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A Brief Study on the Speech Assessment of the Children Suffering from Cerebral Palsy

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Abstract

The present study attempts to assess the ability of the children affected with cerebral palsy whether they can be able to articulate accordingly in such a way that other people can understand. The paper also tries to assess how well they can be able to differentiate the meaning relations. All the twenty children participated in the study were affected with cerebral palsy, in which two children were athetoid and all the others were spastic. This paper also describes the major linguistic features demonstrated by the CP affected children exposed to Hindi speaking environment. The paper reveals that the gross motor function in children with CP is importantly linked with the skill to communicate and thus it is very much significant to take into consideration. Usually the children with disorders in the speech have difficulties using the consonant production and often cause dysarthria. By knowing the ratio of children with CP affected with articulation problems and the skills to acquire the meaning values, it will be easier to give the proper treatment, which would enhance the various disorders in the children affected with cerebral palsy. Using a picture-naming task with 35 common words, the study assessed the articulation and semantic comprehension of 20 Hindi-speaking children with CP. Key findings indicate a strong correlation between motor function and intelligibility, with significant difficulties in producing aspirated consonants and consonant clusters. The study underscores the need for future research to develop language-specific, motor-learning-based intervention programs to improve speech outcomes.

Keywords: cerebral palsy, athetoid, spastic, subjects, disorder

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Introduction

Cerebral palsy (CP) is a chronic disorder with sizeable impact on affected children. The prevention of CP has not been very much successful. However, early diagnosis and a comprehensive administration with a multidisciplinary treatment involving developmental neurologist, orthopedic surgeon, pediatrician, language and speech therapist, occupational therapist and physiotherapist are needed for further satisfactory control of an individual child with CP. The neuromuscular differentiation between spastic and athetoid are not easy to determine their speech level. During our study of the samples of CP affected children, the features of spastics were found in athetoid CP, likewise athetoid subjects had the features of spasticity.

Motor disability in children affected with CP, is a major indication which may affect the intellectual of CP child's speech. It not only affects the voice production but also the articulation and their sequences of speech sounds. Hence the motor disability in CP children will prevent them from proper oral communication. Children with CP have only limited variety of sounds as compared to the same aged normal children. The phonological system also has only few sound units (phonemes) which they use to differentiate meanings in different pair of words. Throughout our research study, the linguistic ability, articulation and the awareness of semantic relations in children with CP have been assessed. The major means of communication is through language, but it is dormant and inactive in children affected with CP. The present study attempts to evaluate the intelligibility of children suffering from Cerebral Palsy in finding the meaning relations in various contexts and circumstances.

Speech therapists use different tools to help children with cerebral palsy improve or overcome the communication struggle. Assistive technologies or assistive devices are also used as communication aids, especially for nonverbal children.

Methodology

The research proceeded with 10 children of varied ages, 5-10, who were observed at an organization specializing in educating and socializing those children. The observation was mainly focused on assessing the linguistic elements that these affected children use to communicate with others. To add additional feedback to the research, a few parents of these children were also interviewed. This was mainly focused in order to get the response from those children for whom there was no response during the observation process. And also, there were frequent visits to the children who are newly affected with CP, to assess if there are any symptoms they show, which will be helpful for further studies. A list of 35 words was prepared, which can be found in Table 1. The children were asked to speak out. To prove the effectiveness of some of the factors that affect language skill development, other developments along with linguistic developments were also considered. The availability of different age groups was also of great help due to the wide range of responses. The study was focused on how many of the children were able to return to normal life after acquiring CP and also how successful these children have been in their motor and linguistic development.

Data Collection

The data for this study was collected through a multi-faceted approach designed to capture the everyday communicative experiences of the children. The process was conducted over several weeks to ensure depth and reliability.

Site Selection

Data collection was carried out at rehabilitation center (Delhi), a specialized institution, dedicated to the education and holistic development of children with physical and neurological disabilities. This site was selected for its access to a relevant participant pool and its environment, which was familiar and comfortable for the children, thereby facilitating more naturalistic observation and assessment.

