Right Hemisphere Language Battery in Hindi

Punam Kumari[1,*], Suman Kumar[2] and Rajnish Ranjan[3]

[1]*Hearing Plus, A Brand Owned by Bengal Speech & Hearing Private Limited, 57/17, Bara Bazar Marg, Old Rajendra Nagar, New Delhi-110005, India*

[2]*Rehabilitation Council of India, B-22, Qutab Institutional Area, New Delhi, 110 016, India*

[3]*Sunderpur, Bahachowki, Munger, Bihar, 811202, India*

Abstract: Communicative deficits are identified by the Speech-Language Pathologists (SLPs) which are otherwise attributed to a loss of memory, attention, or visual-perceptual skills. Tools to measure right hemisphere functions have been developed in only two Indian languages (Kannada and Malayalam), but no test has been developed in Hindi. Hundred participants were considered for the study. They were divided into three groups- eighty normal participants (Group-I) and ten Hindi speaking diagnosed right hemisphere vascular damaged participants (Group- II) and ten Hindi speaking diagnosed left hemisphere vascular damaged participants (Group-III). There is no significant difference existed between the performance of the participants between Right Hemisphere Language Battery (RHLB) and Right Hemisphere Language Battery in Hindi (RHLB-H) across all the subtests at $\alpha = 0.05$ level of significance. A significant difference exists between the obtained mean scores among the normal control participants and Right Hemisphere Disorder (RHD) participants at $\alpha = 0.05$ level significance. ANOVA test results showed that RHD participants had a significantly higher discourse error rating than either Left Hemisphere Disorder (LHD) or controls. Furthermore, the Tukey's Honest Significant Difference (HSD) Post-Hoc test reveals that there is a decrease in the obtained mean scores from Normal Control participants to the LHD and RHD groups in order. It can thus be concluded that there is a significant difference in the mean scores across all the three groups.

Keywords: Language, Right Hemisphere Disorder, Left Hemisphere Disorder, Right Hemisphere Language Battery, Right Hemisphere Language Battery in Hindi.

INTRODUCTION

Language is defined as an accepted structured symbolic system for interpersonal communication composed of sounds arranged in ordered sequence to form words, with rules for combining these words into sequences or strings that expresses thoughts, intentions, experiences and feelings [1].

Language Processing and the Two Hemispheres of the Brain

The two cerebral hemispheres of the brain share complementary specialization [2]. Complementary specialization is seen mainly as language processing by the left hemisphere and visuospatial processing by the right hemisphere [3]. The evidence that the left hemisphere damage (LHD) often causes aphasia and right hemisphere damage (RHD) often causes visuospatial deficits also supports this complementary specialization. The left hemisphere (LH) functions by focal organization and processes information analytically while the right hemisphere (RH) functions by more diffuse processes and processes information holistically [4,5].

*Address correspondence to this author at the Hearing Plus, A Brand Owned by Bengal Speech & Hearing Private Limited, 57/17, Bara Bazar Marg, Old Rajendra Nagar, New Delhi-110005, India; Tel: 9643779427;
E-mail: be.ponam@gmail.com

Language Disorder

A language disorder is an impairment in comprehension and/or use of a spoken, written, and/or other communication symbol system (e.g., American Sign Language). The disorder may involve the form of language (phonology, morphology, syntax), the content of language (semantics), and/or the function of language in communication (pragmatics) in any combination [6].

Right Hemisphere Brain Damage (RHBD)

The functions of the right cerebral hemisphere are complex and diverse and can be regarded as non-dominant or minor only with regard to the linguistic abilities of the left hemisphere. Spatial and affective functions dominate the activities of right hemisphere. Damage to the right cerebral hemisphere caused by stroke, TBI, surgery, infection/ illness and tumor, gives rise to complex neuropsychiatric, neurobehavioral deficits, linguistic and extra linguistic deficits [7,8].

RHD results in a number of impairments like visual spatial neglect and other attention deficits, difficulties with memory and components of executive function such as problem solving, reasoning, organization, planning, and self awareness [9-12].

E-ISSN: 2311-1917/16

Signs and Symptoms of RHBD

Individuals with RHBD may exhibit a wide range of communication impairments that can negatively impact functional performance in social and vocational settings [13-15]. The exchange of communicative intent of the individuals with RHD is affected by the communication deficits through nonverbal and verbal means. The non verbal means of conveying intent are facial expression, body language, and prosody. The verbal means of conveying intent are words, sentences, and discourse. The functional use of language in context, which is said as pragmatics, often involves the combined use of verbal and nonverbal mechanisms in a communicative context. The context can include linguistic cues as well as social cues like familiarity with the communication partner and social status of speaker and partner [10,11,16,17].

Conversation is considered as part of both discourse and pragmatics. In individuals with disorders of prosody, termed as aprosodia, speech production may sound “flat” or monotone and the individual may have difficulty interpreting emotion and/or intent conveyed through prosody [18-20]. RHBD may affect emotional prosody more than linguistic prosody but this finding has not been consistently replicated [21-23].

Prosodic comprehension and production deficits may occur either separately or concomitantly while sentence and discourse level deficits like reduced efficiency and reduced effectiveness of communication, often due to problems conveying or comprehending intent can affect both comprehension and production in individuals with RHBD [14,24]. Comprehension deficits include misinterpretation of intended meaning. This can be related to difficulties using contextual cues and generating inferences or links between sentences to comprehend the gist of a story, deficits in comprehension of non-literal language, including interpretation of metaphors, idioms, and sarcasm [10, 25-27]. Production at discourse level can be affected after RHBD [28]. Discourse in RHBD individuals is described as disorganized, tangential, and overpersonalized [14,15,29,30]. RHD is frequently accompanied by other behavioral deficits that negatively interact with this syndrome [10].

Incidence of Right Hemisphere Damage

It has been estimated that between 50% and 78% of RHD individuals may exhibit difficulties in one or more communication components, leading to inadequate social interactions. As the clinical manifestations evolve over time after a brain lesion so there could be the discrepancies reported in the percentage of RHD patients effectively presenting with communication disorders. Thus, the time post-onset at which participants are recruited is a key variable to be taken into consideration. So far, no longitudinal study has been undertaken with RHD adults regarding the progression of communication deficits over time. The sensitivity of assessment tools used to detect communication deficits might also play a role in the inconsistency of the data [31,32].

The Right Hemisphere Language Battery

Language assessment is defined as an organized, goal-directed evaluation of the variety of cognitive, linguistic and pragmatic components of language. Such an evaluation is carried out in order to determine the client’s ability and impairments and the degree to which these can be modified [33]. While the communication deficits concomitant with left cerebral hemisphere damage can be identified and categorized into aphasic disorders, changed patterns of communicative behavior following right hemisphere damage (RHD) are less definitive, often subtle, and may be misdiagnosed as confusion, personality changes, or emotional [34].

Specific formal structured assessment tools are available in various languages. In English four batteries have been published: *Ross Information Processing Assessment* [35], Mini Inventory of Right Brain Injury [36], *Right Hemisphere Language Battery (2nd ed.)* [37], and Rehabilitation *Institute of Chicago Evaluation of Communication problems in right hemisphere dysfunction Revised* [38]. In Indian Languages only two studies have bee done related to the assessment of right hemisphere: “Right Hemisphere Language Battery in Kannada” [39] and “Right Hemisphere Language Battery in Malayalam” [40].

