1	0
3	Sad	1	1
4	Angry	1	1
5	Sad	0	0
6	Angry	0	0
7	Happy	0	0
8	Sad	0	0
9	Angry	1	1
10	Angry	0	0

Table 3.28 Scores of Subject 7 Task 4

Total:

Happy : 2 (comprehension)/ 3, 1 (production) / 3
Sad : 1 (comprehension)/ 3, 1 (production) / 3
Angry : 2 (comprehension)/ 4, 2 (production) / 4

3.8 Subject 8

This subject is a 32-year-old multilingual female, a native of Hoshiarpur, Punjab. She has good understanding of three languages: Punjabi, Hindi and English and could perform all the linguistic functions very well in all the three languages. She had a stroke in Feb' 03 in the right hemisphere and had an infarct in the frontal temporal parietal region of the brain. Though she had recovered to a certain extent by the time of examination, but as reported by the doctors, her recovery was slow as the stroke was due to an accident.

The percentage scores of the aphasia test battery eight months post onset are – 71% in auditory comprehension, 73.5% in production and 63.33% in praxic movements. This indicates that she was at the third level of the severity scale and had **Unassisted Communication** according to the *'Aphasia Severity scale'*, which means 'The patient discusses almost all everyday problems with little or no assistance. Limited expressive and/or receptive competence makes conversation about complex and abstract material difficult or impossible'.

Score Sheet of Tonal Tasks

Task 1: **Picture Naming Tasks (production of tones)**

(1 for each correct response)

	Level of tone	Score
1	Low	1
2	Low	1
3	Mid	0
4	Low	1
5	Mid	1
6	High	1
7	High	0
8	Mid	1
9	High	1
10	High	1
11	Mid	1
12	Mid	1
13	Mid	1
14	Mid	1
15	Mid	1
16	Mid	1
17	Mid	1
18	Mid	1
19	Mid	1
20	Mid	1

Table 3.29 Scores of Subject 8 Task 1

Total:

Low Tone Words	:	3 / 3
Mid Tone Words	:	12 / 13
High Tone Words	:	3 / 4

Task 2: **Repetition Task (production of tone)**

(1 for each correct response)

	Level of Tone	Score
1	Low	1
2	Mid	1
3	Low	1
4	High	1
5	Low	1
6	High	0
7	High	1
8	Mid	1
9	Low	1
10	High	1

Table 3.30 Scores of Subject 8 Task 2

Total:

Low Tone Words	:	4 / 4
Mid Tone Words	:	2 / 2
High Tone Words	:	3 / 4

Task 3: **Repetition Task (comprehension & production of the tones)**

(1 for each correct response)

	Kind of Statement	Score	
		Comprehension	Production
1	Declarative	1	1
2	Interrogative	1	0
3	Imperative	1	1
4	Declarative	0	0
5	Imperative	1	1
6	Interrogative	1	1
7	Imperative	1	0
8	Interrogative	1	1
9	Interrogative	0	0
10	Declarative	1	1

Table 3.31 Scores of Subject 8 Task 3

Total:

Declarative : 2 (comprehension)/ 3, 2 (comprehension) / 3
Interrogative : 3 (comprehension)/ 4, 2 (comprehension) / 4
Imperative : 3 (comprehension)/ 3, 2 (comprehension) / 3

Task4: Repetition Task (comprehension & production of tones)

(1 for each correct response)

	Kind of Emotion	Score	
		Comprehension	Production
1	Happy	1	1
2	Happy	0	0
3	Sad	0	0
4	Angry	1	1
5	Sad	1	0
6	Angry	1	0
7	Happy	1	0
8	Sad	0	0
9	Angry	0	0
10	Angry	1	1

Table 3.32 Scores of Subject 8 Task 4

Total:

Happy : 2 (comprehension)/ 3, 1 (production) / 3
Sad : 1 (comprehension)/ 3, 0 (production) / 3
Angry : 3 (comprehension)/ 4, 2 (production) / 4

3.9 Subject 9

This subject is a 28-years-old bilingual Punjabi male. He has good proficiency in Punjabi and Hindi but cannot write very well in either of the languages. This is a normal control subject.

Score Sheet of Tonal Tasks

Task 1: Picture Naming Task (production of tones)

(1 for each correct response)

	Level of tone	Score
1	Low	1
2	Low	1
3	Mid	1
4	Low	1
5	Mid	0
6	High	1
7	High	1
8	Mid	1
9	High	1
10	High	1
11	Mid	1
12	Mid	1
13	Mid	1
14	Mid	1
15	Mid	1
16	Mid	1
17	Mid	1
18	Mid	1
19	Mid	1
20	Mid	1

Table 3.33 Scores of Subject 9 Task 1

Total:

Low Tone Words	:	3 / 3
Mid Tone Words	:	12 / 13
High Tone Words	:	4 / 4

Task 2: **Repetition Task (production of tone)**

(1 for each correct response)

	Level of Tone	Score
1	Low	1
2	Mid	0
3	Low	1
4	High	1
5	Low	0
6	High	1
7	High	1
8	Mid	1
9	Low	1
10	High	1

Table 3.34 Scores of Subject 9 Task 2

Total:

Low Tone Words	:	3 / 4
Mid Tone Words	:	1 / 2
High Tone Words	:	4 / 4

Task 3: **Repetition Task (comprehension & production of the tones)**

(1 for each correct response)

	Kind of Statement	Score	
		Comprehension	Production
1	Declarative	1	1
2	Interrogative	1	1
3	Imperative	1	1
4	Declarative	1	1
5	Imperative	1	1
6	Interrogative	1	1
7	Imperative	1	1
8	Interrogative	1	1
9	Interrogative	1	1
10	Declarative	1	1

Table 3.35 Scores of Subject 9 Task 3

Total:

Declarative : 3 (comprehension)/ 3, 3 (production) / 3
Interrogative : 4 (comprehension)/ 4, 4 (production) / 4
Imperative : 3 (comprehension)/ 3, 3 (production) / 3

Task4: Repetition Task (comprehension & production of tones)

(1 for each correct response)

	Kind of Emotion	Score	
		Comprehension	Production
1	Happy	1	1
2	Happy	1	1
3	Sad	1	1
4	Angry	1	1
5	Sad	1	1
6	Angry	1	1
7	Happy	1	1
8	Sad	1	1
9	Angry	1	1
10	Angry	1	1

Table 3.36 Scores of Subject 9 Task 4

Total:

Happy : 3 (comprehension)/ 3, 3 (production) / 3
Sad : 3 (comprehension)/ 3, 3 (production) / 3
Angry : 4 (comprehension)/ 4, 4 (production) / 4

3.10 Subject 10

This subject is a 33-year-old bilingual female. She has good proficiency in Punjabi and a working knowledge of Hindi. This is a normal control subject.

Score Sheet of Tonal Tasks

Task 1: Picture Naming Task (production of tones)

(1 for each correct response)

	Level of tone	Score
1	Low	1
2	Low	1
3	Mid	1
4	Low	1
5	Mid	1
6	High	1
7	High	1
8	Mid	1
9	High	1
10	High	1
11	Mid	1
12	Mid	1
13	Mid	1
14	Mid	1
15	Mid	1
16	Mid	1
17	Mid	1
18	Mid	1
19	Mid	1
20	Mid	1

Table 3.37 Scores of Subject 10 Task 1

Total:

Low Tone Words	:	3 / 3
Mid Tone Words	:	13 / 13
High Tone Words	:	4 / 4

Task 2: **Repetition Task (production of tone)**

(1 for each correct response)

	Level of Tone	Score
1	Low	1
2	Mid	1
3	Low	1
4	High	0
5	Low	1
6	High	1
7	High	1
8	Mid	1
9	Low	1
10	High	1

Table 3.38 Scores of Subject 10 Task 2

Total:

Low Tone Words	:	4 / 4
Mid Tone Words	:	2 / 2
High Tone Words	:	3 / 4

Task 3: **Repetition Task (comprehension & production of the tones)**

(1 for each correct response)

	Kind of Statement	Score	
		Comprehension	Production
1	Declarative	1	1
2	Interrogative	1	1
3	Imperative	1	1
4	Declarative	1	0
5	Imperative	0	0
6	Interrogative	1	1
7	Imperative	1	1
8	Interrogative	1	1
9	Interrogative	1	1
10	Declarative	1	1

Table 3.39 Scores of Subject 10 Task 3

Total:

Declarative : 3 (comprehension)/ 3, 2 (production) / 3
Interrogative : 4 (comprehension)/ 4, 4 (production) / 4
Imperative : 2 (comprehension)/ 3, 2 (production) / 3

Task4: Repetition Task (comprehension & production of tones)

(1 for each correct response)

	Kind of Emotion	Score	
		Comprehension	Production
1	Happy	1	1
2	Happy	1	1
3	Sad	1	1
4	Angry	1	1
5	Sad	1	1
6	Angry	1	0
7	Happy	1	1
8	Sad	1	1
9	Angry	1	1
10	Angry	1	1

Table 3.40 Scores of Subject 10 Task 4

Total:

Happy : 3 (comprehension)/ 3, 3 (production) / 3
Sad : 3 (comprehension)/ 3, 3 (production) / 3
Angry : 4 (comprehension)/ 4, 3 (production) / 4

3.11 Subject 11

This normal control subject is also a bilingual with Punjabi and Hindi, and has a fairly good knowledge of both the languages. She is a 57 years old, working in the administration department of the Punjab Agricultural University.

Score Sheet of Tonal Tasks

Task 1: Picture Naming Task (production of tones)

(1 for each correct response)

	Level of tone	Score
1	Low	1
2	Low	1
3	Mid	1
4	Low	0
5	Mid	1
6	High	1
7	High	1
8	Mid	1
9	High	0
10	High	1
11	Mid	1
12	Mid	1
13	Mid	1
14	Mid	1
15	Mid	1
16	Mid	0
17	Mid	1
18	Mid	1
19	Mid	1
20	Mid	1

Table 3.41 Scores of Subject 11 Task 1

Total:

Low Tone Words	:	2 / 3
Mid Tone Words	:	12 / 13
High Tone Words	:	3 / 4

Task 2: **Repetition Task (production of tone)**

(1 for each correct response)

	Level of Tone	Score
1	Low	1
2	Mid	1
3	Low	1
4	High	1
5	Low	1
6	High	1
7	High	1
8	Mid	1
9	Low	1
10	High	1

Table 3.42 Scores of Subject 11 Task 2

Total:

Low Tone Words	:	4 / 4
Mid Tone Words	:	2 / 2
High Tone Words	:	4 / 4

Task 3: **Repetition Task (comprehension & production of the tones)**

(1 for each correct response)

	Kind of Statement	Score	
		Comprehension	Production
1	Declarative	1	1
2	Interrogative	1	1
3	Imperative	1	1
4	Declarative	1	1
5	Imperative	1	1
6	Interrogative	1	1
7	Imperative	1	1
8	Interrogative	1	0
9	Interrogative	1	1
10	Declarative	1	1

Table 3.43 Scores of Subject 11 Task 3

Total:

Declarative : 3 (comprehension)/ 3, 3 (production) / 3
Interrogative : 4 (comprehension)/ 4, 3 (production) / 4
Imperative : 3 (comprehension)/ 3, 3 (production) / 3

Task4: **Repetition Task (comprehension & production of tones)**

(1 for each correct response)

	Kind of Emotion	Score	
		Comprehension	Production
1	Happy	1	1
2	Happy	1	1
3	Sad	1	1
4	Angry	1	1
5	Sad	1	0
6	Angry	1	1
7	Happy	1	1
8	Sad	1	1
9	Angry	1	1
10	Angry	1	1

Table 3.44 Scores of Subject 11 Task 4

Total:

Happy : 3 (comprehension)/ 3, 3 (production) / 3
Sad : 3 (comprehension)/ 3, 2 (production) / 3
Angry : 4 (comprehension)/ 4, 4 (production) / 4

3.12 Subject 12

This normal control subject is a 48-year-old multilingual with very good articulation. He knows Punjabi, Hindi and English very well.

Score Sheet of Tonal Tasks

Task 1: Picture Naming Task(production of tones)

(1 for each correct response)

	Level of tone	Score
1	Low	1
2	Low	1
3	Mid	1
4	Low	1
5	Mid	1
6	High	1
7	High	1
8	Mid	1
9	High	1
10	High	1
11	Mid	1
12	Mid	1
13	Mid	1
14	Mid	1
15	Mid	1
16	Mid	1
17	Mid	1
18	Mid	1
19	Mid	1
20	Mid	1

Table 3.45 Scores of Subject 12 Task 1

Total:

Low Tone Words	:	3 / 3
Mid Tone Words	:	13 / 13
High Tone Words	:	4 / 4

Task 2: **Repetition Task (production of tone)**

(1 for each correct response)

	Level of Tone	Score
1	Low	1
2	Mid	1
3	Low	1
4	High	1
5	Low	1
6	High	1
7	High	1
8	Mid	1
9	Low	1
10	High	1

Table 3.46 Scores of Subject 12 Task 2

Total:

Low Tone Words	:	4 / 4
Mid Tone Words	:	2 / 2
High Tone Words	:	4 / 4

Task 3: **Repetition Task (comprehension & production of the tones)**

(1 for each correct response)

	Kind of Statement	Score	
		Comprehension	Production
1	Declarative	1	1
2	Interrogative	1	1
3	Imperative	1	1
4	Declarative	1	1
5	Imperative	1	1
6	Interrogative	1	1
7	Imperative	1	0
8	Interrogative	1	1
9	Interrogative	1	1
10	Declarative	1	1

Table 3.47 Scores of Subject 12 Task 3

Total:

Declarative : 3 (comprehension)/ 3, 3 (production) / 3
Interrogative : 4 (comprehension)/ 4, 4 (production) / 4
Imperative : 3 (comprehension)/ 3, 2 (production) / 3

Task4: Repetition Task (comprehension & production of tones)

(1 for each correct response)

	Kind of Emotion	Score	
		Comprehension	Production
1	Happy	1	1
2	Happy	1	1
3	Sad	1	1
4	Angry	1	1
5	Sad	1	1
6	Angry	1	1
7	Happy	1	1
8	Sad	1	1
9	Angry	1	1
10	Angry	1	1

Table 3.48 Scores of Subject 12 Task 4

Total:

Happy : 3 (comprehension)/ 3, 3 (production) / 3
Sad : 3 (comprehension)/ 3, 3 (production) / 3
Angry : 4 (comprehension)/ 4, 4 (production) / 4

Chapter Four

Analysis and Discussion

In this section of the dissertation, the results have been calculated, tabulated and then discussed extensively. These results include the scores of the correct responses obtained from all the tasks and the fundamental frequency of the significant vowel sound, which is being tested across the three tones at lexical level for all the three groups.

The correct responses have been analyzed by using analysis of variance (ANOVA) where the dependent variable is the mean of the percentage of correct responses. This has been done with all the aspects of prosody. In case of the linguistic, the tones (low, mid, high) at lexical level and intonation (declarative, interrogative, imperative) at sentential level are taken into consideration and affective (happy, sad and angry) prosody also to sentential level is taken into account. ANOVA is used with the type of prosody as within-subject factor group (RHD, LHD, NC) and as between-subject factor.

The fundamental frequency has been calculated for four sounds, / ə /, / o /, / ɑ / and / i / for the three tones low, mid and high as termed by previous scholars (refer literature review, p. 7) at the lexical level in case of all the twelve subjects. These frequencies have been calculated by using the PRAAT program (version 4.1.21) at three points of the sound, initial, medial and final in order to study the tonal contours as well as for a comparative view. In this chapter, the average fundamental frequency for initial, medial and final position of each sound is taken into account for all the tones separately. However, only the initial and final ones are considered for discussion to show the contour of the tone and the difference in the range of the fundamental frequency (F0) for the three tones of the normal and the impaired speakers for both males and females.

4.1 Low Tone Words (Test 1 & 2)

The first set of results tabulated in the table 4.1.1 is of low tone words from both the picture naming and repetition tasks and a corresponding graph 4.1 have been plotted. The total numbers of words taken were seven (three from the first task and four from the second). The test variable in this task was production of these tones. The results for correct responses ($F_{2,\ 9} = 5.58$) confirms our hypothesis that left hemisphere is dominant for low tone words. Also we can see that LHD group ($\bar{X}$ = 60.75%) performed significantly worse than RHD group ($\bar{X}$ = 82.14%) and both the groups performed worse than NC group ($\bar{X}$ = 92.86%).

Patient No.	No. of words	Production score	Total	%age	Anatomic Location
1.	3 + 4	2 + 2	4	57.14	Anterior-cerebral Artery; Frontal
2.	3 + 4	2 + 1	3	42.86	Temporo-Parietal
3.	3 + 4	3 + 2	5	71.43	Sub-Cortical Frontal
4.	3 + 4	3 + 2	5	71.43	MCA Infarct Frontal-Parietal
5.	3 + 4	3 + 3	6	85.71	Parietal-Occipital
6.	3 + 4	3 + 3	6	85.71	Basal Ganglionic; frontal parietal
7.	3 + 4	2 + 2	4	57.14	Posterior Cerebral Artery; Temporal
8.	3 + 4	3 + 4	7	100	Frontal temporo parietal
9.	3 + 4	3 + 3	6	85.71	-
10.	3 + 4	3 + 4	7	100	-
11.	3 + 4	2 + 4	6	85.71	-
12	3 + 4	3 + 4	7	100	-

(LHD $\bar{X}$ = 60.75%, RHD $\bar{X}$ = 82.14%, NC $\bar{X}$ = 92.86%)

Table 4.1.1 Score of Low Tone Words

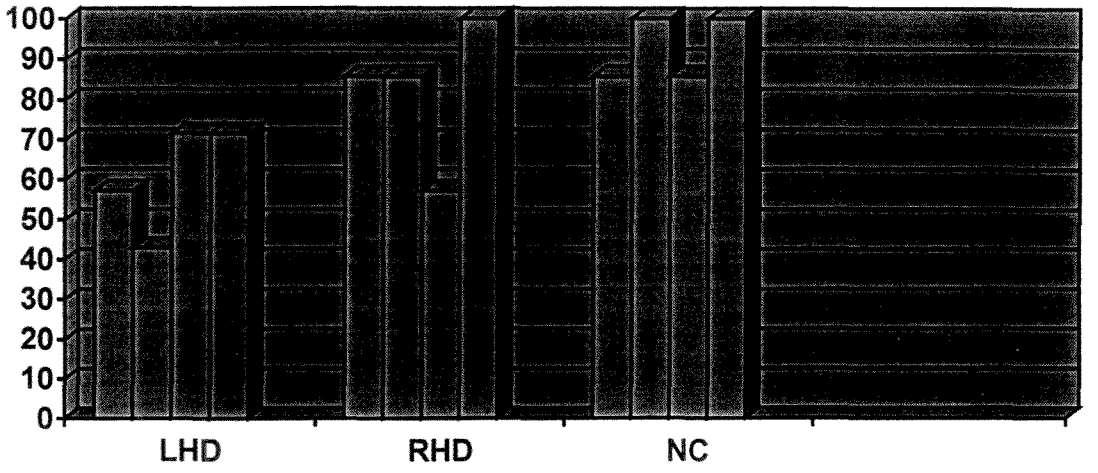


Fig 4.1 Score of Low Tone Words

The second set of results tabulated in the table 4.1.2 is of average fundamental frequency in Hertz at the initial, medial and final positions of the four vowel sounds being tested. As calculated from the data, the average range of the low tone sounds taken into consideration for male speakers in normal control group, was 162.64 Hz – 150.64 Hz with an average fall of the tone being 12 Hz. For female speakers, it is 187.44 Hz – 174.78 Hz with the fall being 12.66 Hz. However, for LHD male speakers it was 148.13 Hz – 136.99 Hz with an average fall of 11.14 Hz and for female speakers 141.74 Hz – 132.25 Hz with an average fall of 9.49 Hz. The average range for RHD male speakers was 152.44 Hz – 140.54 Hz with a fall of 11.9 Hz and for RHD female speakers was 150.1 Hz – 139.48 Hz with a fall of 10.62 Hz. All the averages exclude the incorrect responses, which are marked in bold and would be dealt with in the discussion section.