Data Recording

The primary speech data was recorded using a ASR recorder and further edited on Audacity to ensure acoustic clarity for subsequent phonetic analysis. Each child's responses during the picture-naming task were recorded individually in a quiet room to minimize background noise. The recordings were later transcribed and coded using the specified criteria (✓ , ±, ×, -) for analysis.

Interviews with Parents

Semi-structured interviews were conducted with the parents or primary caregivers of the participating children. The interview protocol was designed to gather qualitative data on the children's communication patterns at home, their history of speech and language development, the strategies families use to understand them, and the perceived challenges faced in daily interactions. These interviews provided crucial contextual information that complemented the formal assessment data.

Observations

Naturalistic observations were conducted both during structured tasks and in informal settings, such as during play or classroom activities. These observations focused on the children's use of nonverbal communication (e.g., gestures, eye gaze, body language), their attempts to initiate communication, their interactions with peers and caregivers, and their responses to various communicative cues. This method helped in understanding the practical intelligibility and adaptive strategies employed by the children beyond the controlled assessment environment.

Speech Assessment

Breathing, feeding, and speech are processed through the innate physiologic mechanisms in humans. An average child is capable of manipulating, soon after birth, the biological mechanisms differentially to meet the needs of breathing, feeding, and speech production. At the same time, in children with cerebral palsied, the defects that occur in the brain will not enable the affected children to regulate the physiological mechanism. Therefore, the necessary intervention programs to enhance the speech reduction, breathing, sucking, swallowing, biting and chewing, laughing, crying and coughing, phonation and articulation are all affected in cerebral palsied children. The lack of these exercises and the deficient and improper nature of their indication inform that the child has some basic defects, in regard to the speech production.

Here, we shall try to point out outputs that we received from the ten children who were persuaded to utter the words given below. The differences in the outputs may be observed in the table given below:

Table 1

Responses of the Children for Speech Assessment Through Pronunciation

S.N.	Words	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10
1.	कुत्ता (Dog)	✓	✓	✓	✓	✓	✓	✓	–	✓	✓
2.	गाय (Cow)	✓	✓	✓	✓	✓	✓	✓	–	✓	✓
3.	शेर (Lion)	✓	✓	✓	✓	✓	✓	±	–	✓	✓
4.	हाथी (Elephant)	✓	✓	✓	✓	✓	×	±	–	✓	✓
5.	गाजर(Carrots)	✓	±	✓	±	×	×	±	–	±	×
6.	मटर (Green peas)	✓	±	✓	✓	✓	×	✓	–	±	×
7.	भिंडी(Ladies finger)	✓	±	✓	✓	✓	✓	✓	–	±	✓
8.	बैंगन (Brinjal)	✓	✓	✓	×	✓	×	±	–	±	×
9.	रेल (Train)	✓	✓	×	✓	✓	×	±	–	±	✓
10.	गाड़ी (Car)	✓	✓	✓	✓	✓	±	±	–	×	✓
11.	साइकिल (Bi cycle)	✓	✓	✓	✓	✓	✓	✓	–	✓	✓
12.	बस (Bus)	✓	×	±	±	✓	±	✓	–	±	✓
13.	कछुआ (Tortoise)	✓	±	✓	×	✓	±	×	–	±	×
14.	केकड़ा (Crab)	✓	×	±	×	×	±	×	–	±	✓
15.	तारामछली (Star fish)	±	✓	±	×	✓	×	×	–	×	✓
16.	मछली (Fish)	✓	✓	✓	✓	✓	✓	✓	–	✓	✓
17.	अनानास (Pine apple)	✓	±	±	×	×	±	±	–	±	±
18.	केला (Banana)	✓	✓	✓	✓	✓	✓	✓	–	✓	✓
19.	अंगूर (Grapes)	✓	✓	✓	✓	✓	✓	✓	–	✓	✓