The *Ross Information Processing Assessment* assesses information processing & cognitive-communication functioning in clients with traumatic brain injury. It enables the examiner to quantify cognitive communication deficits, determine severity levels for each skill area, and develop rehabilitation goals and objectives. Mini Inventory of Right Brain Injury examines body image, visual scanning, reading, writing, visuomotor skills and speech intonation. Rehabilitation *Institute of Chicago Evaluation of Communication problems in right hemisphere dysfunction Revised is used t*o screen those sequelae

that are typically found in the right brain-damaged population and are known to be clinically important to the rehabilitative process. The Right Hemisphere Language Battery [37] tests mainly for extralinguistic problems, evaluating comprehension of metaphors and inferred meanings, appreciation of humor, and the production of emphatic stress as well as other communication abilities, such as discourse analysis. None of the tests in Right Hemisphere Language Battery is dependent on memory skills.

LANGUAGE PROCESSING IN THE RIGHT HEMISPHERE

Lexical-Semantic Processing

While visuospatial, attentional and generalized intellectual impairments may mediate to exacerbate the language impairments found in RHD patients, there is evidence that a specific and independent lexical semantic impairment can occur following RHD where the patient has impairments in comprehending the meaning of individual words [41-44]. RHD patients can have lexical-semantic impairments independent of general cognitive deficits [45].

Metaphorical Language

Winner and Gardner [25] showed that RHD patients are impaired in the comprehension of metaphorical expression in a picture choice test, which could not be explained by visuospatial deficits. Myers and Linebaugh [26] examined the ability of RHD patients to comprehend intended meaning by examining their response to idioms e.g. face the music. Results showed that RHD patients are less adept at comprehending figurative speech than normal controls, even when supportive contextual cues are available. Their errors demonstrated a literal interpretation of the material.

Humor

Gardner, Ling, Flamm and Silverman [46] examined RHD patients on the ability to select the funniest cartoon from a set of four. The RHD patients produced qualitatively different response to both normal and LHD groups. It was suggested that both disordered emotional and specific linguistic difficulties contributed to the deficits seen on this task [47]. A further study by Brownell *et al*., [48] confirmed that a language deficit formed the foundation of the difficulty in appreciating humor.

Integration of Linguistic Information

Difficulty with abstract sentences; logical reasoning and a coherent stream of thought are also relevant to RH involvement in high level linguistic processing [49]. In order to evaluate this clinical impression, Wapner *et al*., [50] examined narrative skills in a number of different tasks such as story arrangement and story retelling.

Discourse

Bryan [43,51] has shown that individuals with RHD can present with difficulties in producing contextually bound discourse, where integration of elements and subsequent inferential processing is required. Joanette and Goulet [45] showed that RHD subjects were significantly impaired, in comparison to the normal controls in producing narrative discourse. Hirst *et al*., [52] showed that RHD patients were able to comprehend conventional or direct meanings of speech acts that could be used directly (as a literal question) or indirectly (as a polite request) e.g., Can you pass the sugar? But they had difficulty in recognizing situations seen on video in which the direct meaning did not apply. Molloy *et al*. [53] outlined the deficits in discourse comprehension found in RHD stroke patients.

Prosody and Stress

It is generally accepted that the right hemisphere (RH) is involved in the processing of various aspects of prosody. The evidence for this comes from investigations of prosody after RHD and from dichotic studies with normal subjects [44]. Although many claims have been made with regard to this processing, the role of the RH is not specified [18,54,55].

Emotional Language

There are two main views on the role of the RH in emotional language. One view is that it is responsible for the control of most emotional behavior [56,57]. The other, that the RH is responsible for control of negative emotion and the LH for control of positive emotion. Support for this right-left model comes from clinical reports which suggest that unilateral LHD tends to produce a depressing effect, but RHD produces the opposite elated or euphoric affect sometimes with anosognosia [47,58].

NEED AND AIM OF THE STUDY

Few studies have been undertaken and published in the area of right hemisphere brain damage, and tools

to measure right hemisphere functions have been developed in only two Indian languages (Kannada and Malayalam), but no test has been developed in the official language- Hindi. However, taking into consideration the linguistic distinctiveness between the two languages, namely Hindi and English, the task of transadapting the tests developed in English across the western countries and administering across our population will be difficult. Thus there is a need to develop language specific test materials. The present study is an attempt to fill up such a gap.

It is well stated that the right hemisphere plays an essential role in human behavior and that it intervenes decisively in the regulation of the pragmatic dimension of verbal communication. Communicational impairments in right brain damaged are usually neglected due to the lack of an appropriate classification or to the absence of adequate assessment tools. So, the Speech-Language Pathologists and other educators should better understand the right hemisphere damage and its assessment so that they do not go neglected.

India is a multilingual and multicultural country, but in India, only 5-10% of population can understand English [59]. However, there are very few available standardized tests in Indian languages to assess either of the receptive or expressive language skills in RHD. So, if Indian's have to take the real advantage of any RHD test, it is necessary to make the information available to the Indians in Indian languages. Thus, with an increasing focus in education and speech language pathology, it is the need of the hour to develop a standardized test for assessing RHD individuals in Indian language.

Hindi has a special status since it is the official language of Union of India and eleven state governments, besides being spoken and understood most widely. English is the associate official language [60,61]. Hindi is spoken by forty one percent of the people as their first language and another ten percent people can speak it as their second language [62].

Though English is also prevalent in India, there is significant difference between the two languages typologically. Phonologically, aspiration, retroflexion, nasal vowels and lack of distinctive stress mark in Hindi, marks it as very different from English. Morphologically, the gender and case distinctions and the devices of reduplication and echo-compounding exemplify the major differences between the two languages. Syntactically, the two aspects of word order differences are striking. Firstly, in Hindi the standard word order is Subject- Object- Verb as against Subject-Verb-Object in English. Secondly, in Hindi the preposition comes after the noun or pronoun it qualifies (i.e., it is most correctly called the postposition), while such is not the case with English.

Moreover, Hindi makes certain semantic distinctions which are not made as clearly in English, namely volitionality and affectiveness. These distinctions result in a closer correspondence between semantic and syntactic grammatical roles that nominal constituents have in a sentence, for example, all agentive (-ne marked) subjects are agents, all dative (-ko marked) subjects are experiencers, and so on [61].

Aim

To develop a test battery in Hindi for the assessment of the Hindi speaking right hemisphere damaged clinical population.

Objectives

1. The first objective was to design a test battery to assess the right hemisphere damaged patients for the presence of language disorders.

2. To assess the how does the performance of RHD patients varies from the performance of normal control subjects.

Hypotheses

1. There will be no significant difference between the test and retest scores of right hemisphere language battery in Hindi (RHLB-H).

2. There will be significant difference between the scores of the RHD, LHD and the Normal control participants and the scores of the RHD participants (Group-I) will be less than the LHD participants (Group- III) and the scores of the LHD participants (Group- III) will be less than the scores of normal participants (Group- I) on each of the subtests of RHLB-H.

METHODOLOGY

In the present study an attempt has been made to design a test battery for the Hindi-speaking right hemisphere damaged population. The test was modeled on the Right hemisphere language Battery (RHLB) by Bryan [37]. So the subtests in the

formulated test, that is, Right Hemisphere Language Battery in Hindi (RHLB-H) is the same as the RHLB [37].

Participants

A total of hundred participants were considered for the study. They were divided into three groups- eighty normal participants (Group-I), ten Hindi speaking diagnosed right hemisphere vascular damaged participants (Group- II) and ten Hindi speaking diagnosed left hemisphere vascular damaged participants (Group-III). Age range the participants in all the three Groups was (20-60) years.

Group I: Normal Right Handed bi/Multilingual Adults with Hindi as a Native Language

This group consisted of eighty normal adults (forty male and forty female), aged (20-60) years. They were bilinguals (Hindi-English) or multilingual whose mother tongue was Hindi equally proficient in both spoken and written forms of the two languages. None of them had the history of any neurological or psychiatric illness.