Patient No.	Sex	Hemisphere of Lesion	è	ò	à	ì
1	M		140.81	148.25	155.57	153.62
		L	135.02	141.62	147.15	150.19
			131.51	137.45	140.13	149.22
2	M	H	130.54	144.72	147.81	169.03
			126.41	129.62	150.63	164.15
		D	124.57	126.16	151.41	160.19
3	F		127.78	143.02	157.68	138.46
			126.41	136.97	153.12	131.25
			119.38	134.86	147.13	127.62
4	M		132.63	149.24	162.33	161.56
			125.42	141.82	157.86	158.91
			123.61	138.17	151.19	162.32
5	M		149.82	164.81	170.67	157.14
		R	139.28	158.02	160.43	150.27
			135.19	150.23	153.14	145.01
6	M	H	122.59	147.63	136.59	170.28
			119.94	141.82	124.72	163.63
		D	115.98	137.62	125.41	161.74
7	F		141.77	147.56	-	138.96
			140.26	145.23		131.27
			136.42	144.61		127.82
8	F		151.64	157.87	162.16	167.59
			145.42	151.51	155.05	160.72
			140.33	145.28	150.50	151.19
9	M		160.43	171.63	158.72	169.66
		N	155.38	166.25	147.32	167.76
			151.26	159.31	139.13	165.81
10	F		212.06	187.65	174.31	178.69
			207.50	180.43	169.93	170.94
		C	200.10	172.69	162.82	165.89
11	F		197.86	177.46	182.16	189.31
			190.45	170.53	180.46	181.59
			184.36	165.67	175.45	171.24
12	M		156.29	160.52	164.71	165.24
			151.87	156.24	158.39	159.11
			147.34	151.31	152.41	154.37

Table 4.1.2 Average Fundamental Frequency of Low tone Words

4.2 Mid Tone Words (test 1 & 2)

These results, also obtained from both the picture naming and repetition tasks, are tabulated in the following table 4.2.1 for mid tone words and a corresponding graph 4.2 is plotted to show the variation across the sets clearly. The total number of mid tone words in the two tasks were fifteen (thirteen from first task and two from the second one). In this test also, the test variable is production of mid tone words. The results ($F_{2,\ 9} = 6.65$) show that mid tone words are also dominant in the left hemisphere. From the data we can see that LHD group ($\bar{X} = 73.34\%$) performed poorly in comparison to RHD ($\bar{X} = 86.67\%$) and NC ($\bar{X} = 95\%$), was much better off than both the other groups.

Patient No.	No. of words	Production score	Total	%age	Anatomic Location
1.	13 + 2	9 + 1	10	66.67	Anterior-cerebral Artery; Frontal
2.	13 + 2	8 + 0	8	53.33	Temporo-Parietal
3.	13 + 2	11 + 2	13	86.67	Sub-Cortical; Frontal
4.	13 + 2	10 + 1	11	73.33	MCA Infarct; Fronto-Parietal
5.	13 + 2	13 + 1	14	93.33	Parietal-Occipital
6.	13 + 2	10 + 2	12	80	Basal Ganglia; Frontal parietal
7.	13 + 2	11 + 1	12	80	Posterior Cerebral Artery; Temporal
8.	13 + 2	12 + 2	14	93.33	Frontal temporo parietal
9.	13 + 2	12 + 1	13	86.67	-
10.	13 + 2	13 + 2	15	100	-
11.	13 + 2	12 + 2	14	93.33	-
12.	13 + 2	13 + 2	15	100	-

LHD $\bar{X} = 73.34\%$, RHD $\bar{X} = 86.67\%$, NC $\bar{X} = 95\%$

Table 4.2.1 Score of Mid Tone Words

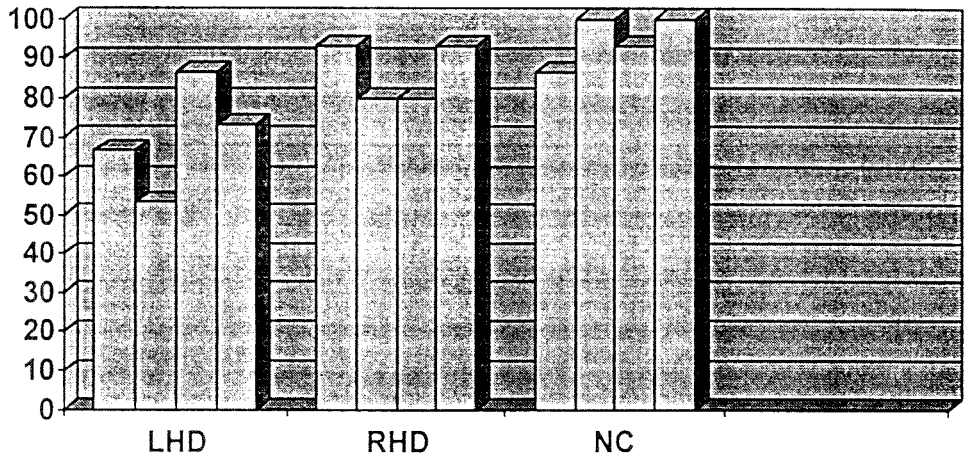


Fig 4.2 Score of mid tone words

The second set of results tabulated in the table 4.2.2 is of average fundamental frequency in Hertz at the initial, medial and final positions of the four vowel sounds being tested. As calculated from the data the average range of mid tone vowel sounds taken into consideration for male speakers in normal control group was 164.81 Hz – 164.62 Hz with an average difference in the two levels of tone being 0.19 Hz. For female speakers it is 186.63 Hz – 184.31 Hz with a difference in the two levels being 2.32 Hz. However, for LHD male speakers, it was 147.66 Hz – 145.76 Hz with an average difference of 1.9 Hz between the two levels and for female speakers 135.95 Hz – 134.60 Hz with an average difference of 1.35 Hz between the two levels. The average range for RHD male speakers was 151.51 Hz – 147.52 Hz with a difference of 3.99 Hz between the two levels and for RHD female speakers was 148.57 Hz – 147.42 Hz with a difference of 1.15 Hz between the two levels. All the averages exclude the incorrect responses, which is marked in bold and would be dealt with in discussion separately.

Patient No.	Sex	Hemisphere of Lesion	ə	o	ɑ	i
1	M		138.62	141.62	162.47	151.31
		L	136.51	139.72	170.52	149.83
			135.42	140.81	168.39	147.42
2	M	H	152.85	139.02	154.16	131.93
			165.26	133.42	159.57	133.45
		D	149.34	131.08	152.83	133.08
3	F		132.48	141.77	135.21	134.33
			133.00	139.46	132.17	131.22
			130.02	138.23	134.86	135.30
4	M		147.11	153.92	154.89	148.96
			144.83	151.27	150.67	146.25
			141.51	156.34	144.38	145.23
5	M		150.66	175.25	**163.5**	161.11
		R	145.73	170.59	**160.62**	158.19
			147.83	**167.51**	**152.17**	155.29
6	M	H	141.69	151.08	134.69	136.27
			137.86	148.05	131.09	134.99
		D	130.49	150.81	128.67	134.98
7	F		**142.96**	151.81	147.41	128.62
			135.62	160.25	140.86	126.17
			130.59	156.63	144.57	131.25
8	F		157.31	159.69	161.01	142.85
			150.62	155.03	165.58	140.56
			144.23	154.08	160.06	137.93
9	M		167.81	161.56	**187.61**	171.56
		N	165.63	165.43	**180.52**	169.42
			163.21	162.91	**177.60**	170.08
10	F		186.35	190.63	180.65	195.62
			181.48	187.19	175.38	189.27
		C	184.62	189.26	177.99	193.17
11	F		189.65	184.21	180.65	185.28
			185.43	185.64	181.36	183.69
			182.62	186.37	179.21	181.21
12	M		166.14	159.01	164.14	161.29
			167.98	158.30	166.37	160.19
			169.32	156.82	167.21	162.02

Table 4.2.2 Average Fundamental Frequency of Mid Tone Words

4.3 High Tone Words (Test 1 & 2)

The first set of results in case of high tone words is tabulated in table 4.3.1 and a corresponding graph 4.3 is plotted. There is not a very significant difference between the subjects of LHD and RHD groups, but yet, the difference is there. The LHD group

($\bar{X}$ = 65.63%) is not much less than RHD group ($\bar{X}$ = 78.13%). However, the NC ($\bar{X}$ = 93.75%) is much better than both the groups. There were a total of eight words (four from the first task and four from the second). Though the difference is not huge, the result ($F_{2, 9} = 3.51$) of the analysis buttress the hypothesis of the left hemisphere being dominant.

Patient No.	No. of words	Production score	Total	%age	Anatomic Location
1.	4 + 4	2 + 3	5	62.5	Anterior-cerebral Artery; Frontal
2.	4 + 4	4 + 3	7	87.5	Temporo-Parietal
3.	4 + 4	3 + 2	5	62.5	Sub-Cortical; Frontal
4.	4 + 4	3 + 1	4	50	MCA Infarct; Fronto-Parietal
5.	4 + 4	4 + 3	7	87.5	Parietal-Occipital
6.	4 + 4	4 + 3	7	87.5	Basal Ganglia; Frontal parietal
7.	4 + 4	3 + 2	5	62.5	Posterior Cerebral Artery; Temporal
8.	4 + 4	3 + 3	6	75	Frontal temporo parietal
9.	4 + 4	4 + 4	8	100	-
10.	4 + 4	4 + 3	7	87.5	-
11.	4 + 4	3 + 4	7	87.5	-
12.	4 + 4	4 + 4	8	100	-

LHD $\bar{X}$ = 65.63%, RHD $\bar{X}$ = 78.13%, NC $\bar{X}$ = 93.75%

Table 4.3.1 Score of High Tone words

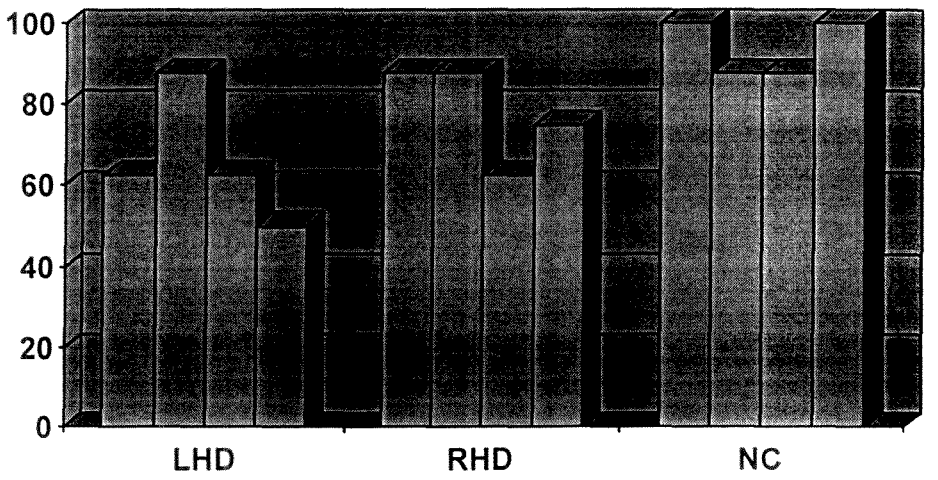


Fig 4.3 Scores of High Tone words

The second set of results, tabulated in the table 4.3.2, is of average fundamental frequency in Hertz at the initial, medial and final positions of the four vowel sounds being tested. As calculated from the data, the average range of high tone vowel sounds taken into consideration for male speakers in normal control group, was 176.85 Hz – 188.72 Hz with an average rise of the tone being 11.87 Hz. For female speakers it is 195.22 Hz – 214.16 Hz with a rise being 18.94 Hz. However, for LHD male speakers, it was 149.17 Hz – 157.45 Hz with an average rise of 8.28 Hz and for female speakers 135.24 Hz – 145.25 Hz with an average rise of 10.01 Hz. The average range for RHD male speakers was 162.43 Hz – 174.62 Hz with a rise of 12.99 Hz and for RHD female speakers was 161.26 Hz – 175.33 Hz with a rise of 14.07 Hz. All the averages exclude the incorrect responses, which are marked in bold and would be dealt with in the discussion later.

Patient No.	Sex	Hemisphere of Lesion	á	ó	ǵ	í
1	M		148.62	**150.61**	161.02	155.85
		L	153.35	**147.26**	167.05	157.52
			157.52	**145.32**	169.92	162.38
2	M	H	141.65	**145.14**	141.32	150.61
			149.82	**142.81**	145.02	156.39
		D	152.38	**140.60**	147.49	158.46
3	F		137.65	**139.33**	135.92	132.14
			144.22	**137.46**	137.03	140.57
			147.63	**136.29**	144.30	143.83
4	M		152.63	**142.98**	147.74	149.61
			155.65	**147.79**	145.62	147.27
			160.92	**151.68**	143.14	145.36
5	M		160.25	**171.61**	181.37	170.35
		R	172.84	**164.53**	190.28	179.82
			179.75	**159.27**	197.86	184.21
6	M	H	189.52	**147.74**	125.32	-
			194.85	**155.57**	124.09	
		D	198.22	**164.51**	123.16	
7	F		161.39	157.87	142.53	161.71
			172.86	168.52	150.89	169.23
			179.54	172.04	157.56	170.09
8	F		167.49	165.39	163.21	170.46
			174.26	172.81	173.67	177.27
			179.31	179.56	182.98	181.53
9	M		177.51	185.65	172.65	175.26
		N	184.67	190.23	177.18	179.38
			190.45	196.16	184.51	188.76
10	F		199.23	194.56	196.75	**185.24**
			205.36	201.19	205.42	**183.19**
		C	212.89	221.05	211.91	**180.67**
11	F		198.56	185.41	191.77	198.63
			207.23	194.37	199.29	209.18
			217.14	202.89	209.36	222.71
12	M		171.25	179.34	174.29	178.85
			176.35	184.32	178.21	185.96
			182.97	189.46	185.64	191.80

Table 4.3.2 Average Fundamental Frequency of High Tone Words

4.4 Declarative Statement

4.4.1 Declarative Statement (Comprehension)

This task tabulated in table 4.4.1 and plotted in graph 4.4 was at sentential level unlike the previous ones and the test variable is comprehension of this tone. By comprehension we mean the subject was supposed to identify the kind of statement produced by the examiner. The hypothesis, which we wish to test, is that the left hemisphere processes prepositional prosody. The total number of utterances was 3. The result ($F_{2,\ 9} = 2.67$) confirms this hypothesis. Also, there is a considerable difference between the scores of LHD ($\bar{x} = 75\%$), RHD ($\bar{X} = 83.35\%$) and NC ($\bar{\bar{X}} = 100\%$).

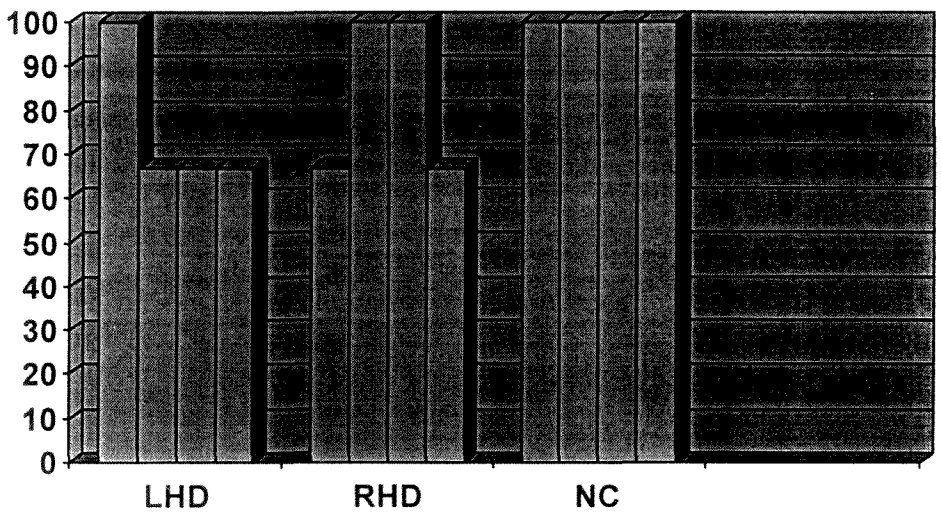


Fig 4.4.1 Scores of Declarative statement (comprehension)

Patient No.	No. of statements	Comprehension score	%age	Anatomical location
1.	3	3	100	Anterior-cerebral Artery; Frontal
2.	3	2	66.67	Temporo-Parietal
3.	3	2	66.67	Sub-Cortical; Frontal
4.	3	2	66.67	MCA Infarct; Fronto-Parietal
5.	3	2	66.67	Parietal-Occipital
6.	3	3	100	Basal Ganglia; frontal parietal
7.	3	3	100	Posterior Cerebral Artery; Temporal
8.	3	2	66.67	Frontal temporo parietal
9.	3	3	100	-
10.	3	3	100	-
11.	3	3	100	-
12.	3	3	100	-

LHD $\bar{X}$ = 75%, RHD $\bar{X}$ = 83.35%, NC $\bar{X}$ = 100%

Table 4.4.1 Scores of Declarative Statement (Comprehension)

4.4.2 Declarative Statement (Production)

In case of production of tones tabulated in table 4.4.2 and plotted in graph 4.4 the subjects were required to repeat the sentence after identifying the tone of the statement. The test variable was production of correct intonation. The tabulated data shows that the LHD subjects' ($\bar{X}$ = 66.67%) performance was lower than that of RHD ($\bar{X}$ = 75%) and both of them were less than that of NC ($\bar{X}$ = 91.67%). The analysis of these data ($F_{2,9}$ = 3.44) shows that left hemisphere plays a major role in processing the linguistic intonation of declarative statements.

Patient No.	No. of statements	Production score	%age	Anatomical location
1.	3	2	66.67	Anterior-cerebral Artery; Frontal
2.	3	1	33.33	Temporo-Parietal
3.	3	2	66.67	Sub-Cortical; Frontal
4.	3	3	100	MCA Infarct; Fronto-Parietal
5.	3	2	66.67	Parietal-Occipital
6.	3	2	66.67	Basal Ganglia; frontal parietal
7.	3	3	100	Posterior Cerebral Artery; Temporal
8.	3	2	66.67	Frontal temporo parietal
9.	3	3	100	-
10.	3	2	66.67	-
11.	3	3	100	-
12.	3	3	100	-

LHD $\bar{X}$ = 66.67%, RHD $\bar{X}$ = 75%, NC $\bar{X}$ = 91.67%

Table 4.4.2 Scores of Declarative Statement (Production)

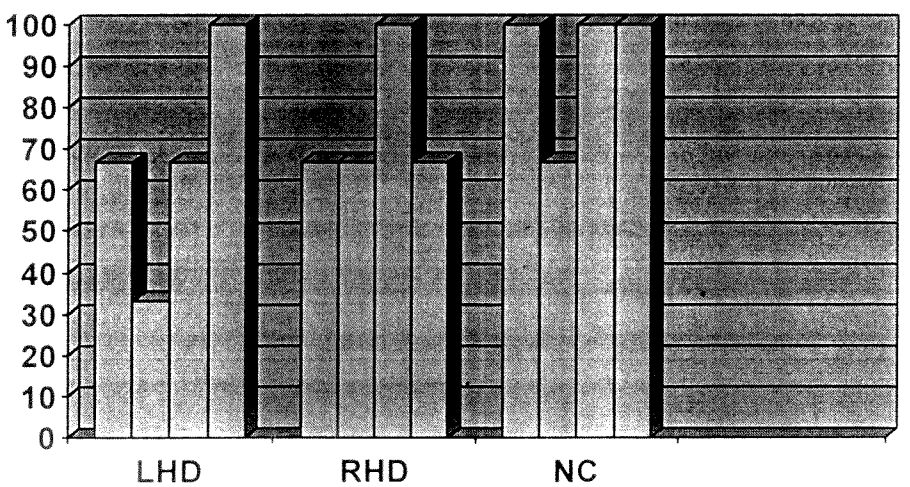


Fig 4.4.2 Scores of Declarative Statement (Production)

4.5 Interrogative Statement

4.5.1 Interrogative Statement (Comprehension)

Score of this nonemotional intonation reveals that comprehension of interrogative statements is mediated by left hemisphere as the number of responses were most effected in case of the LHD group ($\bar{X}$ = 68.75%) as compared to the RHD group ($\bar{X}$ = 75%). Both these groups' performance was significantly less when compared to NC ($\bar{X}$ = 100%). The statistics ($F_{2, 9}$ = 13.46) supports the claim that the comprehension of interrogative statements is controlled by left hemisphere. This data is tabulated in the table 4.5.1 and plotted in 4.5.1 graph below.

