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Original Paper

Perception of Linguistic and Affective Prosody in Individuals with Aphasia

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Abstract

The current study was carried out with the aim of testing the perception of linguistic and affective prosody in individuals with aphasia. Convenient sampling was followed for the recruitment of participants. Comparative group design was used. The participants were divided into two groups. The first group comprised of 10 individuals with aphasia while the second group comprised of 10 neurologically healthy individuals. The study was carried out in native and non-native languages of the participants. Based on this premise, two tasks were configured. The first task required the participants to judge the prosody of sentences in native language and the second task required the participants to judge the sentences based on the prosody in the non-native language. Mann Whitney U test was used to compare the performance of the two groups. Statistically significant difference between the two groups was found on both the tasks. The theoretical premise suggests that the linguistic prosody is affected in left brain damaged adults however, the affective prosody is spared in this population. The findings of the current study contradicted this result as perception of linguistic and affective prosody was found to be affected in persons with aphasia.

Keywords

executive control, response inhibition, cognitive flexibility, trend in performance

1. Introduction

The term prosody refers to the melody in speech. The terms prosody and supra-segmentals are used interchangeably. The term speech prosody therefore affirms to the vocal modulation that combat with speech. Speech prosody is assumed to operate based on pitch modulations (Fiez, 1997) . The frequency, amplitude and duration convey the linguistic and paralinguistic aspects. Stress, rhythm and intonation are the key.

The pitch modulations act as an interface in conveying the linguistic information, in adjunct it can also convey information about the emotional status of the person. The former is termed as linguistic prosody while the latter is called affective prosody (Fonagy, 1978). The affective prosody is assumed to convey the emotional status of the speaker through the changes in pitch, duration and loudness. In other words, the acoustic signal of the speakers signal is assumed to serve to disambiguate the emotional status. The affective prosody is often compared with the facial expressions. The perception and production of linguistic and affective prosody is often investigated in left-brain damaged and right brain damaged individuals (Gandour et al., 1998).

The basis for the studies pertaining to linguistic and affective prosody roots back to case studies. The focus of these study was on lateralisation. It is accepted in consensus that the left hemisphere is associated with lexico-syntactic processing. While the right hemisphere is associated with perception of prosody. Left-brain damaged individuals with aphasia are assumed to confront difficulty in the perception of linguistic prosody while the perception of affective prosody remains intact. The theoretical evidence concerning this claim is derived from the functional lateralization hypothesis, which postulates that the right hemisphere of the brain processes affective prosody while the left hemisphere processes linguistic prosody. The hypothesis is supported by earlier studies (Golfinopoulos et al., 2010), in unilateral right hemisphere lesions In the same lines, difficulty in the perception of linguistic prosody have been reported in patients with lesions in both the left and right brain damage (Pell, 1998).

A meta-analysis of literature on the perception of linguistic and affective prosody by Michel and Steven (2013) revealed that both affective and linguistic prosody are impaired by damage to either hemisphere, The damage to an exclusive left brain damage can have an impact on linguistic prosody predominantly and damage to right hemisphere can have an impact on affective prosody predominantly. This claim has been subjected to testing. The site of lesion may be unclear in few studies while the site of lesion is dispersed or scattered in other studies. Therefore, the neurological literature does not permit an examination of localization hypotheses at a finer scale than the lobe per se. The neuro imaging studies also have failed to provide a linear relationship between the perception of linguistic and affective prosody with the site of lesion. While other studies in this direction (Monrad-Krohn, 1947; Weintraub et al., 1981), testing the functional cue hypothesis or differential cue has attracted criticism as the right hemisphere is assumed to work based on holistic and coarse processing of information. In addition, there are evidences to suggest that the affective prosody is affected in individuals with left hemisphere damage (Pell, 1998). Hence there is no univocal findings on the perception of linguistic prosody in brain -damaged individuals. Prosody conveyed by the linguistic content is termed linguistic prosody while the prosody conveyed by the affective component is termed as affective prosody. The affective prosody is perceived regardless of the language. The perception of linguistic and affective prosody in brain damaged adults has been studied extensively by considering left and right brain damaged adults. The notion is that linguistic prosody is affected in left brain damaged and the affective prosody is

affected in right brain damaged individuals, however the prevalence of right brain damage in clinical scenario is very sparse in nature. Hence it is practically difficult to study linguistic and affective prosody in right brain damaged individuals. As an alternate the perception of linguistic and affective prosody was tested by using native and non-native languages of the participants. The perception of linguistic prosody is tapped through the native language while the perception of affective prosody is tapped through the non-native language. Thus, the current study attempted to investigate the perception of linguistic and affective prosody in individuals with aphasia (IWA) by employing a judgment task in native and non-native languages. Linguistic prosody and affective prosody is considered to be a pre-requisite for correct judgment in native and non-native languages.