Group II: Right Hemisphere Vascular Damaged Participants

This group consisted of ten native Hindi speaking diagnosed right hemisphere vascular damaged participants. Participants were clinically diagnosed through MRI studies as having right hemisphere damage by a neurologist. Participants were not found to have aphasia and/ or dementia diagnosed on Western Aphasia Battery (WAB) and Mini Mental State Examination (MMSE) respectively.

Group III: Left Hemisphere Vascular Damaged Participants

This group consisted of ten Hindi speaking left hemisphere vascular damaged participants diagnosed as having aphasia on WAB with an aphasia quotient of less than 93.5. They were included in the study in order to test the sensitivity of the RHLB-H to LHD participants compared to RHD participants.

Inclusion Criteria

1. All right handed participants.
2. Age between 20- 60 years.
3. No previous history of any neurological disorder.
4. No history of hearing loss.
5. At least first 10 years of formal education in Hindi language.
6. Participants included in Group II did not have aphasia and/ or dementia diagnosed on Western Aphasia Battery (WAB) and Mini Mental State Examination (MMSE) respectively.
7. Vascular damaged participants who were diagnosed as having aphasia on WAB were included in Group III.

Procedures

The study was accomplished in the following five phases:

Phase I: Development of RHLB in Hindi-RHLB-H.

Phase II: Administration of RHLB-H on Group-I.

Phase III: Validation of RHLB-H to find the concurrent validity of RHLB-H by administering it on twenty bilingual (Hindi-English) participants of Group-I selected randomly.

Phase IV: Test- retest reliability of RHLB-H checked by re-administering RHLB-H on thirty participants of Group-I selected randomly after two weeks.

Phase V: Administration of the RHLB-H on Group II and Group III (Discriminant Validity).

Phase I: Development of the RHLB in Hindi-RHLB-H

A set of seven sub tests as in RHLB 2nd edition (Bryan, 1995) was designed to assess the right hemisphere language functions. The RHLB-H consisted of seven subtests namely, 1) Metaphor Picture Test, 2) Written Metaphor Test, 3) Comprehension of Inferred Meaning test, 4) Appreciation of Humor test, 5) Lexical Semantic Test, 6) Production of Emphatic Stress test and 7) Discourse Analysis test. The concept and the number of test items remained the same; however, the test items were altered according to the rules of Hindi language and made culturally appropriate to the Hindi speaking population in India.

The developed test material was given to three Speech Language Pathologists (SLPs) and three Linguists for familiarity rating to be rated on a three point rating scale with 0 indicating least appropriate and 2 indicating most appropriate. Items which were

rated more than 80% familiar were included in the final test material.

After the development of stimulus items, appropriate black and white picture cards were created. While designing the pictures, culture of Hindi speaking population in India and the rules governing the Hindi language were taken into account.

1. Metaphor Picture Test

A set of twenty picturable metaphors was rated by three SLPs and three Linguists (well versed in Hindi) as familiar, not so familiar and not familiar at all. Among these, a set of ten metaphors and one practice item, rated as familiar were chosen for the test. Each of these metaphors was incorporated into short contextual sentences. A set of four pictures was drawn for each of the selected eleven metaphorical sentences which represented the possible meaning of the sentence. These depicted-:

a) The correct metaphorical meaning of the metaphor.

b) The literal meaning of the metaphor.

c) Two control pictures which depicted one aspect of the metaphor.

The practice item was done first and any errors were corrected.

Metaphor Picture Test is enclosed in Appendix I.

2. Written Metaphor Test

This test was done to ensure that any of the deficits on the metaphor picture test is not due to the pictorial nature of the task and compared the performance using the written material.

A set of twenty metaphors was rated by three SLPs and three Linguists (well versed in Hindi) as familiar, not so familiar and not familiar at all. Among these, a set of ten metaphors and one practice item, rated as familiar were chosen for the test. Each of these metaphors was incorporated into short contextual sentences and was printed on a card, and was followed by three sentences, which represented the possible meaning of the sentence. These depicted:-

a) The genuine metaphorical meaning.

b) Primitive metaphorical meaning- focused on the incidental aspect of the metaphor without actually appreciating the metaphorical meaning.

c) Metonymic meaning the sentence was rephrased so that two aspects of the metaphor were interpreted literally.

The practice item was done first and any errors were corrected.

Written Metaphor Test is enclosed in Appendix II.

3. Comprehension of Inferred Meaning

This test was done to assess the ability to comprehend aspects of inferential meaning in short paragraphs, taken from class IXth and class Xth standard, Central Board of Secondary Education (CBSE) text books, which described a situation or an event. Three short culturally appropriate paragraphs in Hindi were taken. The test material was suitable for adults and only simple syntactic structures were used. The content of each passage was controlled by giving emotional, conversational, and narrative passages. A practice item was given at the beginning. Four questions were devised for each passage, the answers to which were not directly stated in the paragraphs, but was clearly implied by its content. The practice item was done first and any errors were corrected.

Comprehension of Inferred Meaning is enclosed in Appendix III.

4. Appreciation of Humor

A set of twenty jokes, each with a clear punch line were taken and rated by three SLPs and three Linguists (well versed in Hindi) as very funny, funny and not so funny. Among these, a set of ten jokes rated as very funny and funny was considered as the test material. The content of the jokes chosen was not offensive. All the words used were frequently used words. The jokes were printed on cards in a large font size [14] and a choice of four punch lines was offered. These were-:

a) The actual punch line.

b) A straight forward ending of neutral content.

c) An ending that is a surprise.

d) An ending that is unrelated to the body of the joke.

Appreciation of Humor is enclosed in Appendix IV.

5. Lexical Semantic Test

A series of twenty high frequency target nouns was selected by three SLPs and three Linguists (well

versed in Hindi) from a range of thirty semantic categories and was depicted by line drawings. For each word, line drawings of five associated items were presented. These items were:

a) Two semantic co- ordinates.

b) A functional associate.

c) A phonological control.

d) A visual control.

Lexical Semantic Test is enclosed in Appendix V.

6. Production of Emphatic Stress

A set of eleven culturally appropriate sentences in Hindi was chosen from a set of twenty sentences by three SLPs and three Linguists (well versed in Hindi). Each of the ten sentences and one practice item, had two clauses, joined by the conjunction (and/ but) and each clause was depicted by line drawings. The practice item was done first and any errors were corrected. Production of Emphatic Stress is enclosed in Appendix VI

7. Discourse Analysis

This analysis was aimed to evaluate discourse that is a two way interaction or conversation. The evaluation was based on 11 parameters, as used in the RHLB [37]. The conversation with the participant during the test as well as a picture description on subtest I and VI was audio recorded.

The discourse analysis rating scale is based on the application of a social interaction scale for rating natural conversation to the study of discourse [63]. The parameters for the assessment of discourse were-

1. Supportive routines- those concerned the politeness and affiliation example- greeting, thanks.

2. Humor- presence or absence of specific humor. Example- jokes as well as humorous tone to conversation on appropriate subjects.

3. Questions- including indirect equivalent for gaining information.

4. Assertive routines- those that are concerned with asserting and changing the behavior of others by exerting initiative. Example-making complaints, demands, criticisms, giving advice.

5. Narrative- this skill includes length of utterances as well as level of detail.

6. Variety of topic content and types of interaction.

7. Formality- level of formality between the participants and the nature of the information disclosed.

8. Turn taking-the balance of interaction between the two participants.

9. Meshing- timing of the interaction.

10. Discourse comprehension.

11. Prosodic rating.

Discourse Analysis is enclosed in Appendix VII.