Patient No.	No. of statements	Comprehension score	%age	Anatomical location
1.	4	3	75	Anterior-cerebral Artery; Frontal
2.	4	2	50	Temporo-Parietal
3.	4	3	75	Sub-Cortical; Frontal
4.	4	3	75	MCA Infarct; Fronto-Parietal
5.	4	3	75	Parietal-Occipital
6.	4	3	75	Basal Ganglia; frontal parietal
7.	4	3	75	Posterior Cerebral Artery; Temporal
8.	4	3	75	Frontal temporo parietal
9.	4	4	100	-
10.	4	4	100	-
11.	4	4	100	-
12.	4	4	100	-

LHD $\bar{X}$ = 68.75%, RHD $\bar{X}$ = 75%, NC $\bar{X}$ = 100%

Table 4.5.1 Scores of Interrogative Statement (Comprehension)

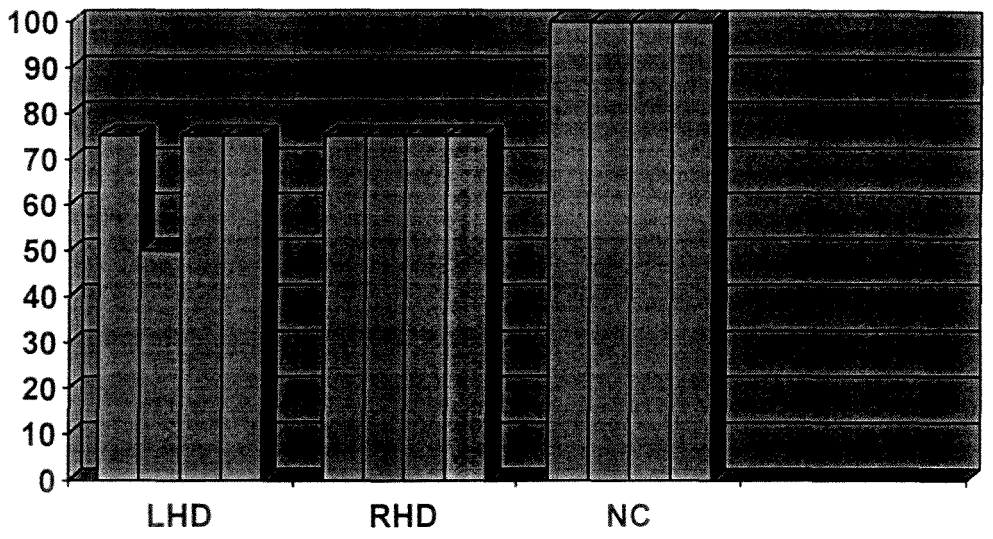


Fig 4.5.1 Scores of Interrogative Statement (Comprehension)

4.5.2 Interrogative Statement (Production)

The average score of subjects of the two effected groups LHD ($\bar{X}$ = 50%) and RHD ($\bar{X}$ = 56.25%) are significantly low as compared to the NC ($\bar{X}$ = 93.75%) in case of producing interrogative statements. Though the results of the statistics ($F_{2,9}$ = 9.21) confirm the dominance of left hemisphere yet the difference is not very significant. This data is tabulated in the following 4.5.2 table and plotted in the 4.5.2 figure.

Patient No.	No. of statements	Production score	%age	Anatomical location
1.	4	2	50	Anterior-cerebral Artery; Frontal
2.	4	1	25	Temporo-Parietal
3.	4	2	50	Sub-Cortical; Frontal
4.	4	3	75	MCA Infarct; Fronto-Parietal
5.	4	3	75	Parietal-Occipital
6.	4	2	50	Basal Ganglia; frontal parietal
7.	4	2	50	Posterior Cerebral Artery; Temporal
8.	4	2	50	Frontal temporo parietal
9.	4	4	100	-
10.	4	4	100	-
11.	4	3	75	-
12.	4	4	100	-

LHD $\bar{X}$ = 50%, RHD $\bar{X}$ = 56.25%, NC $\bar{X}$ = 93.75%

Table 4.5.2 Scores of Interrogative Statement (Production)

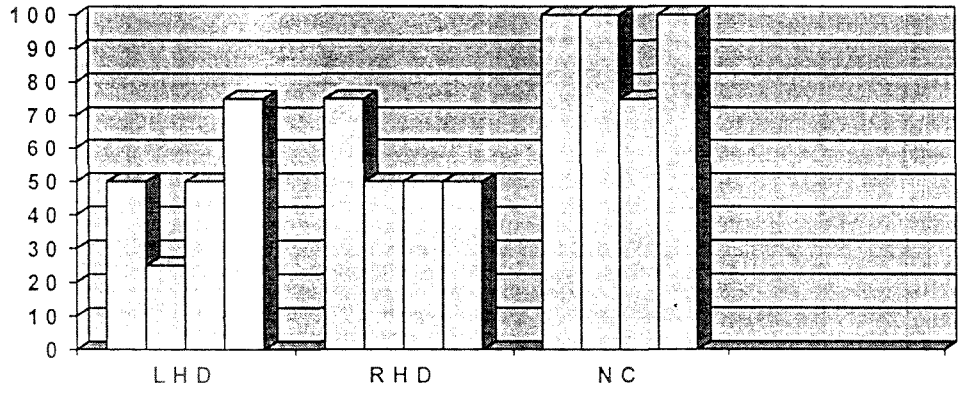


Fig 4.5.2 Scores of Interrogative Statement (Production)

4.6 Imperative Statement

4.6.1 Imperative Statement (Comprehension)

The difference between the responses of the three groups is again not large in case of the comprehension of imperative statements. The LHD group ($\bar{X}$ = 66.67%) performs poorly than the RHD group ($\bar{X}$ = 75%) and both of their performances were much lower than the NC group's ($\bar{X}$ = 91.67%). The analysis ($F_{2, 9}$ = 1.5) shows the significant effect for the group. This data is tabulated in the following 4.6.1 table and plotted in the 4.6.1 graph.

Patient No.	No. of statements	Comprehension score	%age	Anatomical location
1.	3	2	66.67	Anterior-cerebral Artery; Frontal
2.	3	3	100	Temporo-Parietal
3.	3	1	33.33	Sub-Cortical; Frontal
4.	3	2	66.67	MCA Infarct; Fronto-Parietal
5.	3	2	66.67	Parietal-Occipital
6.	3	2	66.67	Basal Ganglia; frontal parietal
7.	3	2	66.67	Posterior Cerebral Artery; Temporal
8.	3	3	100	Frontal temporo parietal
9.	3	3	100	-
10.	3	2	66.67	-
11.	3	3	100	-
12.	3	3	100	-

LHD $\bar{X}$ = 66.67%, RHD $\bar{X}$ = 75%, NC $\bar{X}$ = 91.67%

Table 4.6.1 Scores of Imperative Statement (Comprehension)

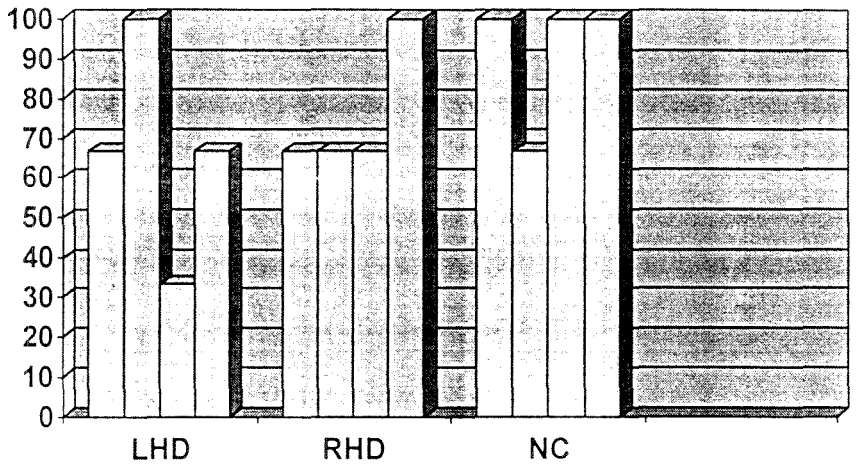


Fig 4.6.1 Scores of Imperative Statement (Comprehension)

4.6.2 Imperative Statement (Production)

Again the scores of the production task have gone down as in the case of declarative and interrogative statement. This time, in the case of another linguistic prosody, that is production of imperative statements. The LHD group ($\bar{X}$ = 50%) performed very poorly. The RHD group ($\bar{X}$ = 58.34%) also did not perform much better when compared to NC ($\bar{X}$ = 83.34%). However, the results ($F_{2,9} = 3.6$) state that production of imperative statements is also taken care by the left hemisphere. This data is tabulated in the following 4.6.2 table and plotted in 4.6.2 graph.

Patient No.	No. of statements	Production score	%age	Anatomical location
1.	3	1	33.33	Anterior-cerebral Artery; Frontal
2.	3	2	66.67	Temporo-Parietal
3.	3	2	66.67	Sub-Cortical; Frontal
4.	3	1	33.33	MCA Infarct; Fronto-Parietal
5.	3	1	33.33	Parietal-Occipital
6.	3	2	66.67	Basal Ganglia; frontal parietal
7.	3	2	66.67	Posterior Cerebral Artery; Temporal
8.	3	2	66.67	Frontal temporo parietal
9.	3	3	100	-
10.	3	2	66.67	-
11.	3	3	100	-
12.	3	2	66.67	-

LHD $\bar{X}$ = 50%, RHD $\bar{X}$ = 58.34%, NC $\bar{X}$ = 83.34%

Table 4.6.2 Score of Imperative Statement (Comprehension)

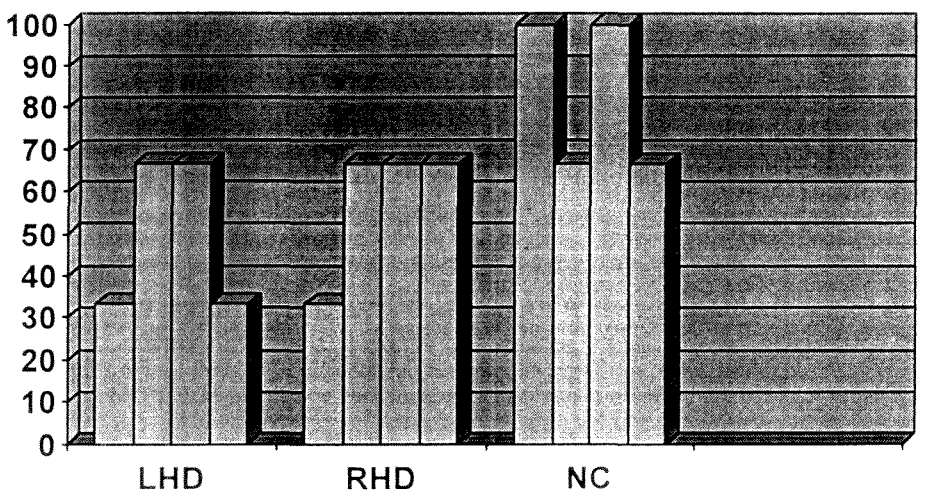


Fig 4.6.2 Scores of Imperative Statement (Production)

4.7 Happy Statement

4.7.1 Happy Statement (Comprehension)

The direction of the scores of correct responses changes in case of the comprehension of this affective tone. From the tabulated data we can see there is a big difference between the LHD ($\overline{X}$ = 91.67%) and RHD ($\overline{X}$ = 58.34%) group. The LHD group had given nearly all correct responses and is very close to the NC ($\overline{X}$ = 100%). The results ($F_{2, 9}$ = 10.93) drawn from the statistics also show a significant effect. This data is tabulated in the following 4.7.1 table and plotted in 4.7.1 figure.

Patient No.	No. of statements	Comprehension score	%age	Anatomical location
1.	3	3	100	Anterior-cerebral Artery; Frontal
2.	3	3	100	Temporo-Parietal
3.	3	2	66.67	Sub-Cortical; Frontal
4.	3	3	100	MCA Infarct; Fronto-Parietal
5.	3	2	66.67	Parietal-Occipital
6.	3	1	33.33	Basal Ganglia; frontal parietal
7.	3	2	66.67	Posterior Cerebral Artery; Temporal
8.	3	2	66.67	Frontal temporo parietal
9.	3	3	100	-
10.	3	3	100	-
11.	3	3	100	-
12.	3	3	100	-

LHD $\overline{X}$ = 91.67%, RHD $\overline{X}$ = 58.34%, NC $\overline{X}$ = 100%

Table 4.7.1 Scores of Happy Statement (Comprehension)

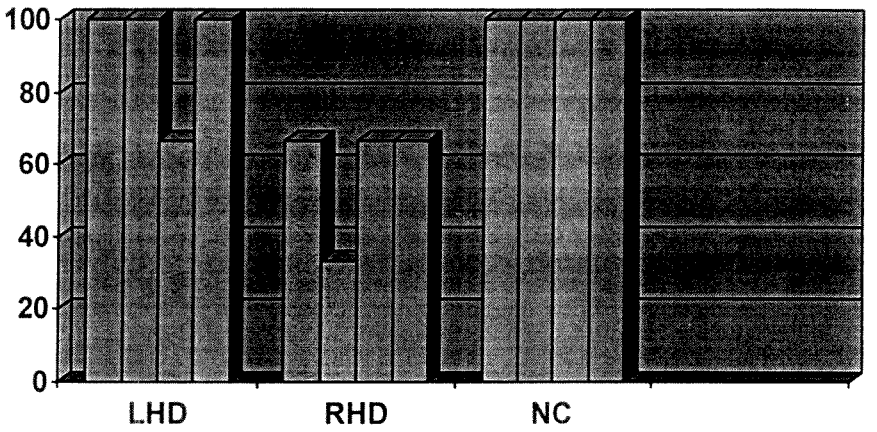


Fig 4.7.1 Scores of Happy Statement (Comprehension)

4.7.2 Happy Statement (Production)

In the case of producing the same tones, the difference between the two groups has increased to a great degree, which emphasizes the role played by the right hemisphere in mediating affective tones. The correct responses of the LHD subjects ($\bar{X}$ = 91.67%) is close to the NC ($\bar{X}$ = 100%) and that of RHD ($\bar{X}$ = 41.67%) is less than half of both the groups. The results ($F_{2, 9}$ = 13.61) show that production is dominantly controlled by the right hemisphere. This data is tabulated in the following 4.7.2 table and plotted in the 4.7.2 figure.

Patient No.	No. of statements	Production score	%age	Anatomical location
1.	3	3	100	Anterior-cerebral Artery; Frontal
2.	3	3	100	Temporo-Parietal
3.	3	2	66.67	Sub-Cortical; Frontal
4.	3	3	100	MCA Infarct; Fronto-Parietal
5.	3	2	66.67	Parietal-Occipital
6.	3	1	33.33	Basal Ganglia; frontal parietal
7.	3	1	33.33	Posterior Cerebral Artery; Temporal
8.	3	1	33.33	Frontal temporo parietal
9.	3	3	100	-
10.	3	3	100	-
11.	3	3	100	-
12.	3	3	100	-

LHD $\bar{X}$ = 91.67%, RHD $\bar{X}$ = 41.67%, NC $\bar{X}$ = 100%

Table 4.7.2 Scores of Happy Statement (Production)

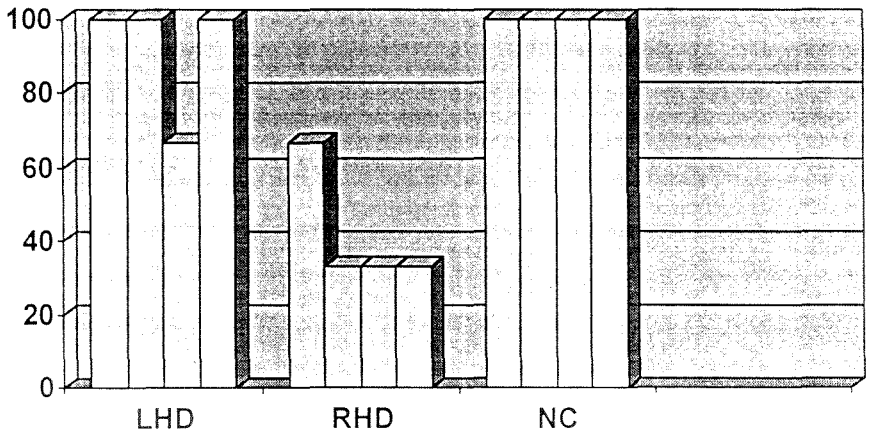


Fig 4.7.2 Scores of Happy Statement (Production)

4.8 Sad Statement

4.8.1 Sad Statement (Comprehension)

In the comprehension of sad statements also we can see that there is a huge difference between percentage of correct responses of all groups, LHD ($\bar{X}$ = 75%), RHD ($\bar{X}$ = 41.67%) and NC ($\bar{X}$ = 100%) and the statistics ($F_{2,9}$ = 3.6) though not very significant, confirms that comprehension of affective tones is carried out in right hemisphere. This data is tabulated in the following 4.8.1 table and plotted in the 4.8.1 figure.