S.N.	Words	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10
20.	सेब (Apple)	✓	✓	✓	✓	✓	✓	✓	-	✓	✓
21.	सूरजमुखी (Sun flower)	✓	×	✓	±	×	✓	×	-	×	×
22.	कमल (Lotus)	✓	✓	✓	✓	✓	✓	×	-	✓	✓
23.	गुलाब (Rose)	✓	✓	✓	✓	✓	✓	×	-	✓	✓
24.	चमेली (Jasmine)	±	✓	±	±	×	±	×	-	±	×
25.	तोता (Parrot)	✓	✓	✓	✓	✓	✓	✓	-	✓	✓
26.	चड़िया (Bird)	✓	✓	±	✓	×	✓	×	-	±	×
27.	हंस (Swan)	✓	✓	×	✓	×	±	×	-	×	×
28.	गद्धि (Vulture)	±	×	×	×	✓	×	✓	-	×	×
29.	रेडियो (Radio)	×	×	×	×	✓	×	±	-	×	✓
30.	टी.वी (Television)	✓	✓	±	±	✓	✓	±	-	×	✓
31.	कंप्यूटर (Computer)	✓	✓	±	±	×	±	✓	-	✓	×
32.	आँख (Eye)	✓	✓	✓	✓	✓	✓	✓	-	✓	✓
33.	पैर (Leg)	✓	✓	±	✓	✓	✓	✓	-	✓	✓
34.	हाथ (Hand)	✓	✓	✓	✓	✓	✓	✓	-	✓	✓
35.	नाक (Nose)	✓	✓	±	✓	✓	✓	±	-	✓	✓

For the analysis of data, in the very first section, 35 words were selected. The words were selected strictly from day-to-day life and that were frequently used by the children. There were names of the animals and birds, fruits and vegetables, electronic appliances, and parts of the body.

On analyzing the responses given by the children on the basis of the presented data (Table 1), we arrived at certain generalizations. In order to summarize the same, the responses were divided into four categories as shown below:

✓ = One response at the time

± = Cue response

× = No response

- = Unable to speak

It can be easily observed here that most of the responses were made orally in one go. But there were a good number of responses that were made just with a cue. Other responses were left blank. That means there were no responses at all.

Analysis of Response Patterns

Beyond quantifying correct and incorrect responses, the study aimed to analyze the nature of the children's interactions during the assessment task. The following patterns were observed:

The stimulus was presented solely as visual images. The children were not shown any written words (orthographic representation) during the task. Therefore, the responses were based entirely on visual recognition and lexical retrieval, not on reading ability. This was a deliberate choice to isolate and assess their spoken vocabulary and articulation skills without the confounding variable of literacy, which can be variably developed in children with CP.

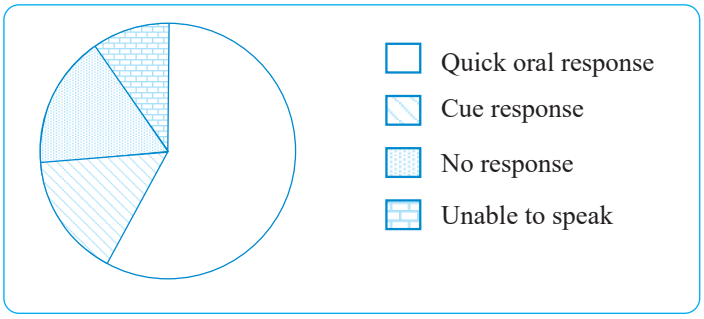
The researcher presented the image and prompted the child with questions like "What is this?" or "Tell me what you see." The researcher did not model the pronunciation of the target word beforehand. This was crucial to elicit the child's own phonological representation and production of the word, rather than testing their ability to imitate sounds, which can often be more accurate than spontaneous speech.

The primary stimulus for each trial was a clear, colorful, and culturally appropriate pictorial

representation of the target word. A set of 35 images was used, corresponding to the words listed in Table 1 and Table 3. The images were presented to the children one at a time in a randomized order to prevent ordering effects. The verbal prompt from the researcher (e.g., "What is this?") served as a secondary stimulus to elicit the production.

Figure 1

Responses of the Children



On the basis of the available data, we find that in the first section, 10 children were expected to respond to 35 words each. Thus, the total expected responses being 350 (i.e.10x35). The pie chart shown above demonstrates the percentage of responses in four categories – quick oral response, cue response, no response, and unable to speak respectively. Here, it can be observed that the percentage of 'Quick Oral Response' was 57.71%. Similarly, the percentage of 'Cue Response' was 15.42% and the percentage of 'No Response' was 16.85. Apart from these, H9 was unable to speak at all; therefore, the percentage of 'Unable to Speak' was 10%. However, H1, H3, and H5 were able to show quick oral responses to most of the words.