Phase II: Administration of RHLB-H on Group-I

Participant information was taken on a Patient Information form (enclosed in Appendix VIII) at the beginning of the test administration.

1. Metaphor Picture Test

Administration: The stimulus picture card was placed before the participant and the stimulus item was read. The participant was asked to think what it means and then point to the picture which matches the meaning of the sentence. The sentence was repeated and no time limit was imposed. The practice item was completed first and any errors in this were corrected.

Scoring: A score of one was given for the correct choice and zero for choosing any other picture. The maximum score was 10.

2. Written Metaphor Test

Administration: The order of the three sentences was randomized. The practice item was carried out first. The card was placed in front of the patient and the metaphorical sentences were read out with the choice of meanings. The participant was asked to point to the alternative that explained it. One repetition of the sentence was allowed.

Scoring: A score of one was given for the correct choice and zero for either of the other sentences. The maximum score was 10.

3. Comprehension of Inferred Meaning

Administration: Each paragraph was printed on a card. The card was placed in front of the participant

and was read aloud twice. The participant was asked questions and was allowed to refer to the card during the time of the testing.

Scoring: A score of one was given for for each sentence correctly answered and zero for incorrect answer. The maximum score was 12.

4. Appreciation of Humor

Administration: Each card was placed in front of the patient, and the jokes with the alternative endings were read twice. The participant was told that the joke needed finishing and that he/she has to point out to the ending that would make it funny.

Scoring: A score of one was given for selecting the correct punch line and zero for any of other alternatives. The maximum score was 10.

5. Lexical Semantic Test

Administration: For each target item, the six words including the target item were depicted by clear line drawings on a card. The position of the target item was controlled and the remaining items are randomly organized in a columnar array in order to control for unilateral neglect. The visual control was included as pictures of objects similar in appearance and it is necessary to check that errors made on lexical semantic test are not perceptual rather than linguistic.

Scoring: a score of one was given for pointing the correct pictures and zero for pointing the incorrect pictures. The maximum score was twenty.

6. Production of Emphatic Stress

Administration: Both the pictures were placed in front of the participant, the first picture was described using the pre-determined phrase, and was produced using the expected stress pattern on the response form. The next picture was pointed to and the participant was asked to describe it.

Scoring: One point was given for the correct stress placement. The maximum score was 10.

7. Discourse Analysis

Discourse analysis was done by the clinician based on the entire conversation with the participant during test administration.

Scoring: The participants were rated on 11 parameters, namely, supportive routines, humor, questions, assertive routines, narrative skills, variety of topic content and types of interaction, formality, turn taking, meshing, discourse comprehension and prosodic rating, on a 0-4 rating scale with 4 representing discourse skills within the normal range and 0 a severely limited performance. Scores for the complete discourse rating therefore ranged between 0 and 44.

After the development of RHLB-H, it was administered on all the eighty participants of Group I and the scores were calculated in order to establish the normative data of RHLB-H for the age range of 20-60 years.

Phase III: Validation of RHLB-H to find the Concurrent Validity of RHLB-H by Administering it on Twenty Bilingual (Hindi-English) Participants of Group-I Selected Randomly

In order to find the validity of the Right Hemisphere Language Battery in Hindi, the test was administered on twenty participants from Group I. Original version of RHLB and the developed test, RHLB-H, were administered on twenty normal participants aged between 20-60 years from Group I. This study was done to verify the suitability of all test materials and comprehension of instructions. Thus, the concurrent validity of the RHLB and the RHLB-H was established.

Phase IV: Test- Retest Reliability of RHLB-H Checked by Re-Administering RHLB-H on Thirty Participants of Group-I Selected Randomly after Two Weeks

The reliability of the RHLB-H was examined by measuring the test-retest reliability. The test-retest reliability measures were obtained from the thirty participants in Group-I selected randomly. The data obtained from the RHLB-H after administration on Group-I was compared with the data obtained by administering the same test on thirty participants of the same group after two weeks. The test-retest reliability was done to check if there was any significant difference between the test scores and the retest scores.

Phase V: Administration of the RHLB-H on Group II and Group III (Discriminant Validity)

RHLB-H was administered on Group-II and Group-III in order to find the sensitivity of the test in RHD and LHD participants respectively.

Statistical Analysis

The data obtained from the participants of all the three groups were fed into Microsoft office Excel 2007

and the statistical analyses were conducted by using Statistical Package for Social Sciences (SPSS), version 17.0. The statistics applied in this study were:

1. Independent t-test- to find the correlation between the scores of Group-I and Group-II, Group-I and Group-III and Group-II and Group-III.

2. Paired t-test- to find the validity of RHLB-H and test-retest reliability of RHLB-H.

3. Pearson's Correlation coefficient-to find the correlation among the subtests of RHLB-H for the Group-II.

4. Analysis of Variance (ANOVA) and Tukey's HSD Post Hoc test- to compare the obtained scores of Group-I, Group- II and Group-III simultaneously

RESULT AND DISCUSSION

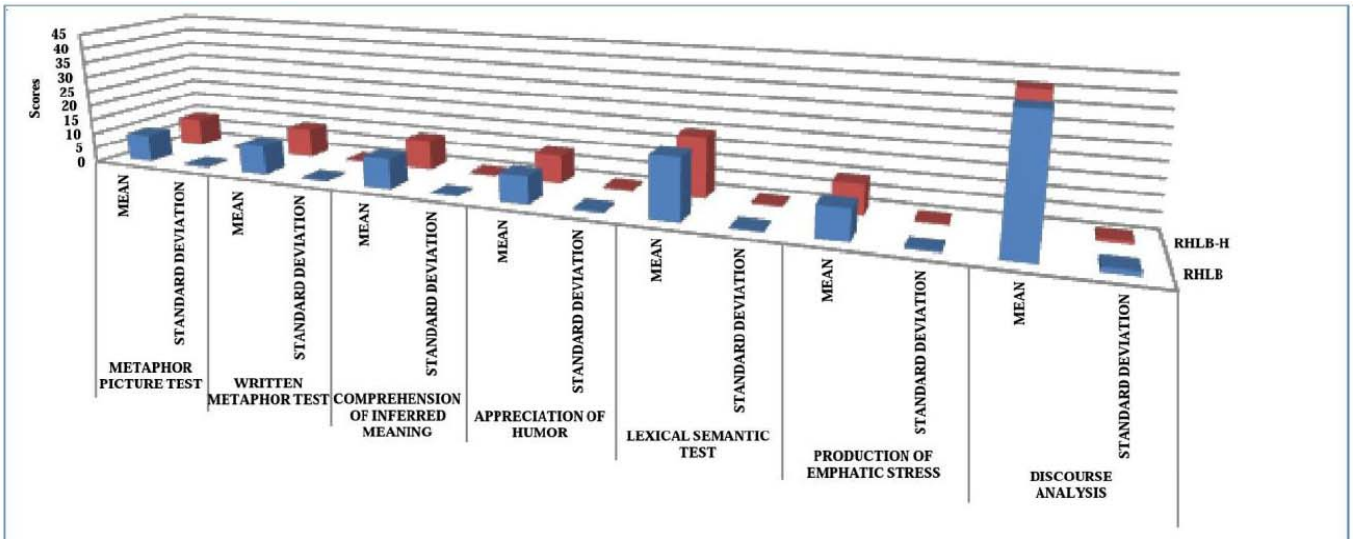
The present study was undertaken to describe the normative data of the developed RHLB-H Test Battery. Normative scores were evaluated for the age range (20-60) years on all the parameters of RHLB-H (e.g., metaphor picture test, written metaphor test, comprehension of inferred meaning, appreciation of humor, lexical semantic test, production of emphatic stress and discourse analysis).