Patient No.	No. of statements	Comprehension score	%age	Anatomical location
1.	3	2	66.67	Anterior-cerebral Artery; Frontal
2.	3	2	66.67	Temporo-Parietal
3.	3	3	100	Sub-Cortical; Frontal
4.	3	2	66.67	MCA Infarct; Fronto-Parietal
5.	3	1	33.33	Parietal-Occipital
6.	3	2	66.67	Basal Ganglia; frontal parietal
7.	3	1	33.33	Posterior Cerebral Artery; Temporal
8.	3	1	33.33	Frontal temporo parietal
9.	3	3	100	-
10.	3	3	100	-
11.	3	3	100	-
12.	3	3	100	-

LHD $\bar{X}$ = 75%, RHD $\bar{X}$ = 41.67%, NC $\bar{X}$ = 100%

Table 4.8.1 Scores of Sad Statement (Comprehension)

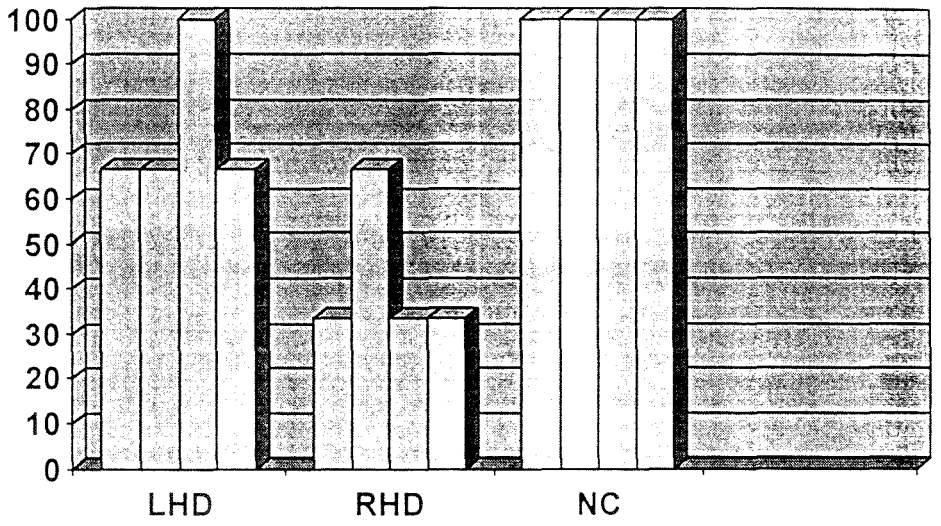


Fig 4.8.1 Scores of Sad Statement (Comprehension)

4.8.2 Sad Statement (Production)

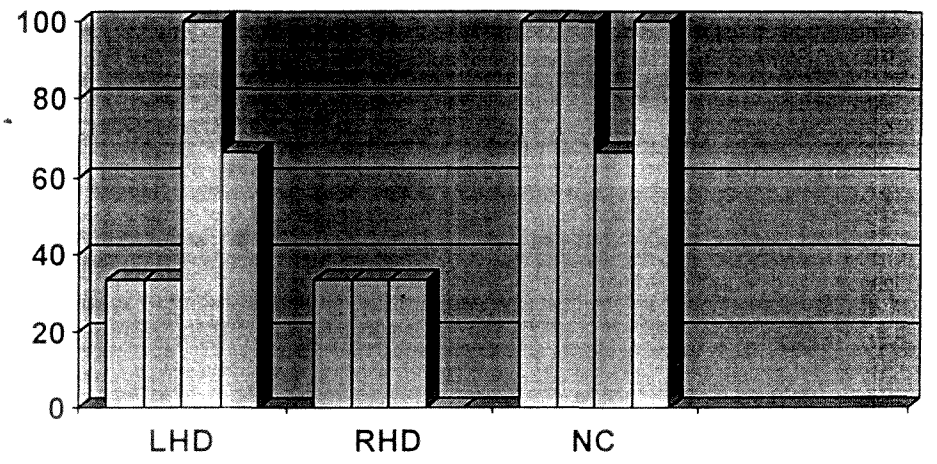
Again, we can see that the percentage of correct responses has gone down and the difference between the groups has increased in case of production as seen in happy intonation. The number of correct responses of LHD ($\bar{X}$ = 58.33%) is more than the double of RHD ($\bar{X}$ = 24.998%) and there is a vast difference between these two and NC ($\bar{X}$ = 91.67%). The results ($F_{2,9}$ = 13.25) confirm that the comprehension of sad utterances is controlled by the right hemisphere. This data has been tabulated in the following 4.8.2 table and plotted in the 4.8.2 graph.

Patient No.	No. of statements	Production score	%age	Anatomical location
1.	3	1	33.33	Anterior-cerebral Artery; Frontal
2.	3	1	33.33	Temporo-Parietal
3.	3	3	100	Sub-Cortical; Frontal
4.	3	2	66.67	MCA Infarct; Fronto-Parietal
5.	3	1	33.33	Parietal-Occipital
6.	3	1	33.33	Basal Ganglia; frontal parietal
7.	3	1	33.33	Posterior Cerebral Artery; Temporal
8.	3	0	0	Frontal temporo parietal
9.	3	3	100	-
10.	3	3	100	-
11.	3	2	66.67	-
12.	3	3	100	-

LHD $\bar{X}$ = 58.33%, RHD $\bar{X}$ = 24.998%, NC $\bar{X}$ = 91.67%

Table 4.8.2 Scores of Sad Statement (Production)

Fig 4.8.2 Scores of Sad Statement (Production)



4.9 Angry Statement

4.9.1 Angry Statement (Comprehension)

The average mean scores of the comprehension of this emotional tone also highlight a significant difference between the three groups. The LHD ($\bar{X}$ = 87.5%) performs much better than the RHD ($\bar{X}$ = 56.25%) and not much worse than the NC ($\bar{X}$ = 100%). The statistics ($F_{2,\ 9}$ = 17.11) show that the comprehension of the emotions of anger is stimulated in the right hemisphere. This data is tabulated in the following 4.9.1 table and plotted in the 4.9.1 figure.

Patient No.	No. of statements	Comprehension score	%age	Anatomical location
1.	4	4	100	Anterior-cerebral Artery; Frontal
2.	4	3	75	Temporo-Parietal
3.	4	4	100	Sub-Cortical; Frontal
4.	4	3	75	MCA Infarct; Fronto-Parietal
5.	4	2	50	Parietal-Occipital
6.	4	2	50	Basal Ganglia; frontal parietal
7.	4	2	50	Posterior Cerebral Artery; Temporal
8.	4	3	75	Frontal temporo parietal
9.	4	4	100	-
10.	4	4	100	-
11.	4	4	100	-
12.	4	4	100	-

LHD $\bar{X}$ = 87.5%, RHD $\bar{X}$ = 56.25%, NC = 100%

Table 4.9.1 Scores of Angry statement (Comprehension)

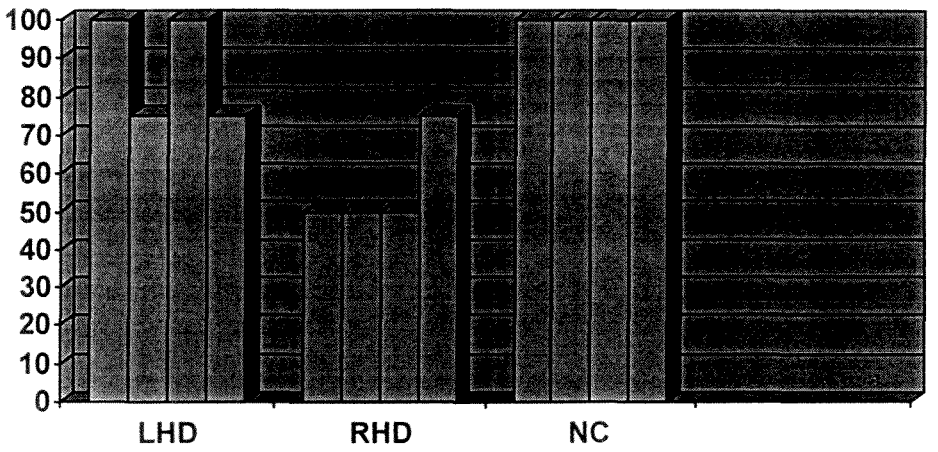


Fig 4.9.1 Scores of Angry Statement (Comprehension)

4.9.2 Angry Statement (Production)

The production of this tone is also stimulated in the right hemisphere as we see in the results ($F_{2,\ 9} = 16.4$) which show a considerable effect. Even the average scores of LHD ($\bar{X} = 62.5\%$) is almost double that of RHD ($\bar{X} = 37.5\%$) but much less than that of NC ($\bar{X} = 93.75\%$). This data is tabulated in the 4.9.2 table and plotted in the 4.9.2 figure.

Patient No.	No. of statements	Production score	%age	Anatomical location
1.	4	3	75	Anterior-cerebral Artery; Frontal
2.	4	2	50	Temporo-Parietal
3.	4	3	75	Sub-Cortical; Frontal
4.	4	2	50	MCA Infarct; Fronto-Parietal
5.	4	1	25	Parietal-Occipital
6.	4	1	25	Basal Ganglia; frontal parietal
7.	4	2	50	Posterior Cerebral Artery; Temporal
8.	4	2	50	Frontal temporo parietal
9.	4	4	100	-
10.	4	3	75	-
11.	4	4	100	-
12.	4	4	100	-

LHD $\overline{X}$ = 62.5%, RHD $\overline{X}$ = 37.5%, NC $\overline{X}$ = 93.75%

Table 4.9.2 Scores of Angry Statement (Production)

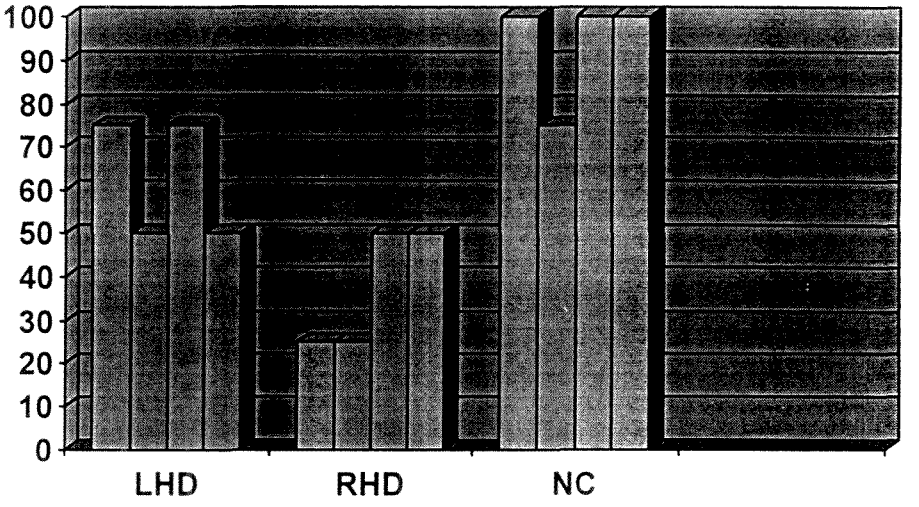


Fig 4.9.2 Scores of Angry Statement (Production)

4.10 Discussion

On the basis of the results obtained a few major findings can be discussed with reference to the similar previous studies carried out in the area. This discussion proceeds in the same order as that of the previous results, that is, the correct responses of each tone along with the pitch variation for the contrasting tones.

First of all, the fundamental frequency of NC group for the three tones gives us an insight into the tonal system that exists in Punjabi. Different names have been given to these tones by various researchers, like, Gill and Gleason name the three tones as "Low", "Mid" and "High" (Gill and Gleason, 1963: 28). According to them, in low tone the pitch falls and then there is a slight rise, in case of high tone there is a rise and a subsequent fall in the pitch of the vowel sound. Mid tone remains at the same level through out. Whereas, Joshi does not agree with this description completely and terms these tones as "Tone 1", "Tone 2" and "Tone 3" (1988: 54) which have different characteristic features on the basis of pitch features, phonation

features, word initial features and word final features. According to Joshi, Tone 1 shows a fall in pitch, and is followed by a rise as mentioned by Gill and Gleason as well, Tone 2 maintains a constant level and incase of Tone 3 there is a rise followed by a fall for non-causative words but fall rise pattern for causative words. He does not emphasize the level of pitch for each of these tones. Later in 1989, Narang in her *Spectrographic Study of Punjabi Vowels* added a new dimension to the then existing research by specifying the contours as well as the level of the frequency that can be attributed to each tone. In her study she termed the three tones as "level/mid tone" (Narang, 1989: 60) which has an average fundamental frequency corresponding to which the other two tones are described. The second tone as "high-rising tone" (Narang, 1989: 60) with a pitch level higher than the level/mid tone, which further rises at the end of the syllable with a fundamental frequency varying between "10 Hz – 15 Hz" (Narang, 1989: 60). The third as "falling-rising" (Narang, 1989: 60), which "begins at mid level and falls by at least 15 – 20 cps sometimes as much as 45 cps and then rises again to the same initial level" (Narang, 1989: 60). Thus, according to her study, Punjabi tones can only be studied as a combination of levels and contours.

The present study, however, reveals a slightly different picture. The data collected shows that there are three tones but the characteristic features are different. The first tone, which falls initially and rises in the end and is commonly termed as low tone, shows only a fall of the pitch in the this study. According to the data, normal speakers have an average fundamental frequency range of 162.64 Hz – 150.64 Hz and an average fall of the tone being 12 Hz for male speakers. For female speakers it is 187.44 Hz – 174.78 Hz with a fall being 12.66 Hz and therefore, could be termed as '**falling tone**'. The second tone, which maintains a constant frequency and is known as mid tone, rather behaves as a level tone and not mid tone as the average starting point of falling tone is the same as that of the level tone. As we can see from the data, the average fundamental frequency for male speakers is 164.81 Hz – 164.62 Hz with an average difference in the two levels of tone being 0.19 Hz. For female speakers it is 186.63 Hz – 184.31 Hz with a difference in the two levels being

2.32 Hz. Therefore, the low tone starts at 162.64 Hz and level tone starts at 164.81 Hz for male speakers. For female speakers the falling tone starts at 187.44 Hz and level tone starts at 186.63 Hz and therefore, could be termed as **'level tone'**. According to the data the third tone is what Narang has termed as "high-rising tone" (1989: 60) as it starts at a higher level of pitch and rises up further. The average range of high tone vowel sounds taken into consideration for male speakers in normal control group was 176.85 Hz – 188.72 Hz with an average rise of the tone being 11.87 Hz. For female speakers it is 195.22 Hz – 214.16 Hz with a rise being 18.94 Hz. Therefore, the falling tone or the so called low tone, and the level / mid tone start at the same level where as high-rising or high tone starts at a much higher level and rises further. So, the last of the three tones can most appropriately be termed as the **'high–rising tone'** rather than 'high tone' or 'rising tone'. "Low tone" (Gill & Gleason and others) or "Falling Rising / Tone 1" (Narang, Joshi) may be attributed to the dialectal differences. All my NC subjects belong to Ludhiana and their dialect may have falling tone as indicated by the data.

As we can see that LHD speakers perform worse than the other two groups in case of tonal contrasts. So, let us take into account these subjects first. The first subject of the LHD group performs consistently throughout in the tonal tasks at lexical level. His performance score is average and ranges from 57% - 67% of correct responses. Similarly, the third subject also performs consistently well for all the three tones and his performance ranges from 62% - 87%. However, the second and the fourth subjects show a very interesting contrast. The second subject performs poorly in case of falling tone but shows an average and an above average performance for level and high – rising tone respectively. On the other hand, the fourth subject performs well for falling and level tone but shows a poor performance in case of high–rising tone lexical units. This shows a tendency to eliminate a tone to probably make the production of sounds less complicated. Though the performance of the

RHD speakers is not consistent, it shows an average or above average performance for the tonal tasks.

Looking at the data of the LHD and RHD speakers, we can see the pattern of deviation of tones in case of both the groups of subjects for all the three tones at lexical level. Now, comparing the fundamental frequencies for falling tone, the average fundamental frequency range for LHD male speakers was 148.13 Hz – 136.99 Hz with an average fall of 11.14 Hz between the two levels and for female speakers 141.74 Hz – 132.25 Hz with an average fall of 9.49 Hz. These averages exclude the incorrect responses of the LHD subjects. They show a tendency to change the falling tone to the level tone when they are uncertain about the lexical item. There is a huge difference of the level at which the normal and impaired male and the female speakers produce low tone. The LHD male speaker's average frequency level is 148.13 Hz where as that of normal speaker is 162.64 Hz. The LHD female speaker's average frequency level is 141.74 Hz where as that of normal speaker is 187.44 Hz. This data is calculated on the basis of one female speaker in the LHD group. Though her responses are correct, the level of pitch has significantly gone down in case of all the three tones. Thus, this case is being discussed separately after discussing the three tones at lexical level. This data shows that the level of the falling/ low tone is significantly lower than that of normal speakers. However, there is not much difference in the contour, which is 12 Hz fall and 12.66 Hz fall for male and female normal speakers respectively, and 11.14 Hz fall and 9.49 Hz fall for LHD male and female speakers respectively. There is a difference in the level of pitch of RHD speakers as well but not as great as that of LHD speakers. The average range for RHD male speakers was 152.44 Hz – 140.54 Hz with a fall of 11.9 Hz and for RHD female speakers was 150.1 Hz – 139.48 Hz with a fall of 10.62 Hz. In this case also, the averages exclude the incorrect responses as they have also shown a tendency to attain level tone. When compared to normal speakers the average level of tone of the RHD male speaker is 152.44 Hz and that of normal male speaker is 162.64 Hz. In case of females, the average level of tone of the RHD speaker is 150.10 Hz and that

of normal is 187.44 Hz. Again, the variation in the range is not significant in case of RHD speakers as well. This shows that low tone is processed in the left hemisphere.

For level/ mid tone also we can see a similar pattern with a very significant difference in the range of average fundamental frequency. The average range of mid tone vowel sounds taken into consideration for male speakers in normal control group, was 164.81 Hz – 164.62 Hz, with an average difference in the two levels of tone being 0.19 Hz. For female speakers it is 186.63 Hz – 184.31 Hz with a difference in the two levels being 2.32 Hz. In case of LHD male speakers it is 147.66 Hz – 145.76 Hz, with an average difference in the two levels being 1.9 Hz and for LHD female speakers, it is 135.95 Hz – 134.60 Hz with an average difference between the two levels being 1.35 Hz. We can see the significant variation in the level of onset of mid tone between normal and LHD male female speakers. It is much higher for both male and female normal control group as compared to the speakers with impairment due to injury in the left hemisphere. These averages do not include the incorrect responses. Only one male produces a low tone instead of level/ mid, which may again be attributed to the non–recognition of the lexical item. He had produced either tòl or dòl, both of which are similar to dol (which was the chosen lexical unit) but with a falling tone. Similarly for RHD speakers, the level goes down but not to the extent as in case of LHD subjects. The average range for RHD male speakers was 151.51 Hz – 147.52 Hz with a difference of 3.99 Hz between the two levels and for RHD female speakers was 148.57 Hz – 147.42 Hz with a difference of 1.15 Hz between the two levels. The normal male and female speakers produce their tones at 164.81 Hz and 186.63 Hz where as male and female RHD speakers produce at 151.51 Hz and 148.57 Hz. In this case also, incorrect responses are not included in the averages. Though the number of incorrect response is high, the reason for that is the incorrect identification of the given lexical units. Most of them used the Hindi cognates, thus leading to errors. The variation is not significant for RHD speakers and thus reinforces the point that the left hemisphere is stimulated for mid tone also.

In case of high – rising/ high tone as well, the left hemisphere plays an important role in stimulating it as can be seen that LHD speakers are the most effected speakers as compared to RHD and NC group. The average range of high tone vowel sounds taken into consideration for male speakers in normal control group was 176.85 Hz – 188.72 Hz with an average rise of tone being 11.87 Hz. For female speakers it is 195.22 Hz – 214.16 Hz with the rise being 18.94 Hz. For LHD male speakers it is 149.17 Hz – 157.45 Hz with an average rise of 8.28 Hz and for female speakers it is 135.24 Hz – 145.25 Hz with an average rise of 10.01 Hz. In this case we see that female speakers seem to be more effected than the male speakers. This result is analyzed due to the poor performance of the female LHD speaker, case no. 3, and is being discussed separately after this paragraph. These averages do not include the incorrect responses. Each subject has made at least one error in producing high tone and instead produce mid tone with a difference of 3 Hz – 5 Hz, but show a falling tendency instead of a rising one. This shows their preference to attain level tone in case of uncertainties. Again the variation in case of RHD speakers is not very significant. The average range for RHD male speakers was 162.43 Hz – 174.62 Hz with a difference of 12.99 Hz between the two levels and for RHD female speakers was 161.26 Hz – 175.33 Hz with a difference of 14.07 Hz between the two levels. These averages also do not include the incorrect responses, which is seen only in the case of one male speaker who produces a low tone instead of high. As compared to normal speakers, the level of average fundamental frequency of LHD speakers is much lower than that of both RHD and normal speaker. This instigates the dominance of the left hemisphere for the processing of high tone.