Now, the responses for section two as shown below:

Table 2

Responses of the Children for Speech Assessment Through Pronunciation

S.N.	Words	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10
1.	कुत्ता (Dog)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2.	गाय (Cow)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
3.	शेर (Lion)	✓	±	✓	✓	✓	✓	✓	✓	✓	✓
4.	हाथी (Elephant)	×	±	✓	✓	✓	✓	✓	✓	✓	✓
5.	गाजर(Carrots)	×	±	×	±	×	✓	±	✓	±	×
6.	मटर (Green peas)	×	✓	✓	±	×	✓	±	✓	✓	✓
7.	भिंडी(Ladies finger)	✓	✓	✓	±	✓	✓	±	✓	✓	✓
8.	बैंगन (Brinjal)	×	±	✓	±	×	✓	✓	✓	×	✓
9.	रेल (Train)	×	±	✓	±	✓	✓	✓	×	✓	✓
10.	गाड़ी (Car)	±	±	✓	×	✓	✓	✓	✓	✓	✓
11.	साइकिल (Bi-cycle)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
12.	बस (Bus)	±	✓	✓	±	✓	✓	×	±	±	✓
13.	कछुआ (Tortoise)	±	×	✓	±	×	✓	±	✓	×	✓

S.N.	Words	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10
14.	केकड़ा (Crab)	±	×	×	±	✓	✓	×	±	×	×
15.	तारामछली (Star fish)	×	×	✓	×	✓	±	✓	±	×	✓
16.	मछली (Fish)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
17.	अनानास (Pine apple)	±	±	×	±	±	✓	±	±	×	×
18.	केला (Banana)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
19.	अंगूर (Grapes)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
20.	सेब (Apple)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
21.	सूरजमुखी (Sun flower)	✓	×	×	×	×	✓	×	✓	±	×
22.	कमल (Lotus)	✓	×	✓	✓	✓	✓	✓	✓	✓	✓
23.	गुलाब (Rose)	✓	×	✓	✓	✓	✓	✓	✓	✓	✓
24.	चमेली (Jasmine)	±	×	×	±	×	±	✓	±	±	×
25.	तोता (Parrot)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
26.	चिड़िया (Bird)	✓	×	×	±	×	✓	✓	±	✓	×
27.	हंस (Swan)	±	×	×	×	×	✓	✓	×	✓	×
28.	गिद्ध (Vulture)	×	✓	✓	×	×	±	×	×	×	✓
29.	रेडियो (Radio)	×	±	✓	×	✓	×	×	×	×	✓
30.	टी.वी (Television)	✓	±	✓	×	✓	✓	✓	±	±	✓
31.	कंप्यूटर (Computer)	±	✓	×	✓	×	✓	✓	±	±	×
32.	आँख (Eye)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
33.	पैर (Leg)	✓	✓	✓	✓	✓	✓	✓	±	✓	✓
34.	हाथ (Hand)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
35.	नाक (Nose)	✓	±	✓	✓	✓	✓	✓	±	✓	✓

✓ = One response at the time

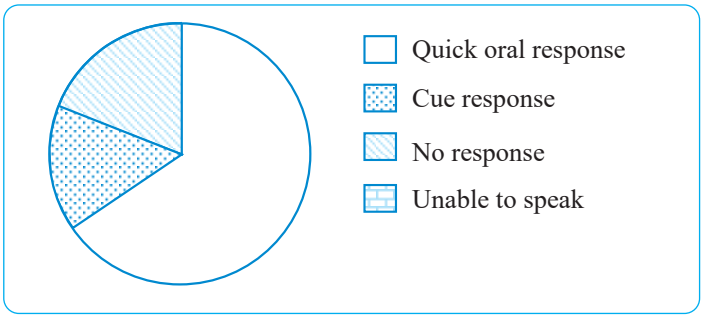
± = Cue response

× = No response

Similarly, in Table 2, ten new children were selected for responses. The data sheet remained the same as in Table 1 and the entire procedure was repeated. The children with one time responses, cue responses, and no responses can be easily identified from the table under discussion.