Validation of RHLB-H

Any refined instrument needs to verify the extent to which it measures what it purports to measure. Since there was no standardized test of Right Hemisphere Damage published in Hindi language, the present test battery was developed to fulfill the need. In order to ensure the extent of its measurements, the RHLB-H and the RHLB were administered on twenty normal Hindi-English bi/multilingual participants. The test results from both the test were compared in order to obtain the concurrent validity of RHLB-H. The obtained results are depicted in Figure **1**.

In order to verify that there will be no significant difference between the obtained scores of RHLB and RHLB-H, "paired t-test" and correlation tests were performed. The results obtained are cited in the Table **1**.

It is evident from Table **1**, that no significant difference exists between the performance of the participants between RHLB and RHLB-H across all the subtests at $\alpha = 0.05$ level of significance, since $p > 0.05$ and t value is less than ±2.26 ($-2.26 > t < 2.26$). This is indicative of the fact that there is a high positive correlation between RHLB-H and RHLB. As the results obtained on RHLB-H and the original RHLB when administered on Hindi-English bi/multilingual speakers



	METAPHOR PICTURE TEST		WRITTEN METAPHOR TEST		COMPREHENSION OF INFERRED MEANING		APPRECIATION OF HUMOR		LEXICAL SEMANTIC TEST		PRODUCTION OF EMPHATIC STRESS		DISCOURSE ANALYSIS	
	MEAN	STANDARD DEVIATION	MEAN	STANDARD DEVIATION	MEAN	STANDARD DEVIATION	MEAN	STANDARD DEVIATION	MEAN	STANDARD DEVIATION	MEAN	STANDARD DEVIATION	MEAN	STANDARD DEVIATION
RHLB	9.15	0.37	9.6	0.5	9.9	0.3	9.15	0.67	19.7	0.47	9.75	0.45	41.25	1.41
RHLB-H	9.25	0.45	9.65	0.49	9.9	0.3	9.25	0.56	19.75	0.45	9.8	0.41	41.7	1.08

Figure 1: Comparison of mean and standard deviation of the sub-tests of RHLB [37] and RHLB-H.

Table 1: "Paired T Test" and Correlation between RHLB and RHLB-H

Subtests	t	Df	P	Correlation (r)
Metaphor Picture Test	1.452	19	0.163	0.728
Written Metaphor Test	-0.567	19	0.577	0.685
Comprehension of Inferred Meaning	-1.52	19	0.293	0.514
Appreciation of Humor	1	19	0.33	0.722
Lexical Semantic Test	-1	19	0.33	0.882
Production of Emphatic Stress	-1	19	0.33	0.866
Discourse Analysis	1.689	19	0.107	0.619

are similar thus it asserts the validity of the developed test battery. Also unlike reliability coefficients, there is no established criterion for the strength of the validity coefficient. The validity of a measure may be established even with a correlation coefficient as low as 0.20 or 0.30 [64]. After the concurrent validation of RHLB-H, the test was administered on participants of Group II and Group III.

Normative of the Different Subtests of RHLB-H (Group I)

The developed test (RHLB-H) was administered on Group I consisting of eighty normal participants (40 male and 40 female) in the age range of (20-60) years. The mean scores obtained across the subtests of RHLB-H have been portrayed graphically in the form of histograms in Figure **2**.

There are minimal differences between the total scores and the mean scores across the subtests of RHLB-H.

Testing the Hypothesis

Hypothesis 1: There will be No Significant Difference between the Test and Retest Scores of RHLB-H

To study the test retest reliability of the obtained total scores, the RHLB-H was administered with a time interval of two weeks and the results have been represented graphically in Figure **3**.

The test-retest scores of RHLB-H shows there is no difference between the scores and thus RHLB-H is a reliable tool for further assessment.

Hypothesis 2: There will be significant difference between the scores of the RHD, LHD and the Normal control participants and the scores of the RHD participants (Group-I) will be less than the LHD participants (Group- III) and the scores of the LHD participants (Group- III) will be less than the scores of normal participants (Group- I) on each of the subtests of RHLB-H

The total scores obtained from Group I, II and III have been summarized graphically. The histogram for

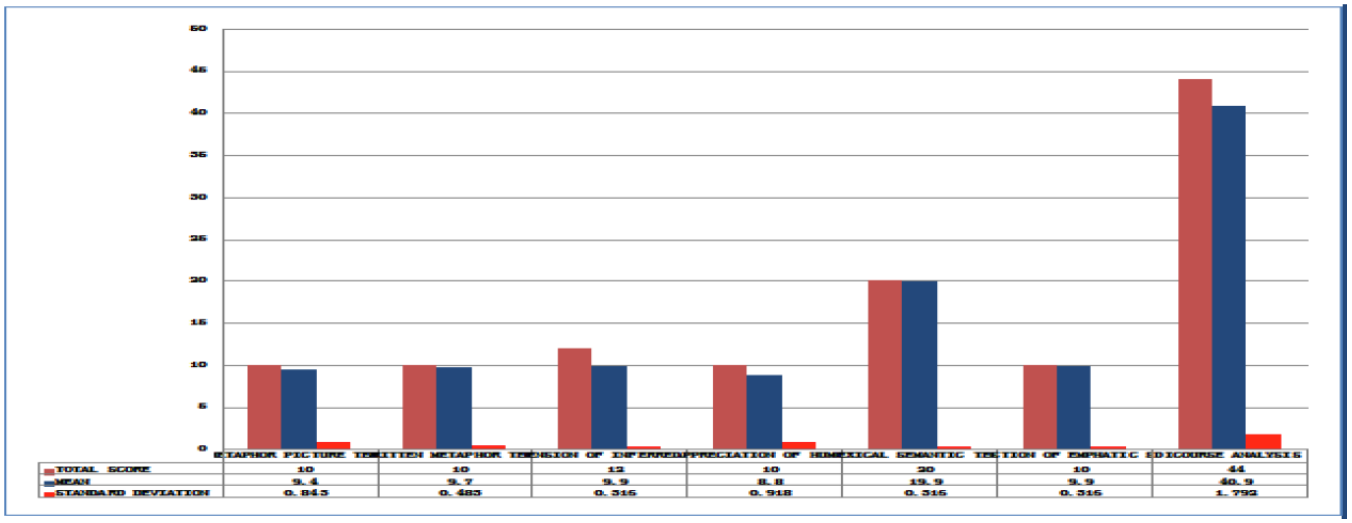


Figure 2: Mean and standard deviation of group I on all the subtests of RHLB-H.

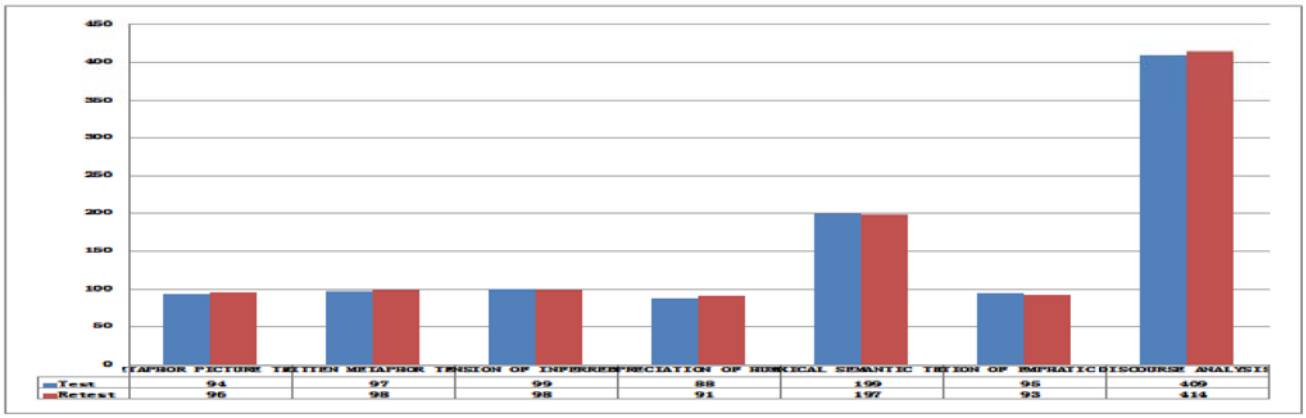


Figure 3: Test retest scores on all the subtests of RHLB-H.

