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Research Paper

CEREBRO-Vascular Accident and Perception of Stress

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ABSTARCT:-
Symptoms of stroke are not easy to recognize because they vary so much. Presentation of information about stroke by hospital and community health services should be improved. Simple and understandable educational materials should be developed and their effectiveness monitored.
The study investigated perception of stress in subjects with cerebro-vascular accidents (CVA) and normal controls speaking Hindi. The study was designed to examine the effect of CVA, acoustic cue and age on the perception of stress. The following research questions were asked: (1) Are there differences between subjects with CVA and normal controls in perception of stress? (2) Are there differences between LHD and RHD (CVA) subjects in perception of stress? (3) Are there differences between young and old CVA subjects in perception of stress? (4) Do LHD and RHD (CVA) subjects use different acoustic cause to perceive stress? and (5) Are there differences between single and multiple cue conditions? To answer these questions, independent manipulation of the cues available in the stimuli was performed. Specifically, three experiments were conducted. Experiment I dealt with acoustic analyses of Hindi words with and without stress, experiment n dealt with generation of synthetic phrases and experiment in dealt with discrimination of stress in individuals with CVA and in normal control subjects. Fifty normal controls and 59 subjects with CVA (27 with left hemisphere damage - LHD and 32 with right hemisphere damage - RHD) listened to phrase pairs altered in individual (fi-equency – F0, intensity – A0, and duration - DO) and multiple acoustic parameters of stress. They responded to the stimuli as 'same' or 'different' on a multiple forced choice response sheet.
Results of experiment I indicated that duration was the major cue of stress in Hindi. Results of experiment III indicated that subjects with CVA scored significantly poorer compared to normal controls. Subjects with LHD scored significantly higher on altered F0D0 and F0A0D0 conditions compared to subjects with RHD. Young subjects scored significantly higher on altered F0 condition and old subjects scored significantly higher on altered D0 condition. Significantly better performance on altered F0 (Young LHD and RHD), altered F0A0D0 (old LHD) and altered D0 (old RHD) conditions was observed.

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I. INTRODUCTION:-

The human brain is the central organ of the human nervous system, and with the spinal cord makes up the central nervous system. The brain consists of the cerebrum, the brainstem and the cerebellum. It controls most of the activities of the body, processing, integrating, and coordinating the information it receives from the sense organs, and making decisions as to the instructions sent to the rest of the body. The brain is contained in, and protected by, the skull bones of the head.

The relation between brain and behavior has attracted researchers for many years. By investigating this relationship, one can independently deduce models of neural organization and cognitive processing. In the search for neuroanatomical correlates of behavior, a great deal of attention has been focused on language processing. Prosody serves a variety of functions in language processing and it is an important component of the linguistic system. Prosody or suprasegmentals incorporate intonation, rhythm, stress and quantity. Intonation is the change in

fundamental frequency (F0) over a period of time. Rhythm refers to an event repeated regularly over a period of time, quantity is the duration of speech sounds and stress refers to extra energy. Stress has been called the most elusive of all prosodic features (Lehiste, 1970) signaled by at least three acoustic correlates i.e. change in fundamental frequency, amplitude and duration (Lieberman, 1960).

In most recent models of speech production (for e.g. Levelt, 1989), the prosody generator is considered as a distinct component of the speech production system or a subcomponent of the phonological system. To date, majority of neurolinguistic research in this area has focused in some detail on the neural basis of the segmental aspects of speech. But far less attention has been devoted to speech prosody. Thus, despite its importance in communication, the neural systems responsible for the production and comprehension of prosody remain largely unspecified.

Some of the continuing questions posing those interested in the neural substrates for the processing and controlling of prosody are (a) is the function (linguistic vs. emotion) lateralized or are the acoustic cues (F0 vs. duration) lateralized? (b) given that the linguistic prosodic system is part of several grammatical components (phonological, lexical and syntactic), to what extent does a particular break down in the prosodic system effect these components?, and (c) are the comprehension and production of prosodic cues similarly affected by brain damage under the hemisphere control?

The first experiment on the comprehension *of lexical stress* in left hemisphere damaged (LHD) individuals (Blumstein & Goodglass, 1972) indicated several errors in Broca's and Wernicke's aphasia. In this study subjects listened to a series of wordsand selected one picture among the four pictures. A further study by Baum, Danilofi Daniloff & Levis (1982) on comprehension of *lexical stress* in sentence by Broca's aphasics and age matched normal subjects indicated that Broca's aphasics made significantly more errors compared to normal's. Behrens (1985) used dichotic listening technique in IS normal subjects to identify stress placement *in phonemic stress* paus (e.g. hotdog vs. hotdog) and demonstrated a significant right-ear (left hemisphere) advantage on this task. Filtering the same stimuli at 200 Hz for presentation or reducing the semantic content of the stimuli (e.g. hotdog) did not lead to a right-ear advantage. The results suggested that left hemisphere processes stress contrasts except when these cues are of minimal linguistic importance (as in the low-pass-filtered stimuli).