The other factor which necessitated the current study is that there is no consensus regarding the perception of linguistic and affective prosody in brain damaged generally and aphasia in specific. The present study was carried out with the aim to investigate the perception of linguistic and affective prosody in IWA and specific objectives to compare the scores on judgment task in native and non-native language in IWA and neuro-typical adults

2. Method

2.1 Study Design and Participants Details

The study involved a comparative group design. A total of 30 participants were considered for the study and the participants involved in the study were divided into two groups: group 1 comprised of 10 stroke survivors and the second group comprised of 20 neuro-typical adults.

Group 1 consisted of 10 stroke survivors All the individuals in group 1 had a left hemisphere damage. The participants were selected based on convenient sampling. Thus, purposive-sampling was used for recruitment of participants. As comprehension is a pre-requisite for judgment task, other types of aphasia were not included deliberately. WAB-K (Ravikumar et al., unpublished) was administered on these participants and it was revealed that 7 individuals had Broca's aphasia and the remaining had anomic aphasia. The details of the participants are represented in Table 1.

Table 1. Details of Participants

Sl No	Age/Gender	Post stroke duration	Initial Diagnosis	Diagnosis at the time of conduct of the current study
1	52/Male	10 months	Broca's aphasia	Broca's aphasia
2	50/Male	6 months	Global Aphasia	Broca's aphasia
3	46/Male	9 months	Global Aphasia	Broca's aphasia
4	49/Male	9 months	Broca's Aphasia	Anomic Aphasia

5	53/Male	1 year 2 months	Global Aphasia	Anomic Aphasia
6	50/Male	7 months	Transcortical motor aphasia	Anomic Aphasia
7	44/Male	6 months	Broca's aphasia	Broca's Aphasia
8	49/Male	1 year	Broca's Aphasia	Broca's Aphasia
9	50/Male	8 months	Global Aphasia	Broca's Aphasia
10	51/Male	9 months	Global Aphasia	Broca's Aphasia

Profiling of persons with aphasia revealed that the mean age range of participants was 49.3 years, all of them were male and Kannada was the native language of these participants. The post-stroke duration was 9 months on an average and all these participants had received therapeutic intervention. Group 2 participants were non-brain damaged and were age matched with group 1 participants. Group 2 participants did not have any history of cognitive, communication and sensory problems/deficits. Informed consent was sought from the participants and caregivers of group 1 and from participants of group 2. Following this, two main tasks was administered on the participants.

Judgment task was used to test the perception of linguistic and affective prosody. To test the linguistic prosody, sentences in the native language were used. It was decided to use 25 sentences in native language (8 interrogative, 9 declarative and 8 exclamatory sentences) were recorded from native Kannada speaker and each sentence had an average of 5 words. These sentences were recorded and played to participants of both the groups. The task of the participants was listen to the sentences and match it with 'smileys'. The smileys corresponded with the prosody conveyed by the sentences. The smileys used in the study is depicted in Figure 1. The participants were acclimatized to the task by using a trail block. Each correct judgment was awarded a score of 1, thus the maximum score was 25.

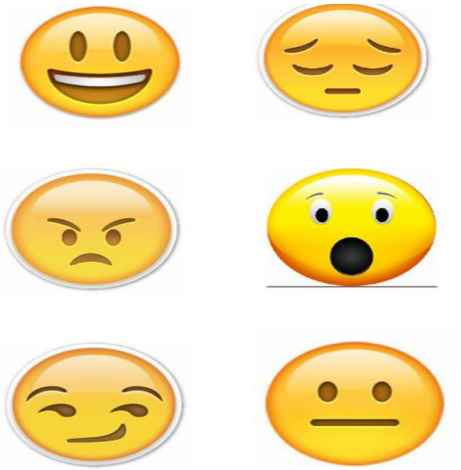

Figure 1. Smileys Used to Depict the Different Form of Sentences

For testing affective prosody, sentences from Malayalam was used, recording, play-back, sentence length, type of sentences was similar to the first task. The maximum score was 25. The only difference was that task 1 used sentences in native language while task 2 used non-native sentences.