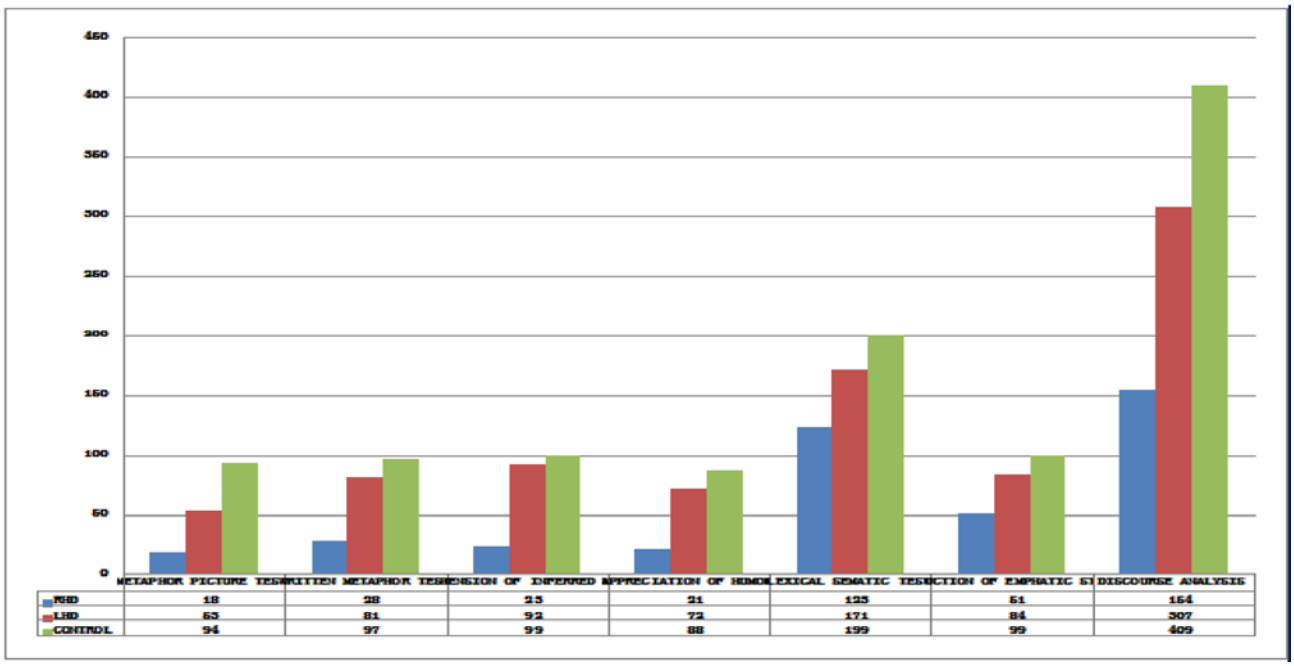


Figure 4: Comparison of the obtained scores of the Control, LHD and RHD participants across the subtests of RHLB-H.

each group has been depicted in Figure **4**. It also shows the variation in the performance of the participants across the three groups.

One way Analysis of Variance (ANOVA) for equality of means was performed to determine the homogeneity of the total score amongst the three groups. In order to determine which groups differ from each other, a Tukey's HSD Post-Hoc test was administered. The test summary has been depicted in Table **2**.

ANOVA test results showed that RHD participants had a significantly higher discourse error rating than either LHD or controls. It is evident from Table **2** that the alternative hypothesis is accepted at $\alpha = 0.05$ level of significance (95% confidence level) across all the three groups, since F obtained > F 0.05 (3.35). Furthermore, the Tukey's HSD Post-Hoc test reveals that there is a decrease in the obtained mean scores from Normal Control participants to the LHD and RHD groups in order. It can thus be concluded that there is a significant difference in the mean scores across all the three groups.

RHD participants made significantly more errors on Metaphor Picture Test by choosing the literal rather than the control items. They also made significantly more errors of inference rather than direct errors on the Comprehension of Inferred Meaning test and significantly more semantic errors than either visual or phonological errors on the Lexical Semantic Test.

In several studies, it has been reported that patients with RHD have more difficulty than patients with LHD

Table 2: Comparison of RHD, LHD and Control Participants on ANOVA and Tukey's HSD Post-Hoc Test

Subtests	TUKEY HSD MULTIPLE COMPARISON TEST			F value
	RHD/LHD	RHD/CONTROL	LHD/CONTROL	RHD/LHD/CONTROL
Metaphor picture test	(***)	(***)	(**)	162.11 (*)
Written metaphor test	(***)	(***)	(**)	189.34 (*)
Comprehension of inferred meaning	(***)	(***)	(**)	256.11 (*)
Appreciation of humor	(***)	(***)	(***)	137.16 (*)
Lexical semantic test	(***)	(***)	(***)	250.87 (*)
Production of emphatic stress	(***)	(***)	(NS)	80.60 (*)
Discourse analysis	(***)	(***)	(***)	319.1 (*)

NS = Not significant.
* = Significant at p = 0.05.
** = Significant at p = 0.01.
*** = Significant at p = 0.001.

and normal controls in interpreting the emotional content depicted in pictures [65-67]. Myers [68] reviewed that the deficits in patients with RHD may be due to a failure to apprehend and analyze information (facial expression) and to derive information from complex visual cues. The reason for this may be that at a behavioral level, emotional processing involves strategies and functions for which the RH is specialized [69]. The right hemisphere is found to be more adept at analyzing the global features, whereas the left hemisphere is biased to analyze the local elements. Although the right hemisphere contribution to lexical processing remains controversial, it is clear that the right hemisphere plays a prominent role in certain paralinguistic tasks [70,71].

While the battery is based on the scores of individual tests rather than to give a total score obtained from all the tests, it is interesting to examine the correlations between the individual tests and the total score obtained by adding together the scores on the individual tests.

It can be seen from Table **3** that there are high correlations between the tests and the total and smaller correlation between the individual tests. This reflects the nature of the problems experienced by RHD individuals, which may be quite specific and differ from one individual to another [37].

CONCLUSION

The present study revealed that there is a smaller difference in the scores of Hindi speaking LHD-Control participants compared to the significant difference in the scores of RHD-Control participants. Hence, it can

Table 3: Pearson Correlation Coefficiens for Individual Tests for the RHD Group

	Metaphor Picture	Written Metaphor	Inferred Meaning	Appreciation of Humor	Lexical Semantic	Stress Production	Discourse Analysis
Metaphor Picture							
Written Metaphor	0.86						
Inferred Meaning	0.84	0.89					
Appreciation of Humor	0.78	0.91	0.84				
Lexical Semantic	0.76	0.89	0.82	0.73			
Stress Production	0.86	0.83	0.94	0.83	0.76		
Discourse Analysis	0.36	0.61	0.53	0.42	0.78	0.33	
Total	0.80	0.86	0.87	0.81	0.77	0.57	0.74

be concluded that the RHLB-H is a sensitive, effective and valid tool for the assessment of Hindi speaking RHD patients in the age range of 20-60 years. Correlation coefficient between the obtained scores of the test and retest trials indicated moderate positive relationship to infer that there is a consistency in performance and the RHLB-H is a reliable tool to be used across various contexts. The test was designed to be clinically useful. In addition, they were planned in such a manner as to avoid performance dependency on memory or visual performance.