As case no. 3, a female LHD speaker shows a very acute change in the level of F0, and hence this case is being discussed separately. The level of the onset of F0 goes down significantly; in fact, it is even lower than that of the male speakers. This is for all the three tones. Her average range of words with falling tone is 141.74 Hz – 132.25 Hz with an average fall of 9.49 Hz. On the other hand, for male speakers it is 148.13 Hz – 146.99 Hz with an average fall of 11.14 Hz. Similarly, is the case with

other two tones as well. So we can see that the level of pitch has really gone down. The interesting point is she retains her power to distinguish the three tones (as seen from the results of percentage of correct responses), though the level is much lower and the range of the fall or rise is also less. This may lead to the fact that female speakers are more affected than male speakers are but the present number is too small to conclude anything. Further research is required to substantiate it.

These comparisons were in case of tones at lexical level, in which case we may hypothesize that the left hemisphere processes the pitch variation in tones for Punjabi, a tone language. Similarly, it could be for other tone languages as well.

Next, we take into consideration the comprehension and production of intonation at sentential level. The first LHD subject shows an average or above average performance in comprehension tasks for all three kinds of statements, that is, declarative, interrogative and imperative. However, the corresponding production scores are much lower. The significant point is that he performs worse in case of the comprehension (66.67%) and production (33.33%) of imperative statements.

The second LHD subject also shows a better performance in case of comprehension as compared to the corresponding production scores of all the tasks for linguistic prosody at sentence level. However, he rates very poorly for the comprehension (50%) and production (25%) of interrogative statements and also does not perform very well for declarative statements (comprehension – 66.67%, production – 33.33%) either.

The third LHD subject shows a variation in the scores. She scores similarly for both comprehension (66.67%) and production (66.67%) of declarative statements. The comprehension (75%) of interrogative utterances is better than its production (50%). However, the comprehension (33.33%) of imperatives is much lower than that of production (66.67%).

The fourth LHD subject also shows similar kinds of variations but in case of declarative statements. His comprehension (66.67%) is lower than its production (100%). The reason for this could be attributed to the fact that there is no rise and fall of tones in declaratives. The comprehension (75%) and production (75%) of interrogatives is impaired, but to a very less extent. However, he performs worse in case of imperatives.

The variations in the performance of each of these subjects when compared with those of RHD and NC group are greater. As this study does not include subjects with same anatomical location, it is difficult to contest for a particular region but the reason for the variations could be the anatomical location of the lesion. Though the RHD speakers also do not have most of their responses correct and have performed poorly in certain tasks like in case of production of interrogatives, their average performance is better than LHD speakers. Thus, we can say that **linguistic prosody at sentential level is processed in the left hemisphere.**

Another kind of prosody tested at sentence level is affective prosody. The three emotions taken into consideration were happiness, anger and sadness. As evaluated from the data, the RHD speakers have performed worse in this case. So, we look at the pattern of disturbance for each subject in RHD group and then compare it with LHD and NC speakers. The first RHD subject shows an average performance of comprehension (66.67%) and production (66.67%) of happy utterances. But is unable to comprehend and produce the tones very well for the other two emotions. The score of comprehension and production of sad statement is the same (33.33%) but in case of angry utterances the subject is able to comprehend (50%) them better than produce (25%) them.

The second RHD subject is the worst affected. She shows a very poor performance in most tasks. Her score to comprehend and produce the emotion of

happiness is 33.33%. However, she is able to comprehend (66.67% - sad, 50% - angry) sad and angry utterances better than produce (33.33% - sad, 25% - angry) them.

The third RHD subject is also severely affected. She shows an average comprehension (66.67%) for happiness but is not able to produce (33.33%) it that well. For sad statement she is neither able to neither comprehend (33.33%) nor produce (33.33%) it very well. As for the angry statement, her comprehension and production score is average (50%). The data shows her major problem is to identify and then express the emotion of sadness.

The fourth RHD subject also shows a similar pattern. He is able to understand (66.67%) the happy statements but not able to produce (33.33%) all of them. Like the previous subject he also has problems with the emotion of sadness. He could comprehend 33.33% of the statements but was not able to produce a single correct response. However, he could understand (75%) angry statements very well and was even able to produce half of them.

In case of affective prosody we can see all the RHD speakers are severely affected, which is unlike LHD subjects. The average scores of LHD patients are significantly better than that of RHD patients. The variations amongst the speakers in RHD group could again be attributed to the anatomical location. However, this would need more research to conclude anything substantial with regard to associating specific regions of brain with specific functions. Therefore, we can say that **affective prosody is processed in the right hemisphere of the brain.**

As expected, the results of the analysis of total errors indicate that the brain-damaged speakers make more errors than the normal speakers do. However, what significantly distinguishes the three groups is the percentage and pattern of errors. The results suggest that both LHD and RHD speakers retain a relative portion of their

power to distinguish the tones at both lexical and sentence level but the portion varies on the basis of the site of lesion.

The LHD speakers make most errors in case of linguistic prosody at both the levels, lexical and sentence. However, very few of them make random errors unlike the RHD and NC group. The occurrence of the error cannot be defined, but in terms of pitch variation they tend to change the falling and high-rising tone to level tone with an increase in the difference in the range of about 2 Hz – 5 Hz. Also, the level of the onset of the F0 of LHD is significantly different from that of RHD and NC. The level of F0 is much lower in LHD speakers as compared to NC. The level of RHD is also lower than NC but not significantly. LHD speakers perform poorly at sentence level as well. These results show the left hemisphere dominance for linguistic prosody.

For affective prosody, the RHD speakers perform worse than LHD and NC speakers do. Again, it is the high percentage of errors in case of RHD speakers that makes the statistics significant. Thus, we could say that the right hemisphere is dominant for affective prosody.

Chapter Five

Summary and Conclusion

In this dissertation, an attempt was made to understand the processing of prosody for Punjabi, a tone language, in the brain. This not only included the lateralization of the different functions (linguistic and affective) of prosody, but also the change in characteristic features of linguistic prosody when the ability to communicate breaks down as a result of brain injury. This study included three groups of native speakers of Punjabi, left hemisphere damaged (LHD), right hemisphere damaged (RHD) and normal control (NC) speakers as subjects. Different parameters were taken into account to understand the linguistic and affective functions of prosody. Linguistic prosody was tested at two levels, at lexical and sentence level and affective at sentence level only.

Punjabi belongs to the Indo-European language family and is spoken in the Pakistani state of Punjab and the Indian state of Punjab. It has ten vowel sounds and thirty-seven consonant sounds. Along with these sounds most dialects of Punjabi have three tones as well, as accepted by the researchers. It was this special characteristic feature of being a tone language, which inspired me conduct this study in Punjabi. There have been continuous discussions about the nature of these three tones. Some researchers believe that only levels are significant in this language and others believe contours as well as level of tones is significant. Accordingly, different linguists use different terminology. For this dissertation, I have discussed at length the viewpoints of Gill and Gleason (refer to p. 8), Joshi (see p. 7) and Narang (see p. 118) and then compared the findings of this research with the previous existing ones. To understand the underlying principles of the tonal system of the language, it was important to establish the variations incurred by the impaired speakers, the subjects in the present study.

To carry out this neurolinguistic study, different tasks were devised to determine the lateralization of pitch (which includes tone and intonation), which plays a major role in the prosody of Punjabi. Tone is significant at lexical level and carries out a phonemic function. Intonation is at the sentence level and can carry out a linguistic and/ or emotive function. All these aspects have been included in this study. Four tasks were devised to study each one of these aspects, one picture naming and three repetition tasks. The objective of these tasks was to see if impaired speakers could comprehend these tones and intonations and then produce them with the same variations as that of normal speakers. The test variable of the first task of picture naming was production of tones at lexical level to see if the speaker has retained all the three tones or not. The test variable of the second task of repetition was production of the contrasting tones at the sentence level to see if the speaker can distinguish between the three tones, when all the other sounds of the lexical units bearing the contrastive tone are the same. The fundamental frequency of each sound bearing the tone was calculated to see the difference in the characteristics when compared with the normal speakers. The third task was also a repetition task. The test variables for this task were comprehension and production of linguistic intonation. The three kinds of statements were declarative, interrogative and imperative. The last task was also a repetition task with comprehension and production of intonation as test variables. However, in this task the function was to test if the brain-damaged subjects have retained their power to comprehend and produce emotive utterances.

Subjects with brain damage for these tasks were out patients in two major hospitals of Ludhiana, Punjab, coming from different parts of the state. The normal speakers were residents of Ludhiana, Punjab. Eight native speakers of Punjabi with a diagnosis of lesions in their brain were randomly selected, out of whom four had lesions in the left hemisphere and four in the right hemisphere. For normal control group too, four speakers were selected. The test was carried out in the hospitals after

taking a detailed report of their medical history from the concerned neurosurgeon. All the responses were recorded in a cassette recorder.

To obtain the results, the data was tabulated separately for all the three tones. This includes the scores for correct responses for each task, which has been further analyzed by ANOVA and the average fundamental frequency for four sounds with all three tones, that is, / ə/, / o /, / ɑ / and / i / sounds with the three tones. Then the average frequency for each tone was calculated to specify the range of that particular tone. The result of both the groups with impaired speakers, that is, LHD, RHD were compared with normal speakers to finally analyze the results.

Results from this study suggest a few findings with respect to linguistic as well as affective prosody, which have been summarized in the following points.

1. **Tones in Punjabi:** Data from the NC group suggests that there are three contrasting tones in Punjabi, which can be described in terms of a combination of the levels and contours. However, it is the variation in the contours and levels that is different. The first tone is a falling tone, which is usually called low tone. This tone shows a fall of approximately 10 Hz – 15 Hz for both male and female speakers during the production of the vowel. The second tone is a level tone, which is usually called mid tone. This tone maintains a constant level of frequency with a minimal variation of approximately 3 Hz – 5 Hz during the production of the vowel. The third tone is a high-rising tone, which is usually called high tone. This tone starts at a high level and further rises by approximately 10 Hz – 20 Hz for both male and female speakers. The onset of the falling tone and the level tone is almost at the same point, whereas, the onset of high-rising tone is at a much higher level. These three tones have been labeled as the falling tone, the level tone and the high-rising tone in this study.

2. **Linguistic prosody of the impaired speakers at lexical level:** This study suggests that these brain-damaged speakers of Punjabi retain their ability to distinguish between the tones to a certain extent, less in case of LHD and more in case of RHD. The data of LHD subjects is 60.75% correct responses for falling tone, 73.34% for level tone and 65.63% for high-rising tone, while the data of RHD subjects is 82.14% for falling tone, 86.67% for level tone and 78.13% for high-rising tone, though the severe LHD cases do show a tendency to change the three-tone system to two-tone system. The interesting point is that, the second subject changes it to falling and level tone and fourth subject to high-rising and level tone. This shows that they try to simplify the system.

3. **Deviation in the level of tones:** This leads to another hypothesis regarding the deviation in the levels and contours of impaired speakers. When compared to normal speakers the level of the onset of each of the tones for both LHD and RHD goes down. But it is the LHD speakers who are most affected in terms of phonemic prosody. The LHD male speaker's average frequency level is 148.13 Hz whereas that of normal speaker is 162.64 Hz. The LHD female speaker's average frequency level is 141.74 Hz where as that of normal speaker is 187.44 Hz. However, there is not much difference in the contour, which is 12 Hz fall and 12.66 Hz fall for male and female normal speakers respectively, and 11.14 Hz fall and 9.49 Hz fall for LHD male and female speakers respectively. The average level of tone of the RHD male speaker is 152.44 Hz and of female speaker is 150.10 Hz again with not much variation in the range. Therefore, the level of LHD subjects is significantly less than that of normal speakers and RHD speakers. The contours are not much affected; thus the range is almost the same for both LHD and RHD. The following graphs show the extent of the variation of the LHD and RHD subjects when compared to NC subjects.

PLATE 1

Average Fundamental Frequency of NC of the three tones of all the 4 subjects

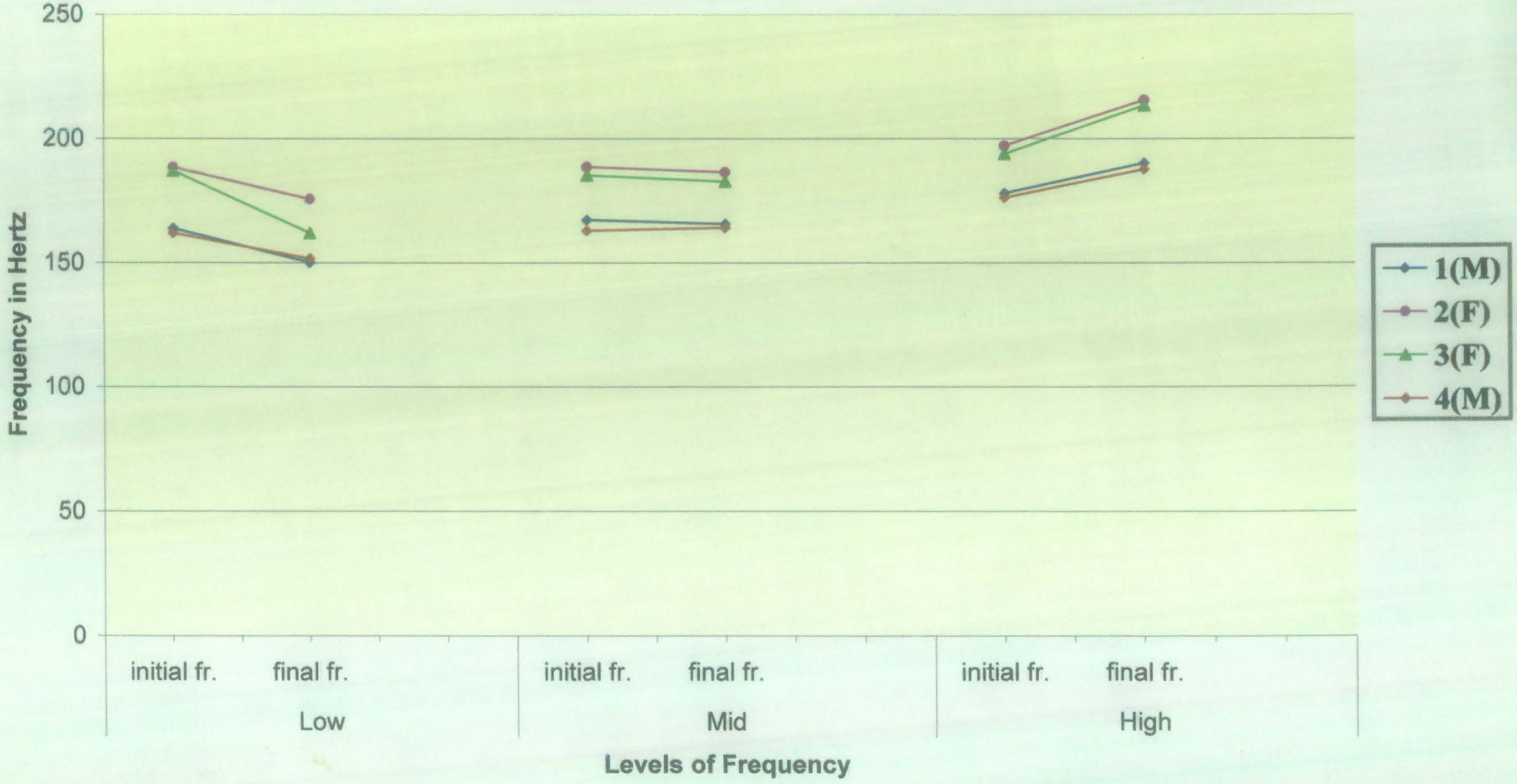


PLATE 2

Average Fundamental Frequency of LHD of the three tones of all the 4 subjects

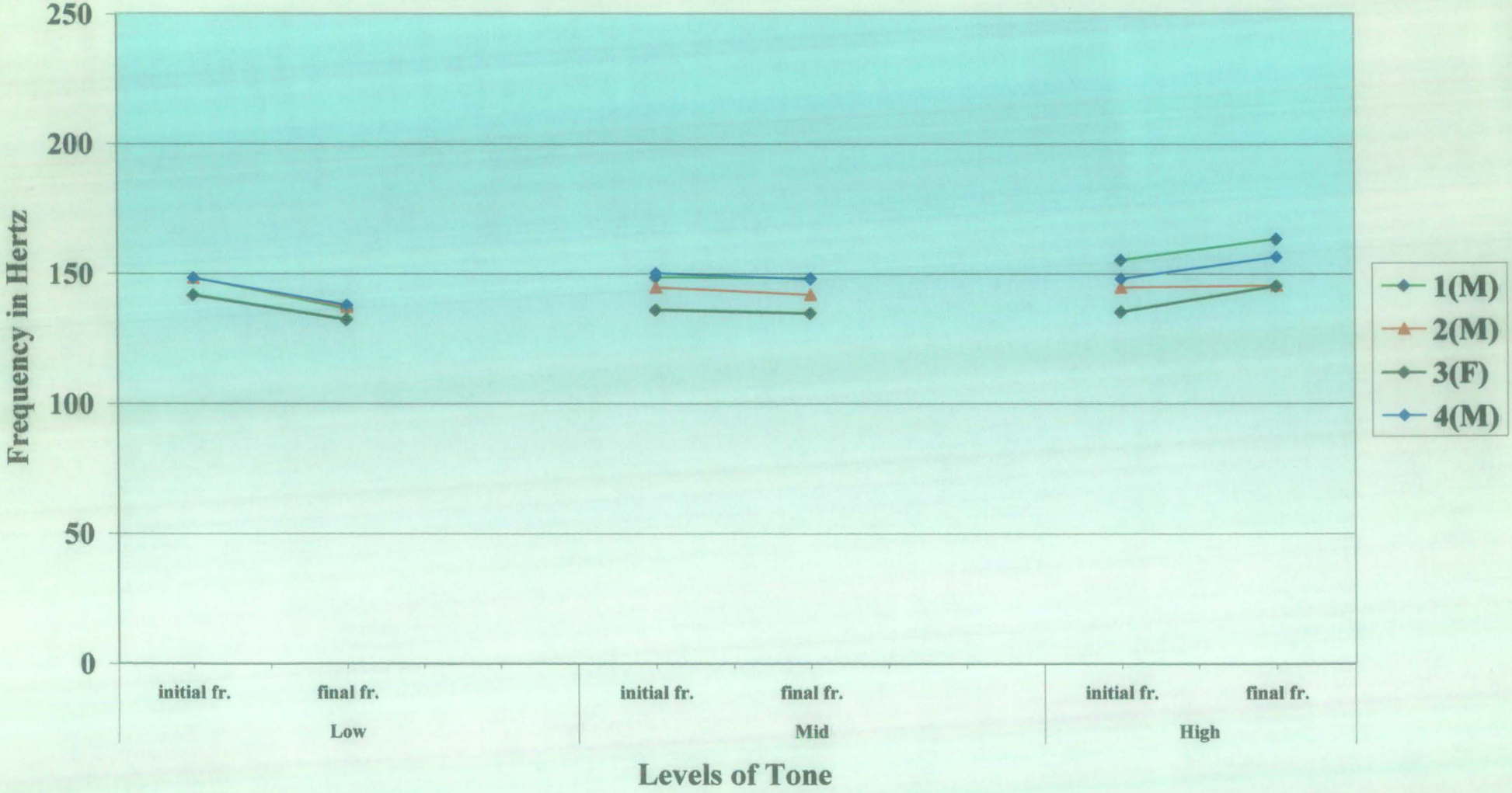
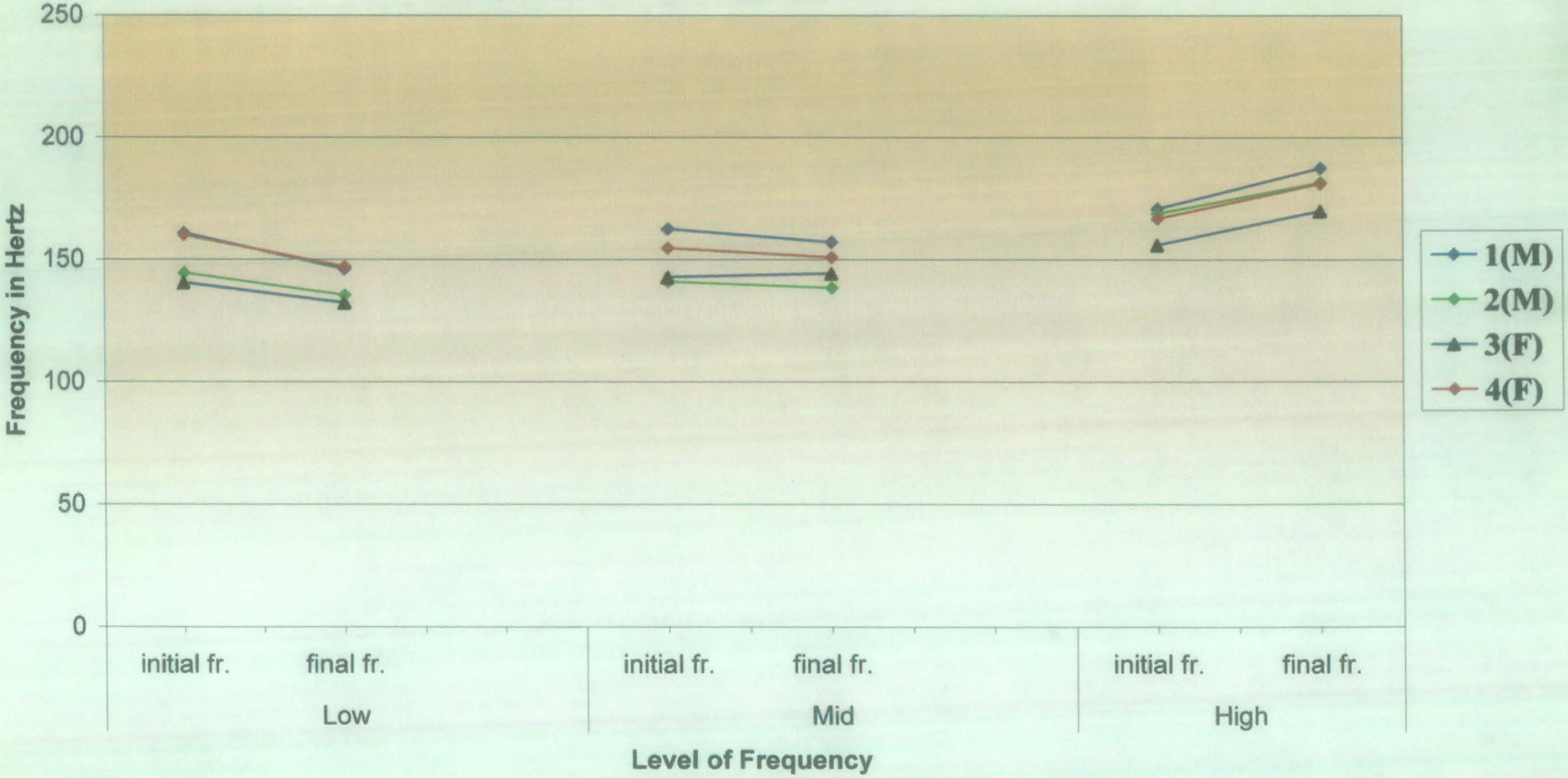