Figure 2

Responses of the Children



In the second section, the same technique was applied for the rest 10 children and the total expected responses were 350. Out of 350 responses in all, 65.42% of responses were 'Quick Oral Response' while 15.42% responses were identified as 'Cue Response'. Similarly, 19.14% of responses fell in the category of 'No Response' and 0% responses fell into the category of 'Unable to Speak', as there was none having the inability to speak. H13, H15, H16, and H19 were able to make quick oral responses to the maximum extent.

The tables containing the words of various types are shown below after the segregation of words from each type in the following table:

Table 3

Categorical Classification of Data Sample

English	Hindi	Category
Pineapple	अनानास	Fruit (फल)
Banana	केला	Fruit (फल)
Grapes	अंगूर	Fruit (फल)
Apple	सेब	Fruit (फल)
Sunflower	सूरजमुखी	Flower (फूल)
Lotus	कमल	Flower (फूल)
Rose	गुलाब	Flower (फूल)
Jasmine	चमेली	Flower (फूल)
Dog	कुत्ता	Animal (जानवर)
Cow	गाय	Animal (जानवर)
Lion	शेर	Animal (जानवर)
Elephant	हाथी	Animal (जानवर)
Tortoise	कछुआ	Animal (जानवर)
Starfish	तारामछली	Animal (जानवर)
Crab	केकड़ा	Animal (जानवर)
Fish	मछली	Animal (जानवर)
Train	ट्रेन	Vehicle (वाहन)
Car	कार	Vehicle (वाहन)
Bicycle	साइकिल	Vehicle (वाहन)
Bus	बस	Vehicle (वाहन)
Carrot	गाजर	Vegetable (सब्जी)
Green Peas	मटर	Vegetable (सब्जी)
Ladyfinger	भिंडी	Vegetable (सब्जी)
Brinjal	बैंगन	Vegetable (सब्जी)
Eye	आँख	Human Organ (अंग)
Leg	पैर	Human Organ (अंग)
Hand	हाथ	Human Organ (अंग)
Nose	नाक	Human Organ (अंग)
Sparrow	गौरैया	Bird (पक्षी)

English	Hindi	Category
Peacock	मोर	Bird (पक्षी)
Parrot	तोता	Bird (पक्षी)
Crow	कौआ	Bird (पक्षी)
Refrigerator	फ्रिज	Home Appliance (घरेलू उपकरण)
Television	टेलीविज़न	Home Appliance (घरेलू उपकरण)
Washing Machine	वाशिंग मशीन	Home Appliance (घरेलू उपकरण)

All the children were shown the images of all the words (shown in Table 3) and were assessed to see if they were able to identify these words. The responses given by each of the children can be observed in the table given below:

Table 4

Representation of Responses of Children from Different Sets of Words (i.e. A-H)