Despite the merits of the developed RHLB-H, the test may still have a lower degree of sensitivity to the RHD patients in certain age and education cells due to the relatively small number of participants. A further study on a larger number of native Hindi speakers and Hindi speaking RHD patients over the age of 60 years would be of worth.

REFERENCES

[1] Nicolosi L, Harryman E, Kresheck J. Terminology of communication disorders: Speech-Language-Hearing. 3rd Ed. Baltimore: Williams & Wilkins 1989.

[2] Tueber HL. Why two brains? In Schmitt FO, Warden FG, Eds. The Neurosciences Third Study Program. Cambridge, Massachusetts: MIT Press 1974.

[3] Levy J. Lateral specialization of the human brain: behavioural manifestations and possible evolutionary basis. In Kiger J, Ed. The Biology of Behaviour. Corvallis: Oregon State University Press 1973.

[4] Semmes J. Hemispheric specialization: a possible clue to mechanism. Neuropsychologia 1968; 6: 11-26. http://dx.doi.org/10.1016/0028-3932(68)90035-3

[5] Nebes RD. Direct examination of cognitive functions in the right and left hemispheres. In Kinsbourne M, Ed. Asymmetrical Function of The Brain. London: Cambridge University Press 1978.

[6] American Speech-Language-Hearing Association. Ad Hoc Committee on Service Delivery in the Schools. Rockville, MD: ASHA Reports 1993.

[7] Burns MS, Halper AS, Mogil S. Communication problems in right hemisphere brain damage: diagnostic and treatment approaches. Rehabilitation Institute of Chicago 1985.

[8] Myers PS, Mackisack EL. Right hemisphere syndrome. In Lapointe LL, Ed. Aphasia and Related Neurogenic Language Disorders. New York: Theime 1990.

[9] American Speech-Language-Hearing Association. Treatment efficacy summary: Cognitive-communication disorders resulting from right hemisphere brain damage. Rockville, MD: Author. 2008. Available from http://www.asha.org/uploadedFiles/public/TESCognitiveCommunicationDisordersfromRightHemisphereBrainDamage.pdf.

[10] Myers PS. Right hemisphere damage: Disorders of communication and cognition. San Diego, CA: Singular Publishing Group 1999.

[11] Tompkins CA. Right hemisphere communication disorders: Theory and management. San Diego, CA: Singular Publishing Group 1995.

[12] Tompkins C, Klepousniotou E, Scott G. Treatment of right hemisphere disorders. In Papathanasiou I, Coppens P, Potagas C, Eds. Aphasia and related neurogenic communication disorders. Sudbury, MA: Jones and Bartlett 2013; pp. 345-364.

[13] Lehman MT, Tompkins C. Inferencing in adults with right hemisphere brain damage: An analysis of conflicting results. Aphasiology 2000; 14: 485-499. http://dx.doi.org/10.1080/026870300401261

[14] Myers PS. Toward a definition of RHD syndrome. Aphasiology 2001; 15: 913-918. http://dx.doi.org/10.1080/02687040143000285

[15] Blake ML. Clinical relevance of discourse characteristics after right hemisphere brain damage. American Journal of Speech-Language Pathology 2006; 15: 255-267. http://dx.doi.org/10.1044/1058-0360(2006/024)

[16] Blake ML. Perspectives on treatment for communication deficits associated with right hemisphere brain damage. American Journal of Speech-Language Pathology 2007; 16: 331-342. http://dx.doi.org/10.1044/1058-0360(2007/037)

[17] Ferre P, Ska B, Lajoie C, Bleau A, Joanette Y. Clinical focus on prosodic, discursive and pragmatic treatment for right hemisphere damaged adults: What's right? Rehabilitation Research and Practice 2011; 1-10. http://dx.doi.org/10.1155/2011/131820

[18] Ross E. The aprosodias: Functional-anatomic organization of the affective components of language in the right hemisphere. Archives of Neurology 1981; 38: 561-569. http://dx.doi.org/10.1001/archneur.1981.00510090055006

[19] Baum S, Dwivedi V. Sensitivity to prosodic structure in left- and right-hemisphere-damaged individuals. Brain and Language 2003; 87: 278-289. http://dx.doi.org/10.1016/S0093-934X(03)00109-3

[20] Pell M. Cerebral mechanisms for understanding emotional prosody in speech. Brain and Language 2006; 96: 221-234. http://dx.doi.org/10.1016/j.bandl.2005.04.007

[21] Pell M. Recognition of prosody following unilateral brain lesion: Influence of functional and structural attributes of prosodic contours. Neuropsychologia 1998; 36: 701-715. http://dx.doi.org/10.1016/S0028-3932(98)00008-6

[22] Baum S, Pell M. The neural bases of prosody: Insights from lesion studies and neuroimaging. Aphasiology 1999; 13: 581-608. http://dx.doi.org/10.1080/026870399401957

[23] Sidtis J, Van Lancker Sidtis D. A neurobehavioral approach to dysprosody. Seminars in Speech and Language 2003; 24: 93-106. http://dx.doi.org/10.1055/s-2003-38901

[24] Joanette Y, Ansaldo A. Clinical note: Acquired pragmatic impairments and aphasia. Brain and Language 1999; 68: 529-534. http://dx.doi.org/10.1006/brln.1999.2126

[25] Winner E, Gardner H. The comprehension of metaphor in brain-damaged patients. Brain 1977; 100: 717-729. http://dx.doi.org/10.1093/brain/100.4.717

[26] Kempler D, Van Lancker D, Marchman V, Bates B. Idiom comprehension in children and adults with unilateral brain damage. Developmental Neuropsychology 1999; 15: 327-350.

[27] Myers PS, Linebaugh C. Comprehension of idiomatic expression by right hemisphere-damaged adults. In Brookshire RH, Ed. Clinical Aphasiology Conference Proceedings. Minneapolis, MN: BRK Publishers 1981; pp. 254-261.

[28] Johns C, Tooley K, Traxler M. Discourse impairments following right hemisphere brain damage: A critical review. Language and Linguistics 2008; 2: 1038-1062. http://dx.doi.org/10.1111/j.1749-818x.2008.00094.x

[29] Chantraine Y, Joanette Y, Ska B. Conversational abilities in patients with right hemisphere damage. Journal of Neurolinguistics 1998; 11: 21-32. http://dx.doi.org/10.1016/S0911-6044(98)00003-7

[30] Glosser G. Discourse patterns in neurologically impaired and aged populations. In Brownell HH, Joanette Y, Eds. Narrative discourse in neurologically impaired and normal aging adults. San Diego, CA: Singular 1993; pp. 191-212.

[31] Benton E, Bryan K. Right cerebral hemisphere damage: Incidence of language problems. International Journal of Rehabilitation Research 1996; 19: 47-54. http://dx.doi.org/10.1097/00004356-199603000-00005

[32] Ferre P, Clermont M, Lajoie C, Cote H, Ferreres A, Abusamra V, Joanette Y. Identification of communication patterns of adults with right brain profiles. Journal of Latin-American Neuropsychology 2009; 1: 32-40.

[33] Murray LL, Chapey R. Assessment of language disorders in adults. In Chapey R, Ed. Language intervention strategies in aphasia and related neurogenic communication disorders. Philadelphia, PA: Lippincott, Williams & Wilkins 2001; pp. 55-126.