PLATE 3

Average Fundamental Frequency of RHD of the three tones of all the 4 subjects



4. **Linguistic prosody of impaired speakers at the sentence level:** At the sentence level also they tend to retain their ability to distinguish between the three intonations. For this as well, LHD subjects are most effected. The data for LHD subjects, which is 75% for comprehension of declarative statements, 66.67% for production of declarative statements, 68.75% for comprehension of interrogative statements, 50% for production of interrogative statements, 66.67% for comprehension of imperative statements and 50% for production of imperative statements, shows their poor performance. The scores of RHD subjects are much better than that of LHD subjects. The least affected type of intonation for all subjects is the declarative statement, which may be because of generally flat intonation throughout the utterance in the aphasic speech.

5. **Affective prosody of the impaired speakers: sentences in three different 'moods':** For affective prosody also both LHD and RHD subjects retain their power to comprehend and produce the three kinds of intonations but only to a certain extent. In this case, the RHD subjects perform worse than the LHD subjects do. The scores of RHD speakers are 58.34% for the correct responses for comprehension of happy statement, 41.67% for production of happy statement, 41.67% for comprehension of sad statement, 29.998% for production of sad statement, 56.25% for comprehension of angry statement and 37.5% for production of angry statements. This data shows that RHD speakers' performance was most affected.

6. **Nature of errors:** This dissertation would not be completed till we discuss the nature of errors made by the impaired speakers. We can see that the normal speaker makes random errors. However, the LHD and RHD speaker makes errors randomly only with reference to their occurrence but make similar kind of errors with reference to the phonetic and phonemic properties. As mentioned earlier, they retain their power to comprehend and manifest prosody to some extent. So

the errors that they make are to reduce the complexities associated with prosody. The level of pitch of LHD subjects is lower, which attributes to the phonetic impairment. They usually retain one or two kinds of prosody at both levels, lexical and sentential. For instance, they may tend to eliminate falling tone and retain high-rising and level tone, or eliminate high-rising and retain falling and low tone. Similarly, for sentential level if they have problems identifying the interrogative they might retain declarative or imperative or both. Also, for affective tones, this holds true. These variations form functional changes and can be attributed to phonemic impairment.

7. **Lateralization of Prosody:** Therefore, looking at all the statistics, we can conclude that LHD stimulates linguistic prosody at both lexical and sentence level. We can also surmise that RHD stimulates affective prosody as we can see from the results that it is the RHD who perform worst in this case.

These findings are on the basis of the language, Punjabi, and may hold true for other tone languages as well. Also, for this study a small number of subjects were selected. So to substantiate the results a more extensive research is required. However, this study reveals some significant findings, which could form the basis for further research as part of my Ph.D. with a greater volume of data. Later, I would like to test the validity of the findings of my present study and incorporate the following parameters after doing an extensive research on the pattern of prosody that exists in Punjabi:

1(a) Firstly, it would confirm the present hypothesis that affective prosody is most affected in case of RHD speakers.

(b) Secondly, I would like to find out more elaborate procedures and methods for testing affective prosody as happy, sad and angry are very general and situation-

oriented emotions. It is difficult for the subject to change emotions within minutes. So these kinds of responses might not actually reflect the emotion with the same gravity as that in real life situations. For this, more specific tasks can be prepared like, story-telling, in which the situations can vary and correspondingly the emotions of the subject.

2(a) Firstly, it would confirm the present hypothesis that linguistic prosody at lexical and sentence level is processed in the left hemisphere.

(b) Secondly, I would like to examine the tones at the word level in detail for both normal and impaired speakers including the level and contours of the tones.

(c) Also, I would like to examine the sentence level function of tones in LHD in detail, for example, 'word' as a grammatical category associated with declarative, interrogative and imperative sentences.

3 Finally, I would also like to study in greater detail, the localization and lateralization of different aspects of prosody to correlate lesion sites with the breakdown of prosody.

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Appendix 1

Subjects Record Sheet

Subject 1

Age	:	70
Sex	:	Male
Date of Examination	:	10th Oct'03
Place of Examination	:	DMCH

Premorbid Handedness

Writing	:	Right
Throwing	:	Right
Scissors	:	Right
Combing	:	Right
Screw driver/Threading needle	:	Right
Striking Match	:	Right
Premorbid change in Handedness if any	:	No
Postmorbid Handedness	:	Right

Education : Primary

Language History

Languages Known	:	Punjabi	Hindi	Urdu
Age of acquisition	:	0 yrs	9 yrs	0 yrs
Manner of acquisition	:	MT	School	School
Comprehension	:	V. Good	V. Good	Poor
Speak	:	V. Good	V. Good	Poor

Read	:	Good	Good	-
Write	:	Not much	Not much	-

Language Use

Language commonly used at home	:	Punjabi
Language commonly used at office	:	Punjabi
Language commonly used with friends	:	Punjabi
Language commonly used to think or calculate mentally	:	Punjabi
Language commonly used to curse	:	Punjabi
Language commonly used to see Movies	:	Hindi
Language commonly used to read	:	Punjabi, Hindi
Preference for a particular language	:	Punjabi
Reasons	:	Mother Tongue and staying in Punjabi speaking community

Medical History

History of familial sinistrality	:	No
Onset (Month)	:	August'03
Paralysis	:	Right side (Upper)
Sensory Loss	:	No
Hemianopia	:	No
Localizing Side	:	Left
Anatomic Location	:	Anterior – Cerebral Artery; Frontal Lobe

Subject 2

Age	:	74 yrs
Sex	:	Male
Date of Examination	:	12th Oct'03
Place of Examination	:	CMC

Premorbid Handedness

Writing	:	Right
Throwing	:	Right
Scissors	:	Right
Combing	:	Right
Screw driver/Threading needle	:	Right
Striking Match	:	Right
Premorbid change in Handedness if any	:	No
Postmorbid Handedness	:	Right (but can't write much & can't lift Heavy objects
Education	:	3 yrs of schooling

Language History

Languages Known	:	Punjabi	Hindi	English
Age of acquisition	:	0 yrs	0 yrs	3 yrs
Manner of acquisition	:	MT	Society/School	School
Comprehension	:	V. Good	Good	Poor
Speak	:	V. Good	Moderately	V. Poor
Read	:	Good	Moderately	No
Write	:	Poor	No	No

Language Use

Language commonly used at home	:	Punjabi
Language commonly used at office	:	Punjabi
Language commonly used with friends	:	Punjabi
Language commonly used to think or calculate mentally	:	Punjabi
Language commonly used to curse	:	Punjabi
Language commonly used to see movies	:	Punjabi/Hindi
Language commonly used to read	:	Punjabi
Preference for a particular language	:	Punjabi
Reasons	:	Mother Tongue and staying in Punjabi speaking community

Medical History

History of familial sinistrality	:	No
Onset (Month)	:	April'03
Paralysis	:	Right (upper & lower)
Sensory Loss	:	Right
Hemianopia	:	No
Localizing Side	:	Left
Anatomic Location	:	Temporo-parietal region infarct

Subject 3

Age	:	60
Sex	:	Female
Date of Examination	:	13th Oct'03
Place of Examination	:	DMCH

Premorbid Handedness

Writing	:	Right
Throwing	:	Right
Scissors	:	Right
Combing	:	Right
Screw driver/Threading needle	:	Right
Striking Match	:	Right
Premorbid change in Handedness if any	:	No
Postmorbid Handedness	:	Right

Education : Higher Secondary

Language History

Languages Known	:	Punjabi	Hindi	English
Age of acquisition	:	0 yrs	3 yrs	3 yrs
Manner of acquisition	:	MT	School	School
Comprehension	:	V. Good	V. Good	Poor
Speak	:	V. Good	V. Good	Poor
Read	:	V. Good	No	No
Write	:	Good	No	No

Language Use

Language commonly used at home	:	Punjabi
Language commonly used at office	:	Punjabi
Language commonly used with friends	:	Punjabi
Language commonly used to think or calculate mentally	:	Punjabi
Language commonly used to curse	:	Punjabi
Language commonly used to see Movies	:	Punjabi/ Hindi
Language commonly used to read	:	Punjabi
Preference for a particular language	:	Punjabi
Reasons	:	Mother Tongue and staying in Punjabi Speaking community

Medical History

History of familial sinistrality	:	No
Onset(Month)	:	August'02
Paralysis	:	Right (upper and lower)
Sensory Loss	:	No
Hemianopia	:	Right
Localizing Side	:	Left
Anatomic Location	:	Sub – Cortical Area, Frontal Lobe

Subject 4

Age	:	25 yrs
Sex	:	Male
Date of Examination	:	13th Oct'03
Place of Examination	:	DMCH

Premorbid Handedness

Writing	:	Right
Throwing	:	Right
Scissors	:	Right
Combing	:	Right
Screw driver/Threading needle	:	Right
Striking Match	:	Right
Premorbid change in Handedness if any	:	No
Postmorbid Handedness	:	Right

Education : Higher secondary

Language History

Languages Known	:	Punjabi	Hindi
Age of acquisition	:	0 yrs	3 yrs
Manner of acquisition	:	MT	School
Comprehension	:	V. Good	Good
Speak	:	V. Good	Good
Read	:	Good	Moderate
Write	:	Good	Moderate

Language Use

Language commonly used at home	:	Punjabi
Language commonly used at office	:	Punjabi
Language commonly used with friends	:	Punjabi
Language commonly used to think or calculate mentally	:	Punjabi
Language commonly used to curse	:	Punjabi
Language commonly used to see movies	:	Punjabi
Language commonly used to read	:	Punjabi
Preference for a particular language	:	Punjabi
Reasons	:	Mother Tongue and staying in Punjabi Speaking community

Medical History

History of familial sinistrality	:	No
Onset (month)	:	August'03
Paralysis	:	Right (upper)
Sensory Loss	:	No
Hemianopia	:	No
Localizing Side	:	Left
Anatomic Location	:	MCA Infarct, Frontal – Parietal Lobe

Subject 5

Age	:	65 yrs
Sex	:	Male
Date of Examination	:	15th Oct'03
Place of Examination	:	DMCH

Premorbid Handedness

Writing	:	Right
Throwing	:	Right
Scissors	:	Right
Combing	:	Right
Screw driver/Threading needle	:	Right
Striking Match	:	Right
Premorbid change in Handedness if any	:	No
Postmorbid Handedness	:	Right

Education : High Secondary

Language History

Languages Known	:	Hindi	Urdu	Punjabi	English
Age of acquisition	:	0 yrs	3 yrs	30 yrs	5 yrs
Manner of acquisition	:	MT	School	Society	School
Comprehension	:	V. Good	Good	Good	Moderate
Speak	:	V. Good	Moderate	Good	Poor
Read	:	V. Good	Moderate	No	Poor
Write	:	Good	Poor	No	No

Language Use

Language commonly used at home	:	Hindi
Language commonly used at office	:	Punjabi
Language commonly used with friends	:	Hindi and Punjabi
Language commonly used to think or calculate mentally	:	Hindi
Language commonly used to curse	:	Hindi and Punjabi
Language commonly used to see movies	:	Hindi
Language commonly used to read	:	Hindi and Urdu
Preference for a particular language	:	Hindi
Reasons	:	Mother Tongue

Medical History

History of familial sinistrality	:	No
Onset (month)	:	July'03
Paralysis	:	Left
Sensory Loss	:	No
Hemianopia	:	No
Localizing Side	:	Right
Anatomic Location	:	Parietal Occipital

Subject 6

Age	:	19 yrs
Sex	:	Male
Date of Examination	:	16th Oct'03
Place of Examination	:	DMCH

Premorbid Handedness

Writing	:	Right
Throwing	:	Right
Scissors	:	Right
Combing	:	Right
Screw driver/Threading needle	:	Right
Striking Match	:	Right
Premorbid change in Handedness if any	:	No
Postmorbid Handedness	:	Right

Education : 11 yrs

Language History

Languages Known	:	Punjabi	Hindi
Age of acquisition	:	0 yrs	3 yrs
Manner of acquisition	:	MT	School
Comprehension	:	Good	Good
Speak	:	Good	Good
Read	:	Good	Moderately
Write	:	Good	Moderately

Language Use

Language commonly used at home	:	Punjabi
Language commonly used at office	:	Punjabi
Language commonly used with friends	:	Punjabi
Language commonly used to think or calculate mentally	:	Punjabi
Language commonly used to curse	:	Punjabi
Language commonly used to see movies	:	Punjabi and Hindi
Language commonly used to read	:	Punjabi
Preference for a particular language	:	Punjabi
Reasons	:	Mother Tongue and staying in Punjabi Speaking Community

Medical History

History of familial sinistrality	:	Yes (grandmother - had a stroke and died)
Onset (month)	:	September'03
Paralysis	:	Right (upper and lower)
Sensory Loss	:	Slightly
Hemianopia	:	No
Localizing Side	:	Right
Anatomic Location	:	Frontal Parietal

Subject 7

Age	:	40 yrs
Sex	:	Female
Date of Examination	:	18th Oct'03
Place of Examination	:	CMC

Premorbid Handedness

Writing	:	Right
Throwing	:	right
Scissors	:	Right
Combing	:	Right
Screw driver/Threading needle	:	Right
Striking Match	:	Right
Premorbid change in Handedness if any	:	No
Postmorbid Handedness	:	Right

Education : 08 yrs

Language History

Languages Known	:	Punjabi	Hindi
Age of acquisition	:	0 yrs	3 yrs
Manner of acquisition	:	MT	School
Comprehension	:	V. Good	Good
Speak	:	Good	Moderate
Read	:	Good	Moderate
Write	:	Moderate	Poor

Language Use

Language commonly used at home	:	Punjabi
Language commonly used at office	:	Punjabi
Language commonly used with friends	:	Punjabi
Language commonly used to think or calculate mentally	:	Punjabi
Language commonly used to curse	:	Punjabi
Language commonly used to see movies	:	Punjabi/ Hindi
Language commonly used to read	:	Punjabi/ Hindi
Preference for a particular language	:	Punjabi
Reasons	:	Mother Tongue and staying in Punjabi Speaking community

Medical History

History of familial sinistrality	:	No
Onset (month)	:	May' 03
Paralysis	:	Left (mild)
Sensory Loss	:	No
Hemianopia	:	No
Localizing Side	:	Right
Anatomic Location	:	Posterior Cerebral artery (Subarachnoid haemorrhage); small temporal haematoma; Temporal

Subject 8

Age	:	32 yrs
Sex	:	Female
Date of Examination	:	22nd Oct'03
Place of Examination	:	DMCH

Premorbid Handedness

Writing	:	Right
Throwing	:	Right
Scissors	:	Right
Combing	:	Right
Screw driver/Threading needle	:	Right
Striking Match	:	Right
Premorbid change in Handedness if any	:	No
Postmorbid Handedness	:	Right

Education : High School

Language History

Languages Known	:	Punjabi	Hindi	English
Age of acquisition	:	0 yrs	3 yrs	5 yrs
Manner of acquisition	:	MT	School	School
Comprehension	:	V. Good	V. Good	Good
Speak	:	V. Good	V. Good	Good
Read	:	V. Good	Good	Good
Write	:	V. Good	Good	Good

Language Use

Language commonly used at home	:	Punjabi
Language commonly used at office	:	Punjabi
Language commonly used with friends	:	Punjabi and Hindi
Language commonly used to think or calculate mentally	:	Punjabi
Language commonly used to curse	:	Punjabi
Language commonly used to see Movies	:	Hindi
Language commonly used to read	:	Punjabi and Hindi
Preference for a particular language	:	Punjabi
Reasons	:	Mother Tongue and staying in Punjabi Speaking community

Medical History

History of familial sinistrality	:	No
Onset (month)	:	Feb' 03
Paralysis	:	No
Sensory Loss	:	Yes
Hemianopia	:	No
Localizing Side	:	Right
Anatomic Location	:	Frontal Temporal Parietal

Subject 9

Age	:	28 yrs
Sex	:	Male
Date of Examination	:	10th Oct'03
Place of Examination	:	Punjab Agricultural University

Premorbid Handedness

Writing	:	Right
Throwing	:	Right
Scissors	:	Right
Combing	:	Right
Screw driver/Threading needle	:	Right
Striking Match	:	Right
Premorbid change in Handedness if any	:	No
Postmorbid Handedness	:	-