3. Result

The median score on judgment task in native language (task 1) and non-native language (task 2) was computed from group 1 and group 2 participants. Group 1 participants secured a score of 11 on task 1 and 9 on task 2. Group 2 participants obtained a score of 24 and 18 on task 1 and task 2 respectively.

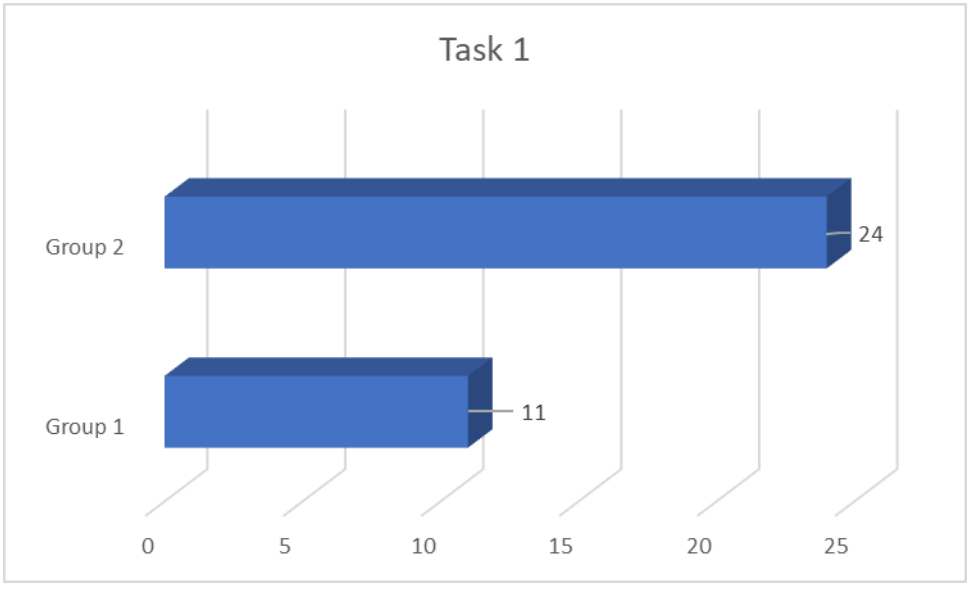

Figure 2. Comparing Group 1 and Group 2 on Task 1

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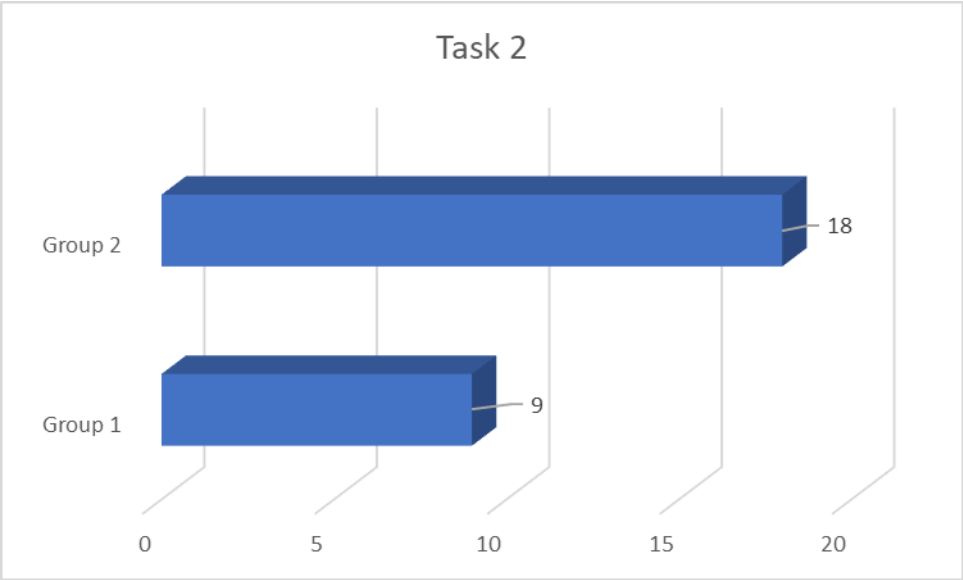