Samples	Categories of Words								Total
	A	B	C	D	E	F	G	H	
H1	4/4	3/4(1±)	2/3	4/4	4/4	3/4(1±)	7/8(1±)	4/4	31/35(3±)
H2	3/4(1±)	¾	2/3	¾	4/4	3/4	6/8(1±)	1/4(3±)	25/35(5±)
H3	3/4(1±)	3/4(1±)	0/3(2±)	2/4(1±)	2/4(2±)	1/4(1±)	6/8(2±)	4/4	21/35(10±)
H4	3/4(1±)	2/4(2±)	0/3(2±)	3/4(1±)	4/4	3/4	5/8	2/4(1±)	22/35(7±)
H5	¾	2/4	2/3	4/4	4/4	2/4(2±)	7/8	3/4(1±)	27/35(3±)
H6	3/4(1±)	1/4(2±)	1/3(1±)	1/4(2±)	4/4	2/4(1±)	4/8(2±)	1/4	17/35(9±)
H7	3/4(1±)	0/4	1/3(2±)	2/4(2±)	3/4(1±)	2/4	3/8(2±)	2/4(2±)	16/35(10±)
H8	-	-	-	-	-	-	-	-	-
H9	3/4(1±)	2/4(1±)	1/3	1/4(1±)	4/4	1/4(1±)	5/8(2±)	0/4(4±)	17/35(10±)
H10	3/4(1±)	2/4	2/3	4/4	4/4	1/4	7/8	1/4	24/35(1±)
H11	3/4(1±)	1/4(2±)	1/3(1±)	1/4(2±)	4/4	2/4(1±)	4/8(2±)	1/4	17/35(9±)
H12	3/4(1±)	0/4	1/3(2±)	2/4(2±)	3/4(1±)	2/4	3/8(2±)	2/4(2±)	16/35(10±)
H13	¾	2/4	2/3	4/4	4/4	2/4(2±)	7/8	3/4(1±)	27/35(3±)
H14	3/4(1±)	2/4(1±)	1/3	1/4(1±)	4/4	1/4(1±)	5/8(2±)	0/4(4±)	17/35(10±)
H15	3/4(1±)	2/4	2/3	4/4	4/4	1/4	7/8	1/4	24/35(1±)
H16	4/4	3/4(1±)	2/3	4/4	4/4	3/4(1±)	7/8(1±)	4/4	31/35(3±)
H17	3/4(1±)	¾	2/3	¾	4/4	3/4	6/8(1±)	1/4(3±)	25/35(5±)
H18	3/4(1±)	3/4(1±)	0/3(2±)	2/4(1±)	2/4(2±)	1/4(1±)	6/8(2±)	4/4	21/35(10±)
H19	3/4(1±)	2/4(2±)	0/3(2±)	3/4(1±)	4/4	3/4	5/8	2/4(1±)	22/35(7±)
H20	¾	2/4	2/3	4/4	4/4	2/4(2±)	7/8	3/4(1±)	27/35(3±)

From the table given above, one may infer the following facts:

- H1 and H16 were able to identify all the 35 terms used in the study and however three terms with cue response. H1 and H16 possessed an intelligent percentage of 88.5%.
- H5, H13 and H20 were able to identify 27 terms, with five terms with no response and three terms with cue

response. These samples possessed an intelligent percentage of 77%.

- H2 and H17 showed an intelligent percentage of 70% with 5 cue response and 10 no response.
- Samples H3, H4, H10, H18, H19 and H15 showed intelligent percentage of 60% - 68%.
- In samples H6, H7, H9, H11, H12 and H14 showed an intelligent percentage of 45% - 48%. In these samples there were more than 10 no response. Hence these children were not so good in differentiating or assessing the relations between the words.
- And sample H8 was not able to make a response as she was able to produce only some sound.

Linguistic Assessment of the Children Suffering from Cerebral Palsy (CP)

Cerebral palsy mainly affects a person in many ways such as the ability to control the muscles, movement and posture and also affects the ability to communicate with others. One of the important aspects of normal speaking is the control of breathing and muscles which is lacks among the children with cerebral palsy, such as some children affected with CP sounds breathy while talking, while others finds it difficult to produce sound, some children may have the ability to produce sound but they cannot or find it difficult to control the muscle movements. About 1/4th of the people affected with cerebral palsy cannot be able to talk properly.

Alphabets

So far as the alphabets are concerned, the subjects had almost no difficulty in pronouncing them, may that be Hindi or English. Though, being non-native speakers of English, most of the subjects committed errors at certain places in various words but that were negligible.

Phonology

Almost all the subjects are native speakers of the Hindi language. The Hindi language has more vowels and consonants as compared to English. It arises many problems arise associated with the pronunciation. One of the main problems is differentiating phonemes in words such as */par/ and /paw/; /vet/ and /wet/; /said/ and /sad/* etc., and words with the letters /th/ (as in t*hings, months, this*, etc.) cause Hindi learners the same kind of problems that the learners of English normally face, for example, */s/* in the word *pleasure* is pronounced differently as compared to *pressure*. In English language, the consonants sounds together with vowel sounds make a cluster at the beginning, middle, or at the end of the words which is generally not found in Hindi. This could lead to errors in the pronunciation of words such as film (*filam*), straight (*istraight*) and form (*faram*). These are some of the important issues that the subjects had to face so frequently.

When compared to English, Hindi language can be easily predicted with weak stress. This creates a difficulty for the beginners to deal with unbalanced stress patterns with words such as *photograph*. Hindi language learners are not willing to "*swallow*" unstressed syllables such as the syllable at the start of the word *intelligent, remember, tomorrow,* etc. They attempt to articulate clearly some of the short common words that are usually weakly stressed in English like *and, was, has, to*, etc.