[34] Blake ML, Duffy JR, Tompkins, CA, Myers PS. Right hemisphere syndrome is in the eye of the beholder. Aphasiology 2003; 17: 423-32. http://dx.doi.org/10.1080/02687030344000120

[35] Ross ED. Modulation of affect and nonverbal communication by the right hemisphere. In Mesulam M-M, Ed. Principles of behavioural neurology. Philadelphia: F. Davis 1985; pp. 239-257.

[36] Pimental PA, Kingsbury NA. Mini Inventory of Right Brain Injury, PRO-ED, Texus: Austin 1989.

[37] Bryan KL. Right hemisphere language battery (2nd ed.). London: Whurr Publishers Ltd 1995.

[38] Halper AS, Cherney AS, Burns MS, Mogil SI. Rehabilitation Institute of Chicago Evalutation of Communication Problems in Right Hemisphere Dysfonction-Revised (RICE-R), Rockville: Aspen 1996.

[39] Sampath ATR. The Right Hemisphere Language Battery in Kannada. Unpublished Master Dissertation. University of Mysore: Mysore 1996.

[40] Raihanath A. The Right Hemisphere Language Battery in Malayalam. Unpublished Master Dissertation. Mangalore University: Mangalore 1998.

[41] Lesser R. Verbal comprehension in aphasia: An English version of three Italian tests. Cortex 1974; 10: 247-263. http://dx.doi.org/10.1016/S0010-9452(74)80017-1

[42] Gainotti G, Caltagirone C, Miceli G. Selective impairment of semantic-lexical discrimination in right brain-damaged patients. In Percmen E, Ed. Cognitive Processing in the Right Hemisphere. London: Academic Press 1983.

[43] Bryan KL. Assessment of language disorders after right hemisphere damage. British Journal of Disorders of Communication 1988; 23: 111-125. http://dx.doi.org/10.3109/13682828809019881

[44] Code C. Language, Aphasia and the Right Hemisphere. Chichester: John Wiley 1987.

[45] Joanette Y, Goulet P. Narrative discourse in right brain damaged right hands. In Joanette Y, Brownell HH, Eds. Discourse Ability and Brain Damage. New York: Springer 1990.

[46] Gardner H, Ling PK, Flamm L, Silverman J. Comprehension and appreciation of humorous material following brain damage. Brain and Language 6: 301-317.

[47] Gainotti G. (1972). Emotional behaviour and hemispheric side of the lesion. Cortex 1975; 8: 41-55. http://dx.doi.org/10.1016/S0010-9452(72)80026-1

[48] Brownell HH, Michelow D, Powelson J, Garner H. Surprise but not coherence: sensitivity to verbal humor in right hemisphere patients. Brain and Language 1983; 18: 20-27. http://dx.doi.org/10.1016/0093-934X(83)90002-0

[49] Carmazza A, Gordon J, Zurif EB, DeLuca D. Right hemispheric damage and verbal problem solving behaviour. Brain and Language 1976; 6: 41-46. http://dx.doi.org/10.1016/0093-934X(76)90005-5

[50] Wapner W, Hamby S, Gardner H. The role of the right hemisphere in the appreciation of complex linguistic materials. Brain and Language 1981; 14: 15-33. http://dx.doi.org/10.1016/0093-934X(81)90061-4

[51] Bryan KL. Discourse after right hemisphere damage. Paper presented at Australian Association of Speech Therapists Conference. Perth, April 1989b.

[52] Hirst W, LeDoux J, Stein S. Constraints on the processing of indirect speech acts: evidence from aphasiology. Brain and Language 1984; 23: 26-33. http://dx.doi.org/10.1016/0093-934X(84)90003-8

[53] Molloy R, Brownell HH, Gardner H. Discourse comprehension by right hemisphere stroke patients: deficits in prediction and revision. In Joanette Y, Brownell HH, Eds. Discourse Ability and Brain Damage. New York: Springer 1990. http://dx.doi.org/10.1007/978-1-4612-3262-9_5

[54] Ryalls JH, Behrens SJ. An overview of changes in fundamental frequency associated with cortical insult. Aphasiology 1988; 2: 107-115. http://dx.doi.org/10.1080/02687038808248897

[55] Bryan KL. Language prosody and the right hemisphere. Aphasiology 1989a; 3: 285-299. http://dx.doi.org/10.1080/02687038908249000

[56] Schwartz GE, Davidson RJ, Maer F. Right hemisphere lateralization for emotion in the human brain: interactions with cognition. Science 1975; 190: 286-288. http://dx.doi.org/10.1126/science.1179210

[57] Ley RG, Bryden MP. A dissociation of right and left hemispheric effects for recognizing emotional tone and verbal content. Brain and Cognition 1982; 1: 3-9. http://dx.doi.org/10.1016/0278-2626(82)90002-1

[58] Ley RG, Bryden MP. Consciousness, emotion and the right hemisphere. In Underwood G, Stevens R, Eds. Aspects of Consciousness; Structural Issues. London: Academic Press 1981 Volume I.

[59] Bharati A, Kulkarni A. English from Hindi viewpoint: A Paaninian perspective. Paper presented at Platinum Jubilee conference of Linguistic Society of India, University of Hyderabad 2005.

[60] Koul ON. Modern Hindi grammar: Hyattsville: Dunwoody Press 2008.

[61] Kachru Y. Hindi-Urdu-Hindustani. In Kachru BB, Kachru Y, Sridhar SN, Eds. Language in south Asia. New York: Cambridge University Press 2008 pp. 81-102.

[62] Census of India. Primary census abstract. 2001. Available from http://www.censusindia.gov.in

[63] Trower P, Bryant B, Argyle M. Social Skills and Mental Health. University of Pittsburgh Press: Pittsburgh 1978.

[64] Anastasi A, Urbina S. Psychological testing (7th ed.). Upper Saddle River, NJ: Prentice Hall 1997.

[65] Cicone M, Wapner W, Gardner H. Sensitivity to emotional expressions and situations in organic patients. Cortex 1980; 16: 145-158. http://dx.doi.org/10.1016/S0010-9452(80)80029-3

[66] DeKosky ST, Heilman KM, Bowers D, Valenstein E. Recognition and discrimination of emotional faces and pictures. Brain and Language 1980; 9: 206-214. http://dx.doi.org/10.1016/0093-934X(80)90141-8

[67] Cancelliere AEB, Kertesz A. Lesion localization in acquired deficits of emotional expression and comprehension. Brain and Cognition 1990; 13: 133-147. http://dx.doi.org/10.1016/0278-2626(90)90046-Q

[68] Myers P. Communication disorders associated with right-hemisphere brain damage. In Chapey R, Ed. Language intervention strategies in adult aphasia. Baltimore: Williams & Wilkins 1994; pp-513-534.

[69] Borod J. Interhemispheric and intrahemispheric control of emotion: A focus on unilateral brain damage. Journal of Consulting and Clinical Psychology 1992; 60: 339-348. http://dx.doi.org/10.1037/0022-006X.60.3.339

[70] Sergent J. The cerebral balance of power: Confrontation or cooperation? Journal of Experimental Psychology: Human Perception and Performance 1982; 8: 253-272. http://dx.doi.org/10.1037/0096-1523.8.2.253

[71] Robertson LC, Lamb MR, Knight RT. Effects of lesions of temporal-parietal junction on perceptual and attentional processing in humans. Journal of Neuroscience 1988; 8: 3757-3769.

Received on 08-10-2015 Accepted on 30-11-2015 Published on 14-05-2016

DOI: http://dx.doi.org/10.12970/2311-1917.2016.04.01.3