Figure 3. Comparing Group 1 vs Group 2 on Task 2

The objective was to compare the performance of group 1 and group 2 individuals on task 1 and task 2. In other-words, between and within group comparison was carried out. Within group analysis revealed that the data did not abide the properties of normal distribution as evident on Shapiro-Wilk's test ($p<0.05$), Wilcoxon's signed rank test, a non-parametric test was used for comparison. For group 1, there was a marginal difference between the performance on task 1, task 2, Z score obtained was 0.83, and the statistic revealed no significant difference. For group 2, the performance was clearly better in task 1 than task 2, Z score obtained was 2.08 ($p<0.05$) and the corresponding p value showed significant difference. Between group comparison was carried out to compare group 1 and group 2 on task 1 and task 2. The Z score was 3.02 ($p<0.05$) for task 1 and 2.89 ($p<0.05$) for task 2. The corresponding p values showed significant differences on both comparisons. In summary, within group analysis revealed that there was no significant difference between task 1 and task 2 for group 1. For group 2, there was a significant difference between task 1 and task 2.

4. Discussion

As stated in the method section, the study involved a comparative group design. The participants of the study were divided into two groups. The first group consisted of persons with aphasia. This group represented brain damaged population. The second group on the other hand consisted of neurologically healthy individuals and this group represented non brain damaged individuals. Two judgment based tasks were administered on the participants. The first task used sentences from the native language of the participants and tapped linguistic prosody. The second task on the other hand used sentences from the non-native language and tapped affective prosody.

Group 1 comprised of IWA. All these individuals were stroke survivors with lesion in the left

hemisphere and the right hemisphere was intact for all participants. The theoretical evidence in left-brain damaged individuals' show that linguistic prosody is affected in this population [4]. Linguistic prosody was tapped through native sentences while sentences in non-native language (Malayalam in this case) tapped the affective prosody. The participants were not exposed to Malayalam in their routine hence the judgment was based on affective prosody. The theoretical claim from the differential cue hypothesis is that the left hemisphere mediates the linguistic prosody and the right hemisphere mediates the affective prosody. The site of lesion was different for different participants but the site of lesion was in the left hemisphere itself for all the participants considered hence the participants can be deemed as left brain damaged individuals. Even with intact right hemisphere, the participants underperformed in non-native language. The descriptive scores on affective prosody (task 2) showed that they exhibited difficulty in judging sentences in non-native language also. In adjunct they exhibited difficulties in judging sentences of native language, which can be attributed to the linguistic deficits. It is note-worthy that the three individuals with anomic aphasia performed better compared to individuals with Broca's aphasia. Hence recovery and the quantum of linguistic deficits had a direct bearing on the results.

The findings of the current study also throws light the probable pattern of co-activation of left and right hemisphere and shows that the perception of affective prosody could be affected in IWA. Neuro-typical participants on the other hand performed well in both the tasks tapping the linguistic and affective prosody. Native language advantage was evident and it attributed to better performance in native language. In non-native, they exhibited difficulty especially in distinguishing interrogative and exclamatory sentence. The overall findings show that perception of speech prosody regardless of native or non-native language resort on an intact left hemisphere (Monrad‐Krohn, 1947; Pell & Baum, 1997; Weintraub et al., 1981). The primary limitation of the current study was that only limited number of participants were considered and the neurological and linguistic deficits were heterogeneous. The study can be extended by considering more number of individuals with aphasia, this would enable studying the site of lesion, quantum of linguistic deficits and correlating these factors with the performance on judgment tasks.

In summary, the study was carried with aim of investigating linguistic and affective prosody in IWA. 10 IWA and 20 neuro-typical participants were considered. Linguistic and affective prosody was tested through judgment task in native and non-native language of participants. The findings showed that there was a clear distinction between native and non-native languages in neuro-typical participants. IWA flaunted difficulty in both native and non-native language even with the right hemisphere being intact. There was a significant difference between IWA and neuro-typical participants in both native as well as non-native language The findings show that perception of speech prosody in native or non-native language would demand the left hemisphere to be intact.

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