Thus, the effect of mother tongue influence (MTI) along with Hindi, their subsidiary language, could be easily noticed in the pronunciation of the subjects.

Grammar – Tense/Verb

The tenses used in the Hindi language are similar to that of English language such as present, past and future etc., but there is a lack of connection while using it to express various meanings. In the normal conversation with the subjects, it was noticed that most of them used continuous form of the tenses so frequently. The overuse of simple present tense by the subjects can also not be neglected.

Vocabulary

The vocabulary of the subjects was comparatively weak as compared to normal children. As Hindi language has borrowed many words from English, it helps many of the Hindi learners and beginners who quickly want to learn the large vocabulary. But, the articulation of many of these words has made significant variation in the Hindi language. It is just because of the influence of English sound over Hindi sound that most of the subjects pronounced */f/* sound not as a bilabial but as a labiodental sound while articulating the word such as *phir, phikar*, etc.

Intellectual Ability

According to the available data, a major variation was noticed in the intellectual ability of the subjects under discussion. The formula for calculating the Intellectual ability:

Intelligibility (%) = (Number of Correct Responses ✓ / Total Possible Responses) × 100

This variation can be observed in the table given below:

Table 5

Intellectual Ability of Children Through Various Gestures, Vocalization, and Sign

Speaker	Age	Gender	Condition	Intelligibility (%)	Modes of Communication (Reported)
H1	8	M	Spastic	88.5%	All the subjects were able to produce some vocalization through gesture, vocalization and sign.
H2	5	M	Spastic	71.0%	
H3	10+	M	Spastic	60.0%	
H4	9	M	Spastic	62.0%	
H5	9	M	Spastic	77.0%	
H6	7	F	Spastic	48.5%	
H7	5	M	Spastic	45.7%	
H8	4+	F	Spastic	-	
H9	10	M	Athetoid	48.5%	
H10	6		Spastic	68.5%	
H11	7	F	Spastic	48.5%	
H12	5	M	Spastic	45.7%	
H13	4+	F	Spastic	77.1%	
H14	10	M	Athetoid	48.5%	
H15	5	M	Spastic	68.5%	
H16	8	M	Spastic	88.5%	
H17	5	M	Spastic	71.4%	
H18	10+	M	Spastic	60.0%	
H19	9	M	Spastic	62.0%	
H20	9	M	Spastic	77.0%	

From the table given above (Table 5), one may infer that the intellectual ability of the male subjects is greater than the female subjects. The age factor cannot be considered for the variation in percentages at all. The cases of spastic are quite higher than that of the athetoid. The percentage of intellectual ability of the subjects varies from 45.7% to 88.5%. Out of four female subjects, only

one crossed the optimum level (if we consider 50% as the threshold point). An overall assumption can also be made that the condition of female subjects is more pathetic in comparison to the male subjects.

The data from the current study gives preliminary information to propose an intervention approach; and it is aimed at enhancing and designing an efficient intervention program to develop the speaking abilities in children affected with cerebral palsy. This study may provide an insight which may result in an improved motor-speech control. The findings from the study will be a small step in the future studies, which will assess the various phases of motor learning in targeting motor speech strategies in children affected with cerebral palsy. The use of the principle involving the motor learning i.e. the ability of speech-learning is very much recommended for the children (Ludlow, et al., 2008; Maas et al., 2008). The principle of motor learning is very much significant for enhancing the motor skills and the research in these has been limited in the developing nations such as India. The results from the study showed that the subjects exhibited different phases of skills acquisition.

As discussed previously the motor disability in cerebral palsy is an initial symptom and it may sometime lead to the defects in the intelligibility of the CP child's speech. It affects the production of voice in speech, the pronunciation of speech sounds and their series, and also while producing the appropriate sentence melody in the sentences. Thus, the disability in the motor skills in the CP affected children results in the prevention ofthe oral communication skills. Furthermore, the prevalence of the CP itself varies among individuals. Each cerebral palsied child is unique with their own specific skills for speech production and comprehension. A particular sound variation will be missing in a CP child's inventory with the one form other affected children. The language environment also varies from another. In other words, the general activity of speech defects in Cerebral Palsy children as a whole may be worked out for a population but its use in assessing the specific speech abilities of the CP individual and training the same individual in speech production and comprehension has several limitations.