The results of the above studies support the ***functional lateralization hypothesis*** that ***left hemisphere*** controlled ***linguistic prosody*** and ***right hemisphere*** controlled ***emotional prosody*** (Van lancker, 1980). According to this hypothesis, the specialized role of the left hemisphere is revealed for processing prosodic structure that perform a linguistic function (e.g., conveying lexical stress differences), and the right hemisphere for processing nonlinguistic prosodic information (e.g., conveying emotion). This theory does not account for potential hemisphere differences in processing the acoustic characteristics of the prosodic structure at a perceptual level. Rather, it suggests that hemispheric specialization is determined at later stages of sentence processing where an in-depth analysis of the linguistic and nonlinguistic function is determined.

Bryan (1989) examined the right hemisphere contribution to the processing of Imagistic prosody by presenting a battery of 13 linguistic prosody tests that incorporated stimuli of various perceptual domains (phonemic/emphatic stress discrimination, identification of declarative vs. interrogative intonation). Results of her study indicated that individuals with RHD were impaired on all 13 tasks of linguistic prosody relative to the NBD and on 8 tasks relative to the individuals with LHD. Further, individuals with LHD were significantly impaired relative to the NBD on 10 of the 13 tasks suggesting bilateral control for at least some aspects of linguistic prosody.

Baum (1998) conducted an experiment to decipher the role of FO and duration in the perception of linguistic stress by individuals with brain damage and non-brain damage (NBD). The stimuli included a naturally stressed syllables and syllable in which the FO was neutralized and set of stimuli in which the duration cue was effectively neutralized. The results indicated that subjects with LHD were unpaired in perception even when full cue was provided, RHD were poorer than NBD but were better than LHD. For FO neutralized stimuli even NBD and RHD performed poorly. LHD performed at chance factor. There was high individual variability in the results obtained. Baum (1998) concluded that neural substrates of prosody remain elusive, undoubtedly both hemispheres involve in the processing of prosody. Also, there is differential preference for temporal and spectral cues for processing stress in the brain damaged.

To answer these questions, independent manipulation of the cues available in the stimuli was performed. Specifically, three experiments were conducted. Experiment I dealt with acoustic analyses of Hindi words with and without stress, experiment n dealt with generation of synthetic phrases and experiment III dealt with evaluation of perception of stress in individuals with CVA and in normal control subjects. The results of the study have theoretical and clinical implications. Research on prosodic perception will add information about the neuroanatomical regions active in prosodic processing, and the specific role of hemispheres in prosodic processing which will be helpful in providing effective diagnostic and rehabilitative methods to individuals with brain damage (CVA).

II. METHODOLOGY:-

The objective of the study was to investigate perception of stress in subjects with cerebro-vascular accident (CVA), and normal controls speaking Hindi. Three experiments were conducted to achieve this objective. Experiment 1 dealt with acoustic analyses of Hindi phrases with and without word stress, experiment deal with generation of synthetic phrases and equipment HI dealt with perception of stress in normal control subjects and in subjects with CVA.

LHD	Young Male	Young Female	Old Male	Old Female	Total
Number	10	0	12	5	27
Age range	26-45		49-66	53-79	
Mean Age	37.30		55.16	62.0	
RHD	Young Male	Young Female	Old Male	Old Female	
Number	7	2	20	3	32
Age range	38-45	31-39	46-75	46-54	
Mean Age	41.71	35.0	55.60	51.33	

Altered parameters	No. of Phrase pairs
Frequency	7
Amplitude	0
Duration	12
Frequency and amplitude	5
Frequency and duration	14
Amplitude and duration	13
Frequency, amplitude and duration	16
Total	**67**

Group/age	F0 **	D0 **	F0A0 **	F0D0 **	A0D0 **	F0A0D0 **
LHD Young	37.14 (27.40-46.88)	18.33 (8.54-28.12)	36.66 (20.11-53.22)	27.62 (7.81-47.42)	23.33 (11.53-35.14)	35.21 (19.19-51.22)
LHD old	15.40 (8.73-22.08)	37.42 (24.23-50.60)	28.23 (13.97-42.50)	31.23 (13.65-48.82)	20.81 (7.83-33.80)	38.97 (23.07-54.87)
Total	23.45 (16.81-30.10)	30.35 (21.00-39.69)	31.36 (21.07-41.64)	29.89 (17.46-42.33)	21.75 (13.10-30.49)	37.58 (26.63-48.52
RHD young	31.21 (13.18-49.25)	22.84 (13.92-31.76)	27.40 (17.01-37.79)	15.08 (8.74-21.42)	15.67 (3.95-27.39)	24.07 (15.08-33.06)
RHD old	10.35 (8.32-12.38)	27.53 (23.88-31.19)	17.39 (13.15-21.62)	12.94 (9.03-16.85)	25.08 (19.64-30.52)	25.63 (21.65-29.62)
Total	16.21 (10.54-21.90)	26.21 (22.79-29.63)	20.21 (15.10-21.41)	13.54 (10.39-16.70)	22.43 (17.45-27.41)	25.19 (21.66-28.73)

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