Education : 10 yrs

Language History

Languages Known	:	Punjabi	Hindi
Age of acquisition	:	0 yrs	3 yrs
Manner of acquisition	:	MT	School
Comprehension	:	V. Good	Good
Speak	:	V. Good	Good
Read	:	Good	Good
Write	:	Good	Good

Language Use

Language commonly used at home	:	Punjabi
Language commonly used at office	:	Punjabi
Language commonly used with friends	:	Punjabi
Language commonly used to think or calculate mentally	:	Punjabi
Language commonly used to curse	:	Punjabi
Language commonly used to see movies	:	Punjabi and Hindi
Language commonly used to read	:	Punjabi
Preference for a particular language	:	Punjabi
Reasons	:	Mother Tongue

Medical History

History of familial sinistrality	:	No
Onset (month)	:	-
Paralysis	:	-
Sensory Loss	:	-
Hemianopia	:	-
Localizing Side	:	-
Anatomic Location	:	-

Subject 10

Age	:	33 yrs
Sex	:	Female
Date of Examination	:	12th Oct' 03
Place of Examination	:	Punjab Agricultural University

Premorbid Handedness

Writing	:	Right
Throwing	:	Right
Scissors	:	Right
Combing	:	Right
Screw driver/Threading needle	:	Right
Striking Match	:	Right
Premorbid change in Handedness if any	:	No
Postmorbid Handedness	:	-

Education : 4 yrs

Language History

Languages Known	:	Punjabi	Hindi
Age of acquisition	:	0 yrs	3 yrs
Manner of acquisition	:	MT	School
Comprehension	:	Good	Moderate
Speak	:	Good	Moderate
Read	:	Good	Moderate
Write	:	Moderate	Poor

Language Use

Language commonly used at home	:	Punjabi
Language commonly used at office	:	Punjabi
Language commonly used with friends	:	Punjabi
Language commonly used to think or calculate mentally	:	Punjabi
Language commonly used to curse	:	Punjabi
Language commonly used to see movies	:	Hindi/ Punjabi
Language commonly used to read	:	Punjabi
Preference for a particular language	:	Punjabi
Reasons	:	Mother tongue and staying in Punjabi Speaking community

Medical History

History of familial sinistrality	:	-
Onset/Date	:	-
Paralysis	:	-
Sensory Loss	:	-
Hemianopia	:	-
Localizing Side	:	-
Anatomic Location	:	-

Subject 11

Age	:	57 yrs
Sex	:	Female
Date of Examination	:	13th Oct'03
Place of Examination	:	Punjab Agricultural University

Premorbid Handedness

Writing	:	Right
Throwing	:	Right
Scissors	:	Right
Combing	:	Right
Screw driver/Threading needle	:	Right
Striking Match	:	Right
Premorbid change in Handedness if any	:	No
Postmorbid Handedness	:	-

Education : Senior Secondary

Language History

Languages Known	:	Punjabi	Hindi
Age of acquisition	:	0 yrs	3 yrs
Manner of acquisition	:	MT	School
Comprehension	:	V. Good	Good
Speak	:	V. Good	Good
Read	:	V. Good	Good
Write	:	V. Good	Good

Language Use

Language commonly used at home	:	Punjabi
Language commonly used at office	:	Punjabi
Language commonly used with friends	:	Punjabi
Language commonly used to think or calculate mentally	:	Punjabi
Language commonly used to curse	:	Punjabi
Language commonly used to see movies	:	Hindi/ Punjabi
Language commonly used to read	:	Punjabi
Preference for a particular language	:	Punjabi
Reasons	:	Mother tongue and staying in Punjabi Speaking community

Medical History

History of familial sinistrality	:	-
Onset/Date	:	-
Paralysis	:	-
Sensory Loss	:	-
Hemianopia	:	-
Localizing Side	:	-
Anatomic Location	:	-

Subject 12

Age	:	48 yrs
Sex	:	Male
Date of Examination	:	15th Oct'03
Place of Examination	:	Punjab Agricultural University

Premorbid Handedness

Writing	:	Right
Throwing	:	Right
Scissors	:	Right
Combing	:	Right
Screw driver/Threading needle	:	Right
Striking Match	:	Right
Premorbid change in Handedness if any	:	-
Postmorbid Handedness	:	-

Education : Masters Degree

Language History

Languages Known	:	Punjabi	Hindi	English
Age of acquisition	:	0 yrs	5 yrs	5 yrs
Manner of acquisition	:	MT	School	School
Comprehension	:	Excellent	V. Good	V. Good
Speak	:	V. Good	V. Good	V. Good
Read	:	V. Good	Good	V. Good
Write	:	Good	Moderate	Good

Language Use

Language commonly used at home	:	Punjabi
Language commonly used at office	:	English/ Hindi
Language commonly used with friends	:	Punjabi/ English
Language commonly used to think or calculate mentally	:	Punjabi
Language commonly used to curse	:	Punjabi
Language commonly used to see movies	:	Hindi/ English
Language commonly used to read	:	English
Preference for a particular language	:	English
Reasons	:	Professional requirement

Medical History

History of familial sinistrality	:	-
Onset/Date	:	-
Paralysis	:	-
Sensory Loss	:	-
Hemianopia	:	-
Localizing Side	:	-
Anatomic Location	:	-

Appendix 2

DIAGNOSTIC TEST BATTERY FOR APHASIA IN HINDI

HOSPITAL REFERRING PHYSICIAN
PT IDENTIFICATION NO.: RADIOLOGY NUMBER:
NAME: AGE: DOB:

ADDRESS AND TELEPHONE NUMBER (IF ANY):

EDUCATION (yrs from first grade):

ILLITERATE (no reading and writing skills):

HANDEDNESS (based on the hand preference for throwing a ball, hammering a nail, brushing teeth, cutting a potato, and writing)

RIGHT FORCE RIGHT LEFT MIXED

OCCUPATIONAL INFORMATION

LANUGAGES	HINDI	ENGLISH	OTHER(S)
SPEAKING	_____	_____	_____
UNDERSTANDING	_____	_____	_____
READING	_____	_____	_____
WRITING	_____	_____	_____

ILLNESS: NATURE, ONSET AND DURATION:

PARALYSIS:	RIGHT (upper lower)	LEFT (upper lower)
SENSORY LOSS:	RIGHT (upper lower)	LEFT (upper lower)
HEMIANOPIA:	RIGHT	LEFT

LOCALIZING INFORMATION: DATE SIDE ANATOMIC LOCATION

CAT-SCAN/MRI:	_____	_____	_____
ANGIORAM:	_____	_____	_____

APHASIA SEVERITY SCALE

O LEVEL:	NO COMMUNICATION. Because of the severity of aphasia in speaking and comprehending no communication is possible. The patent may not even attend to the task.
1 Level	ONLY LIMITED COMMUNICATION. The patent communities using fragmentary verbal expressions with and without accompanying gestures. The listener carries the primary burden for communication and has to interfere, guess, and ask question of successful communication.
2 Level	FAMILIAR COMMUNICATION. The patient communicates only about familiar subjects and can only convey limited information with and without accompanying gestures. Both the listener and patient carry the responsibility for communication.
3 Level	UNASSISTED COMMUNICATION. The patient discusses almost all everyday problems with little or no assistance. Limited expressive and/or receptive competence makes conversation about complex and abstract material difficult or impssible.
4 Level	MODERATE APHASIA. A noticeable loss of fluency in speech or facility of comprehension interferes with communication, but it does not pose a significant limitation on the content and/or the form of expression.
5 Level	MINIMAL APHASIA. With Minimal discernible aphasic manifestations, the patient may have subjective difficulties that are not apparent to the listener.

(Adapted from the BDAE, Goodglass and Kaplan, 1983).

RATING SCALE PROFILE OF SPEECH CHARACTERISTICS

	(Maximum deficit) 1	2	3	4	5	6	(Minimum deficit) 7
MELODIC LINE Intonationl Contour	Absent		Limited to short phrases & stereotypes			Runs through entire sentence	
PHRASE LENGTH The Longest occasional uninterrupted run of words	1 word		4 words			7 words	
ARTICULATORY Facility at phonemic articulatory level	Always impaired or impossible		Normal only in familiar words and phrases			Never impaired	
GRAMMATICAL FORM Variety of grammatical structures	None available		Limited to simple declarative & stereotypes			Normal range	
PARAPHASIA IN RUNNING SPEEC Inappropriate word selection	Present in every utterance		Once per minute of conversation			Absent	
WORD FINDING Information content in relation to fluency	Fluent without information		Information proportional to fluency			Speech exclusively content word	
REPETITION	(0-14)	(15-28)	(29-42)	(43-56)	(57-70)	(71-84)	(85-100)
AUDITORY COMPREHENSION	(0-14)	(15-30)	(31-45)	(46-60)	(61-75)	(76-90)	(91-100)

(Adapted from Goodglass and Kaplan, 1983).

1. EXPOSITORY SPEECH AND OPEN-ENDED CONVERSATION

The purpose is to elicit enough verbal output so that on the basis of the residual communicative capacity, the severity of the communicative loss can be determined and a graphic profile of the characteristics of the speech production can be assigned.

Conduct an informal conversation with the patient along the line of suggested questions for eliciting necessary speech output and Feel free to elaborate on any of the question or use additional materials. A record of the patient's speech should be made verbatim on the paper, or if possible, on a tape. Encourage the patient to speak at least 4-5 minutes. This sample will be analyzed using the guideline discussed in the for scorin Speech Production Parameters. See text for explanation.

SUGGESTED QUESTIONS:

1. आज अपकी तबियत कैसी है?
   How are you today?

2. क्या आप यहाँ कभी पहले भी आये है?
   Have you ever been here before?

3. आप को क्या बीमारी है?
   Please tell about your sickness?

   b. आप बीमार कैसे हुए?
   How did you get sick?

   c. आपने अपनी बीमारी के बारे में क्या किया?
   What have you done about the treatment of your sickness?

   d. यह बीमारी किस कारण से हुई?
   What do you think has caused the sickness?

4. बीमार होने से पहले आप क्या काम करते थे?
   What kind of work you did before falling sick?

5. मुझे अपने परिवार के बारे में कुछ बताइये। जैसे कि आपके कितने भाई और बहिन है? वे लोग क्या करते है? कहाँ रहते हैं?
   Please tell me all about your family.

PICTURE DESCRIPTION: Ask
the patient to describe everything that he sees in the picture. If the patient ignores parts of the picture of provides limited responses, point to the picture and ask the patient to elaborate responses. Record the verbal output from the open-ended conversation, this provides crucial information for the speech production parameters that is needed for preparing the speech profile.

Check the manual (page) to see the guidelines for analyzing the speech production paramenters of the conversational speech.

2. AUDITORY COMPREHENSION

A. Word Discrimination And Recognition

The purpose of this subtest is to assess the patient's ability to recognize auditorily presented lexical stimuli and to point to their pictorial forms.

Present test CARDS 2. (objects), 3 (actions), 4 (colors) and 5 (adjectives and shapes) separately, and ask the patient to recognize each object carefully. If the patient does not understand or requests, one repetition of the command is allowed.

Allow no more than 5 seconds for each response before providing phonemic (initial sound) or semantic (functional descriptions) cue(s).

INSTRUCTION. ..... दिखाइये।
"Point to....."

SCORING:
2. points for each correct/self corrected response.
1. point for a cued response.
0. for incorrect response or if more than one object is pointed to

Card 2: OBJECTS

Correct response 2 points	Cued response 1 point	Incorrect response 0 points

1- घड़ा/मटका (pitcher) _____

2- पंख (feather) _____

3- धनुष/कमान (bow) _____

4- मकान (house) _____

5- पेढ़ (tree) _____

6- घडी (watch) _____

7- पतंग (kite) _____

8- सायकिल (bicycle) _____

CARD 3: ACTIONS

9- पढ़ना (to read) _____

10- सोना (to sleep) _____

11- रोना (to cry) _____

12- खाना (to eat) _____

13- सुलाना (to make sleep) _____

14- गिरना (to fall) _____

15- दौड़ना (to run) _____

16- काटना (to cut) _____

CARD 4: COLORS

17- हरा (green) _____

18- नीला (blue) _____

19- लाल (red) _____

20- काला (black) _____

CARD 5: ADJECTIVES AND SHAPES

21- लंबा लड़का (tallest, boy) _____

22- छोटा लड़का (youngest boy) _____

23- गोलदायरा (circle) _____

24- तिकोन (triangle) _____

25- चौखाना (चार कोनों वाला)

(quadrangle) _____

MAXIMUM SCORE 50 PTS SCORE _____

B. Auditory Verbal Comprehension

Yes/No Task: The purpose of this test is to assess the patient's ability to process auditorily presented conceptual sentences that vary in processing complexity. These sentences require access to previously storied information and knowledge about wordily objects. Their processing also entails an intellectual component. The patient responds through yes/no to indicate if the sentences are factually rue or false.

If the patient confuses between yes or no mode of answer, a gestural response including an eye blink can be substituted.

One repetition of the instruction and the sentence is allowed.

Instruction: हाँ या ना मै जवाब दीजिए।
"Answer these questions with yes or no".

Scoring : 2 points for each correct verbal response
1 point for each correct gestural response.

	Verbal	Gestural
1- क्या आप इस समय एक अस्पताल में है? *Are you in a hospital now?*		
2- क्या इस कमरे में पंखा चल रहा है? *Is the fan on in this room?*	_____	_____
3-क्या सायकिल रेलगाड़ी से तेज़ चलती है? *Does the bicycle go faster than the train?*	_____	_____
4-क्या मंगलवार सोमवार से पहले आता है? *Does Tuesday come before Monday?*	_____	_____
5-क्या दो किलो चार किलो से ज़्यादा होते हैं? *Are two kilos more than four kilos?*	_____	_____
6-क्या घोड़ा हाथी से बड़ा होता है? *Is a horse bigger than an elephant?*	_____	_____
7-क्या पत्थर पानी में डूब जाता है? *Will a stone sink in water?*	_____	_____

8- क्या स्वेटर गर्मियों में पहनते हैं?
Do we wear sweaters in the summer? _____ _____

9- क्या आकाश नीला होता है?
Is the sky blue? _____ _____

10-क्या ताला लगाने से पहले दरवाज़ा बन्द करते हैं?
Do we close the door before locking it? _____ _____

Maximum score 20 PT's Score

C. Syntactic Decoding

The purpose of this subtest is to assess the patient's ability to comprehend some complex syntactic structures that are verbally presented in short paragraphs. Later, the patient is required to answer questions that depend on the processing of those sentential structures in paragraphs.

One repetition of the instruction and the stimulus item is allowed.

Intruction : मैं आपको कुछ छोटी–छोटी कहानियाँ सुनाऊँगा। उनको आप ध्यान से सुनिए क्योंकि हर कहानी के बाद में आपसे कुछ सवाल पूछूँगा।
"First, I will read you a short story,
and then I will ask you a few questions"?

Scoring : Each correct response is given the points listed after each of the questions.

1. Passive construction

एक बार एक साँप और नेवले में ज़ोर की लड़ाई हुई। लड़ाई में साँप बहुत ही बहादुरी से लड़ा फिर भी वह नेवले के हाथों मारा गया।

Questions:

लड़ाई में बहादुरी से कौन लड़ा? साँ या नेवला?

लड़ाई में कौन मारा गया? साँप या नेवला

1. Once a snake and a mongoose had a fierce fight. The snake fought bravely but was still killed by the mongoose.

2. Which fought bravely in the fight, the snake or the mongoose?
which died in the fight, the snake or the mongoose?

2. Comparative Construction
सीता और कमला दो बहनेथीं। सीता पढ़ने में कमला से तेज थी लेकिन देखने में कमला सीता से सुन्दर थी।

Questions:

पढ़ने में कौन तेज़ थी सीता या कमला? 5

देखने में कौन सुन्दर थी सीता या कमला? 5

Sita and kamala were two sisters. Sita was a better student than kamala, but kamala was better looking.

1. Who was better in studies, Sita or Kamala?
2. Who was better looking, Sita or Kamala?

5. Temporal and Comparative Construction

आप दिल्ली से आगरा रेल या बस किसी से भी जा सकते हैं। रेल दिल्ली से सुबह सात बजे चलकर दिन में बारह बजे आगरा पहुँचती है। जबकि बस दिल्ली से सुबह आठ बजे चलकर ग्यारह बजे ही आगरा पहुँच जाती है।

Questions:
दिल्ली से पहले क्या चलती है? रेल या बस? 5

आगरा पहले क्या पहुँचती है? रेल या बस? 5

You can take either a bus or a train togo from Delhi to Agra. The train leaves Delhi at seven. A.M. and arrives at Agra at twelve noon the same day. On the other hand, the bus departs Delhi at eight in the morning and reaches Agra at eleven A.M. the same day.

1. Which departs earlier from Deli, the train or the bus?
2. Which reaches Agra earlier, the train or the bus?

Maximum Score 30 PT'S Score

3. Verbal Expression

A. Object Naming

The purpose of this subtest is to assess the patient's ability to name on confrontation. The stimuli to be named are pictured objects, actions, colours and shapes in, test CARDS 2,3,4 and 5. The patient names stimuli in the order they are listed below. The clinician guides the patient by pointing to each stimulus.

If no response appears to be forthcoming, the clinician may provide appropriate semantic (functional description) and phonemic (initial sound) cues. All the distorted responses must be transcribed verbatim so that a note can be made of neologisms (unrecognizable word), verbal paraphasia (inappropriate seleection of related or unrelated word), and phonemic paraphasia (inappropriate sound selection or sequence) in the speech of the patient.

Allow 5 seconds for each stimulus naming.

Intruction: इसे ...क्या कहते हैं? *"What is it?* (for Objects/Shapes)

यहाँ क्या हो रहा है? *"What is happening?"*

यह कौन सा रंग है? *"What colour is it?"* (for Colours)

Scoring: 2 points for each correct/self-corrected response.
1 point for each cued response.

	Correct Response 2 points	Cued response 1 point	Incorrect respone 0 point

Card 2: Objects:

1. घटका/मटका (*pitcher*) _____
2. पंख (*feather*) _____
3. धनुष/कमान (*bow*) _____
4. मकान (*house*) _____
5. पेड़ (*tree*) _____
6. घड़ी (*Watch*) _____
7. पतंग (*fly*) _____
8. साइकिल (*bicycle*) _____

Card 3: Actions:

9. पढ़ना (*read*) _____
10. सोना (*to sleep*) _____
11. उठाना (*to lift*) _____
12. खाना (*to eat*) _____
13. सुलाना (*to make sleep*) _____
14. गिरना (*to fall*) _____
15. दौड़ना (*to run*) _____
16. काटना (*to cut*) _____

Card 4: Colors:

17. हरा (*green*) _____

18. नीला (*blue*) _____

19. लाल (*red*) _____

20. काला (*black*) _____

Card 5: Shapes:

21. गोलदायरा (*circle*) _____

22. तिकोन (*triangle*) _____

23. चौखानाँचार कोनों वाला (*quadrangle*)_____

Maximum Score 46 PT Score

B. Responsive Naming

The purpose of this test is to assess the patient's ability to relate orally presented functional descriptions with the retrieval of corresponding lexical items.
One repetition of the instruction as well as the stimulus sentence is permitted. Allow 5 seconds for a response.

Instruction:
सुनिये और बताइये कि मैं किस शब्द के बारे में बोल रहा हूँ?

"Provide word corresponding to the following questions."

Scoring: 2 for each correct response

	Correct	Incorrect
1. सब्ज़ी किस से काटते हैं? *Whatdo we cut vegetables with?*		
2. एक दर्जन में कितनी चीजें होती हैं? *How many things are in a dozen?*	_____	_____
3. बीमार होन पर कहाँ जाते हैं? *Where do we go when we are sick?*	_____	_____
4. गरम कपड़े कब पहनेजाते हैं? *When do we wear warm clothes?*	_____	_____

कोयला किस रंग का होता है?
What color is coal?

