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Investigation of auditory temporal processing in Broca's aphasics with phonological paraphasia: New dimension towards temporal cue based language rehabilitation

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Introduction: Aphasia defined as a multimodal loss of language is one of the most feared symptoms of stroke. About 21–38% of acute stroke survivors suffer from aphasia. Broca's aphasia is a classical form of expressive aphasia. Preserved auditory comprehension, impaired repetition, nonfluent speech and lesion in the foot of the third frontal convolution (Broca's area, Broadmann's no. 44) are classical features of Broca's aphasia.

Aim: (1) To investigate the relationship between phonological paraphasia and auditory temporal processing deficits in persons with Broca's Aphasia. (2) To investigate the role of auditory temporal training for the treatment of phonological paraphasia in persons with Broca's aphasia.

Method: Participants: Twenty participants with a history of ischemic stroke in the left Middle Cerebral Artery and clinically diagnosed as Broca's Aphasia were selected for the study. Twenty participants were divided into two groups based on their neurolinguistic features. There were a group of 10 aphasics with semantic paraphasia and the other 10 with phonological paraphasia. Informed consent was taken from the participants and all the procedures were strictly adhered to ethical guidelines.

Stimuli: Auditory temporal processing testing was carried out using a maximum likelihood procedure toolbox, which implements an MLP in MATLAB software. The participant's ability to detect a temporal gap in the center of a 750 msec broadband noise was measured. The noise had 0.5 msec cosine ramps at the beginning and end of the gap. In a two-interval alternate forced choice protocol was used.

Phase 1: Psychoacoustic evaluation of temporal processing was done by estimating gap detection threshold (GDT). Comparison was done between the semantic paraphasia group and phonological paraphasia group. GDT of both the groups were compared with the normal age matched subjects thresholds (which was obtained for the purpose of another study).

Phase 2: Phonological paraphasia group was divided into two, group A and B with five participants in each group. Group A was taken as control group and Group B was taken as experimental group. Group B was given 15 hours of auditory temporal based cue training which included speech and non-speech stimuli with difference only in durational aspects. After 15 sessions of training group A and B were tested by using Gap detection test and percentage of phonological paraphasia was also calculated.

Results: There was significant difference in the GDT scores of phonological paraphasia group and semantic paraphasia group ($P < 0.05$). Phonological paraphasia group had poor GDT scores on the right ear which is opposite to the site of lesion. However, semantic paraphasia group had values similar to the normal participants. Within group investigation of temporal cue based training indicated that there were no substantial changes in GDT and percentage of phonological paraphasia (POP) of group A. However, GDT became improved for group B and POP was also reduced. Improved temporal resolution was seen in the right ear responses of Group B.

Discussion: Our findings are emphasizing the need for viewing the deficits and rehabilitation options of persons with Broca's aphasia slightly different from a conventional view. Study gives insight into the need for temporal cue based assessment and treatment options for persons with Broca's Aphasia. The reason for the poor GDT of phonological paraphasia group was tried to explain based on the nature of site of lesion and recent evidences in the role of Broca's area in speech perception. Supporting evidences were taken from current models of brain language processing claim that several temporal, parietal and frontal areas interact in order to deliver the many features of language ability. Results were also supported by experience dependent neuroplasticity based research in aphasia. Current study attempted to highlight the need for translational research in aphasia also. The study will serve as a contemporary perspective in Aphasiology.

Biography

Daly Sebastian is currently working as a junior Lecturer in Department of Speech Language Studies, Dr. S. R. Chandrasekhar Institute of Speech and Hearing, Bangalore University. Her areas of research interest are neurogenic communication disorders, Multilingualism and neuro cognition. She has published papers in reputed journals and contributed chapter in International text books.

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