Maximum Score 10 PT's Score

C. Word Fluency

The purpose of this test is to determine the intactness of the lexical stock in the patient. The task requires the patient to name as many objects from one semantic category as he can in a minute (normals can recall up to 15 or so).
One repetition of the instruction is allowed.

Instruction:
आप एक मिनट में जितनी भी सब्जियों के नाम याद कर सकते हैं उन्हें बताइये।

"Name as many vegetables as you can think of in one minute".

Scoring : 1 points for each name recalled with an upper limit to 10 names. In case of duplication, score an item only once. No credit is given for fruits.

Maximum Score 10 PT's Score

D. Automatized Expressions (Days)

The purpose of the following two subtests is to assess the patient's ability to reproduce automatic verbal expressions.

Ask the patient to recite each of the following series. If necessary, the patient can be assisted with the first sound. Make a note of all paraphastic (phonemic and verbal) errors.

Instruction: हफ्ते में दिनों के नाम बताइये।
"Name the days in a week."

Scoring 2 for each correct and properly sequenced response. Accept bothHindi and English names. 1 point for each correct response without a sequence.

Maximum Score 14 PT Score

E. Sentence Formation (This subtest is not required of illiterate subjects; however, the clinician may attempt the task by reading stimuli words to the patient).

The purpose of this subtest is to determine the patient's ability to formulate proper sentences, use grammatical structures, and incorporate grammatical markers, if proper lexical items are provided.

Have the patient first read eachof theword strings separatelyon CARD 6 (where words are listed in an order that needs to be changed for constructing an acceptable sentence). The patient constructs appropriate sentences using semantic and syntactic constraints in any tense. The clinician can assist the patient by giving an example in the beginning.

Instruction:

इन शब्दों को पढ़िये और फिर इनसे वाक्य बनाइये।

"Construct sentences using these words".

Scoring: For a sentence is completed within 20 seconds:
1 for properly ordered words (noun and verb)
2 for the proper conjugation of the verb
2 for the correctly used auxiliary in the sentence.

The maximum possible score for each construction is written after eachof the sentences.

उड़ना	चिड़िया		
to fly	*bird*		
सोना	लड़का		
to sleep	*boy*		
खाना	केला	लड़की	केला
to eat	*banana*	*boy*	
चलाना	कार	आदमी	
to drive	*car*	*man*	

Maximum Score 20 PT's Score

5. Repetition

The purpose of this subtest is to assess is to assess the patient's ability to reproduce orally presented stimuli differing in length and complexity. Record the patient's repetition verbatim and examine it for paraphasic (literal and verbal) errors and neologisms.

Stimuli and the instruction can be repeated once.

Instruction:
मैं जो भी कहूँ इसे आप मेरे बाद दाहराइए (मेरे पीछे बोलिए)/ रिपीट कीजिए।

"Repeat the following phrases after me."

Scoring: 2 points for each recognizable repeated word. The maximum possible score is written at the end of each of the stimulus sentence. Distortions are scored correctly, but paraphasic errors receive no credit.

1. सरकार
government

2.दस हज़ार
ten thousand

3. दुश्मन को हारना पड़ा
The enemy was d efeated.

4. वे कभी वापिस नहीं आये।
The never came back.

5.शादी की तैयारियाँ शुरू हो गयी।
The preparations for the wedding had begun.

6. दहेज लेना देना एक गुनाह है।
Untouchabilityis the crme against mankind.

7.भाखड़ा बाध आज़ादी के बाद बनाया गया पहला बांध है।
Bhakara dam was the first dam to be made after the independence.

8.लड़ाई में बरबादी देखकर अशोक का दिल पिघल गया और उसने अहिंसा का व्रत ले लिया।
Ashoke was moved by seeing the destruction, in the war and thereafter, he pledged to practice non-violence.

Maximum Score 100 PT Score

6. Reading (Not required of patients who cannot read and write).

A. Letter Recognition

The goal of this test is to assess the patient's ability to recognize and read letters listed on CARD 7.

Instruction: इन अक्षरों को पढ़िए।

"Read these letters".

Scoring: 2 for each correctly read letter
Recognizable distortion are scored corectly.

थ	TH
छ	D
भ	BH
न	N
घ	GH

Maximum Score 10 PT's Score

B. Word (Phonetic) Matching

The goal of this test is to assess the patient's perceptual ability to match identical written words. The patient is first shown the written word on CARD 7 and 8, and is asked to locate the corrsponding word from a group of four words.

Instruction: bl 'kCn dks /;ku ls nsf[k;s fQj crkb, og bl dknZ esa dgka fy[kk gSA

"First see this word, then locate it on this card.

Scoring: 2 for each correct response.

1. घर

Home

पर
नर
कर
घर

2. राजा king	माला जाना राजा आना
3. कमल lotus	चमेली कीमत कमर कमल
4. लड़का boy	ककड़ी लकड़ी लड़की लड़का
5. किताब book	कागज पेपर किताब हिसाब

Maximum Score 10 PT's Score

C. Written Word-Picture Matching

The goal of this test is to examine the patient's ability to match the picture form with its written form. Use test CARD 2 and 9. First, present CARD 8 and show eachof the words individually. Later, present the card that has the corresponding pictured stimulus.

Instruction: इन शब्दों को पढ़िये और इनकी तस्वीर इस कार्ड में दिखाइए।
"Point to the picture of this word on this card".

Scoring: 2 for each correct response.
0 for each incorrect response.

	Correct Response 2	Incorrect response 0
1- घड़ा/मटका *picture*		
2- धनुष/कमान *bow*	_____	_____
3- पेड़ *Tree*	_____	_____
4-घड़ी *watch*	_____	_____
5- मकान *house*	_____	_____

Maximum Score 10 PT Score

D. Spoken –written word matching

The purpose of thissubtest is to assess the patient's ability to choose the written form of a stimulus that isorally presented by the examiner. Use CAD 10.

Instruction: मैं जो शब्द कहूँ उसे यहाँ दिखाइए।
"Point to the written form of the word I say".

Scoring: 2 for each correct response

	Correct Response 2	Incorrect response 0
1. खाना to eat	_____	_____
2. गोलदायरा circle		

3. चौखाना
square _____ _____

4. सफेद
white _____ _____

5. घड़ी
watch _____ _____

Maximum Score 10 PT's Score

E. Command Comprehension

The purpose of this task is to assess the patient's ability to comprehend written commands listed on CARD 11 and then to associate it with actual skilled movements.

Instruction: जैसा यहाँ लिखा है उसे कर के दिखाइए।

Scoring: Points for each correct response are specified at the end of each stimulus.

1. नमस्ते कीजिए (5)
Assume the positive for greeting

2. मुट्ठी बनाइए (5)
Make fists

3. दोनों आँखें (5) बन्द कीजिए (5)
Close both eyes

4. पहले ऊपर देखिए (5), फिर नीचे देखिए (5)
First look up and then down

Minimum Score 30 PT's Score

F. Sentence Comprehension
This subtest assesses the patient's comprehension of written sentences with graduated complexity. The patient is first required to read an incomplete sentence or a paragraph and then supply the missing items. Use CARD 12 and 13.

Instruction: इन शब्दों को पढ़िये फिर बताइये कि इन में से कौन सा शब्द इन वाक्यों में ठीक लगता है।
"Read these setences and complete them."

Scoring: 5 for each correct response on sentences.

1. कुत्ता..... है।
The dog..... (s)

रेंकता
बोलता
भौंकता
गाता

2. ..... की शादी हुई।
..... *was wedded.*

ककड़ी
लड़की
घड़ी
बिल्ली

3. शेर तभी शिकार करता है जब वह ..... हो
The lion ..... only when it is hungry.

दुखी
सुखी
भूखा
बीमार

4. बारिश के बाद ज़मीन ..... हो जाती है।
The ground gets ..... after it has rained.

सुखी
गरम
गोली
बजर

5. राम पढ़ाता है इसलिए वह ..... है।
Ram teaches and therefore he is a .....

अध्यापक
चिकित्सक
मालिक
छात्र

6. पहले स्टील बहुत महँगा था क्योंकि इसे विदेशों से मंगाया जाता था। अब स्टील देश में ही बनाया जाता है। इसलिए अब इसकी ..... काफ़ी कम हो गयी है।

Previously, the stainless steel was very costly because it was imported. Enolugh stainless steel is now produced domestically so that the ..... of the steel has lowered.

जरूरत
खुपत
मांग
कीमत

Maximum Score 30 Patient's Score

7. Writing (Not required of those who did not learn to read and write)

A. Writing on Request

The purpose of this test is to determine if the patient can write automatized information on request.

Instruction: अपना नाम और पता लिखिए।
"Please write your name and address".

Scoring : 10 for a correct and complete response.
Take ½ point off for eachspelling or paraphastic error.
Take 1 point off for each deleted word.
Recognizable mechanical deviations receive full credit.
If the patient fails to write, the clinician should write the name and address and ask the patient to copy it. Score 2 points if the patient can successfully copy.

Maximum Score 10 PT's Score

B. Serial writing

The goal is to determine if the patient can write the numbers serially, an automatized task.

Instruction: 11 से 20 तक गिनती लिखिए।
"Write the numbers from 11 to 20".

Scoring: 2 for each sequentially correctnumber only. (Allow numbers in both Roman and Devanagri scripts).

Maximum Score 20 PT's Score

C. Writing to Dictation

The purpose of this test is to assess the patient's ability to transcode auditorily presented information into corresponding graphic forms.

Instruction: मैं जो कहूँ उसे लिखिए।
"Write what I Say'.

Scoring: 2 for each correct response

Letters: क, च, ठ, ल, म

Words: जाना, बालक, मकान, किताब, दरवाजा

Maximum Score 20 PT's Score

D. Visual Graphic Naming

The purpose is to assess the patient's ability to write the names of objects pictured on CARD 2. The patient writes in the order the objects are pointed to by the clinician.

Instruction: मैं जो तस्वीर दिखांऊ उसका नाम यहाँ लिखिए।
"Write the names of the pointed objects".
Scoring 2 for each correct response

1. घड़ा/मटका
pitcher

2. पंख
feather

3. धनुष/कमान
bow

4. पेड़
tree

5. पतंग
kite

Maximum Score 10 PT's Score-

E. Written formulation

The goal is to assess the patient's ability to graphically describe a picture. Present Kalidas' picture (CARD1) and instruct the patient to write what he/she sees on it.

Instruction: इस तस्वीर में आप जो भी देख रहे हैं उसके बारे में यहाँ लिखिए।
"Describe what you see in this picture".

Scoring:
40 – fully complete (syntactically and semantically) description
30- some relevant writing but semantically incomplete and ambiguous
20 – some relevant writing but syntactically wrong
10 – some relevant writing but semantically and syntactically incomplete
5 – only if some isolated words are written
0 – no attempt

Maximum Score 40s PT's Score

8. Praxic Movements

Apraxia refers to the breakdown in the ability to carry out purposeful skilled movements voluntarily while the patient retains adequate motor strength for movement and intact auditory comprehension for commands.

A. Bucco-Facial and Upper Limb Apraxia
(Intransitive movements)

The purpose of this test is to assess the patient's ability to carry on intransitive skilled movements on request using bucco-facial structures and upper limbs. If no response is forthcoming, the clinician may ask the patient to imitate.

Instruction: मैं जो कहूँ उसे कर के दिखाइए।
"Please do what I ask you to do".

Scoring: 2 for each correctly pretended response.
1 for an approximate or imitated performance.

An approximated/distorted performance should be accepted as being correect for patients with hemiplegia and involuntary motor movements. These patients may also be given needed physical assistance.

	Pretended	Imitated
1. जय हिन्द (सलाम) कीजिए। *salute*	_____	
2. मुंह से रोकने का इशारा कीजिए। *blow a candle*	_____	
3. हाथ से रोकने का इशारा कीजिए। *sign for stopping*	_____	
4. दो बार सूंघियें। *sniff twice*	_____	
5. अपना गला साफ़ कीजिए। *clear your throat*	_____	

Maximum Score 10 PT's Score

B. Functional/Instrumental Apraxia
(Transitive Movements)

The purpose of this test is to assess the patient's ability to gesturally demonstrate the useof an object abstractly. If the patient does not respond, ask him to imitate.

Instruction: मैं जो कहूँ उसे करके दिखाइए।
"Please do what I ask you to do".

Scoring : 2 for each correct response
1 for an approximate or imitated performance

An approximated/distorted performance should be accepted as being correct for patients with hemiplegia and involuntary movements such as tremors. These patients with may also be given needed physical assistance.

Pretended Imitated

1. दिखाइये जैसे कि आप ताला खोल रहे हो।
pretend unlocking _____

2. दिखाइए जैसे कि आप कील ठोक रहे हो।
pretend hammering a nail _____

3. दिखाइए जैसे कि आप गेंद पकड़ (कैच कर) रहे हो।
pretend catching a ball _____

4. दिखाइए कि आप कप से चाय पी रहे हैं।
pretend drinking tea with a cup _____

5. दिखाइए जैसे कि आप फोन पर बात कर रहे हों।
pretend talking on the telephone _____

Maximum Score 10 PT's Score

C. Conceptual (Use Real Objects)

The purpose of this test is to assess the patient's abilityto use real objects in an orderly manner. The patient is given a set of real objects and is required to demonstrate how the objects are properly used. In the ideational apraxia, it is the conceptual knowledge of the object and its manipulation that is impaired. If the patient does not respond, see if he can imitate the clinician.

Instruction: मैं जैसे कहूँ उसे इन चीजों के साथ करके दिखाइए।
"Do what Iask you to do using these objects."

Scoring 4 for each correctly pretended response.
2 for an approximate or imitated response.

An approximated/distorted performance should be accepted as being correct for patients withhemiplegiaand withtremor. Patients with hemiplegia and involuntary movements ayalso be given needed physical assistance.

	Pretended	Imitated
1. (provide a capped pen and a sheet of paper). पेन खोल कर इस कागज परदस्तखत कीजिए। *Open the pen and sign on this sheet of paper*	_____	
2. (provide an envelopeand a sheet of paper). इस कागज़ को मोड़कर इस लिफाफे में रखिए और लिफाफा बंद कीजिए *Fold the sheet, put it in the envelope and then close it.*	_____	
3. (provide a pencil, sharpener and a sheet of paper). पहले पेंसिल को छील करइसकागज पर दस्तखत कीजिए फिर पेंसिल की अपनीजेब में रखिए। *After shapening the pencil sign on this sheet, then put the pencil in your pocket.*		

4. (provide a watch).
इस घड़ी में चाभी भरिए फिर चार बजाके दिखाइए।
wind this watch and set it at four o'clock _____

5. (Provide a string).
इस रस्सी में एक गाँठ लगाकर फिर उसे खालिए।
Put a know and then untie the string _____

Maximum Score 20 PT's Score

9. Visuospatial and Quantitative Tasks

A. Drawing

The purpose of thistest is to assess the patient's visuospatial skills and the ability to draw objects. The patient is asked to draw the following figures on request. Provide a separate sheet of paper.

If the patient does not respond or appears to be confused, allow the patient to look at shapes on test CARD5 and the figures of pitcherand watchon CARD 2 for 20seconds; however, the pictures should be removed before the patient begins to draw.

Instruction: इस कागज पर..... खींचिए।
"Draw..... on this sheet.

1. घड़ा/मटका
pitcher

Scoring: 6 for a complete and circled pitcher
4 for a rough approximation of the pitcher
2 for a complete pitcher only after looking at the figure

2. चौखाना (चार कोनों वाला)
square

Scoring: 6 for a closed square
4 for theunconnected lines
2 for the closed square only after looking at the figure

3. तिकोन
triangle

Scoring: 6 for a completely closed triangle
4 for unconnected lines
2 for closed triangle only after looking at the figure

4. मुँह
face

Scoring : 6 for a complete face with all parts
4 for justan outline without facial parts
2 for a closed outline only after looking at the figure

5. घड़ी
watch/clock (Show the real object or present CARD 2).

Scoring : 6 for a complete figure
5 for a complete figure with partially or fully absent numbers
4 for a complete figure with missing hands
3 for a figure with missing numbers and hands
2 if numbers are out of circle
1 if the figure is unintelligible

Maximum Score 30 PT's Score

B. Left Right Orientation

The purpose of this test is to assess the patient's ability to identify left and right parts on his/her body.
Instruction: मै जो कहूँ उसे छूकर दिखाइए।
"Point to your....."

Scoring : 2 for each correct response

1. बॉया /उल्टा कान
left ear

2. दाया/सीधा हाथ
right hand

3. बॉयीं /उल्टी कोहनी
left elbow

4. दायीं/सीधी आँख
right eye

5. बॉया/उल्टा गाल
left cheek

Maximum Score 10 PTS Score

D. Double Crossed/Uncrossed Body-Part Identification

The purpose is to examine the patient's ability to process complex commands involving crossed and uncrossed body parts and to identifythem on his/her and theclinician's body.
Instruction: मैं जिस चीज़ को कहूँ उसे छू कर दिखाइए।
"Touch the body part you are asked to".

Scoring : 5 for each correct response.
There is no partial credit for any performance.

1. बाये/उल्टे हाथ से अपना दॉया/सीधा कान छूइए।
Touch your right ear with your left hand.

2. दॉयें/सीधे हाथसे अपनी बॉयीं/उल्टी ऑख छूइए।
Touch your left eye with your right hand.

3. बॉयीं/उल्टी हाथ से अपना दॉयें/सीधे कंधा छूइए।
Touch your left shoulder withyour left hand.

4. दॉयें/सीधे हाथसे अपनी दाया /सीधा कान छूइए।
Touch your right ear with your right hand.

5. बॉयें/सीधे हाथ से मेरा बॉया/सीधा कान छूइए।
Touch my left ear with your left hand.

6. अपने दॉयें/सीधे हाथ से मेरा दाया/सीधा कंधा छूइए।
Touch myright shoulder with your right hand.

Maximum Score 30 PT's Score

E. Calculation
This subtest is designed to assess the patient's ability to perform simple and basic calculations. If the patient can not read these Arabic numbers, transcribe them into Devanagari numbers. If the patient is illiterate and is unable to read the numbers, the numbers and the required functions may be presented orally. There is a separate instruction for each different calculation.

Instruction: इन नम्बरों को जोड़िये और सही उत्तर दिखाइए।
इन नम्बरों को घटाइये और सही उत्तर दिखाइए।
इन नम्बरों को गुणा कीजिए और सही उत्तर दिखाइए।
इन नम्बरों का भाग कीजिए और सही उत्तर दिखाइए।
"Add, subtract, multiply and divide these numbers and point to the correct answer".

Scoring 5 for each correct response.

Addition:		Example 2+2=		4, 5,6,7
2	6	4	8	
+7	5	+3	4	
	9		9	
	3		7	

Subtraction:		Example 7-3=		3, 4, 7, 9
9	5	5	6	
- 5	3	- 2	3	
	9		8	
	4		5	

Division :

9	5
3	3
	6
	8

Example 4/4= 3, 1, 5, 2

30	15
5	10
	6
	8

Multiplication:

4	6
x 2	4
	2
	8

Example 3 x 3 = 9, 7, 3, 5

3	10
x 6	18
	12
	09

Maximum Score 50

PT's Score

Graphic Summary of Scores

Auditory Comprehension	Verbal Expression	Verbal Expression	Apraxia	Reading	Writing VI	Con Spa.	Tasks
100							100
90							90
80							80
70							70
60							60
50							50
40							40
30							30
20							20
10							10
0							0
Auditory Comprehension	Verbal Expression	Verbal Expression	Apraxia	Reading	Writing VI	Con Spa.	Tasks

Note: A. Plot the scores on the dots.

A. Retest scores should be plotted in different colored ink.

First testing Black: Second testing: Red.