Consonant profile

Mostly the subjects of CP face problems in the articulation of stops and nasal sounds. Normally, Hindi has the following stops and nasal consonant sounds:

Table 6

Hindi Consonant Chart

	Voiceless		Voiced		Nasals
	Un-aspirated	Aspirated	Un-aspirated	Aspirated	
Velar	/k/	/kh/	/g/	/gh/	/N/
Palatal	/c/	/ch/	/j/	/jh/	/ñ/
Retroflex	/ṭ/	/ṭh/	/ḍ/	/ḍh/	/ɳ/
Dental	/t/	/th/	/d/	/dh/	/n/
Labial	/p/	/ph/	/b/	/bh/	/m/

Table 7

The Subjects' Consonant Chart

	voiceless		voiced		Nasals
	Un-aspirated	Aspirated	Un-aspirated	Aspirated	
Velar	/k/		/g/		
Palatal					
Retroflex					
Dental	/t/		/d/		/n/
Labial	/p/		/b/		/m/

As shown in the table (Table 7),the aspirated consonant sounds are generally neglectedby the subjects of CP, and therefore, absent from their consonant chart. The subjects feel problem in articulating the consonant clusters too. The table above reveals that the subjects have only the voiceless /k/, /t/, and /p/ and voiced /g/, /d/, and /b/ sounds in their consonant system. The nasals include the dental /n/ and labial /m/ sounds.

The following are the sounds absent from the subjects' repertoire:

1) All aspirated sounds.
2) Palatal stops /c/ and /j/.
3) Retroflex stops /ṭ/ and /ḍ/.
4) Velar, palatal and retroflex nasals /N/, /ṇ̃/, /ṇ/ respectively.
5) Fricatives /h/ and /f/.
6) Retroflex lateral /l/.
7) Trill /r/.

These are some of the important observations made from the available data. Other important features may also be pointed out from the same.

Cognitive skills

There is a misconception that children with CP have problems with their physical abilities, but not their cognitive skills. But the language disorders occurring in children clearly indicate that cerebral palsy may be impaired in cognitive skills, too. Furthermore, the defects in the perceptual, sensorimotor, and conceptual levels may be distorted, delayed, arrested, or retarded in various degrees of severity in cerebral palsy. CP children were seriously delayed in acquiring all the abilities related to communication, even when they were not mentally retarded (Lencione,1968; Eisenson,1972). This growth is also obviously seen in the acquisition and use of words and categories of words (parts of speech) in the subjects. The CP child does not get all the parts of speech and classes of words that are found in the normal language of the environment.

Major Findings & Conclusion

Our study of the speech of the cerebral palsied children with Hindi as their language of environment reveals the following characteristics:

- Children with cerebral palsied who have moderate to severe category, have only a few sound variations as compared to a normal child.
- Their phonological system also has only a few phonemes, which helps them to differentiate the meanings. However, these limited phonemes are also used with great inconsistency by these children.
- This defect is more marked in the consonant sounds. These children substitute one consonant for another, or in some cases, they insert a consonant that is not normally required in normal speech.

- In terms of vowels, the CP-affected children may have more vowels than the normal usage. These additional vowels may be used marginally. These may also be used in place of or in addition to their equivalent in the phonological system of normal communication.
- The normal corresponding pairs of sounds that we come across in the oral language need not occur in the CP-affected child's speech. If a normal child has a specific phonation in his speech language, this may not be found in the language of a CP-affected child. Many of the ordinances of varying sounds in the sound system of the language of the surroundings may not be fully acquired at all. For instance, all the consonant sounds in the non-speech and speech communication consonant series, like / ph/, /bh/, /kh/, /gh/were not learnt by the children who were assessed in the study. In addition to these, the fricatives such as /s/, /h/, and /s/were also not acquired.
- Articulation of the aspirated sounds such as /bh/, /kh/, /gh/ in Hindi requires a great effort and a finer perspective of the organs that help in the articulation of these speech sounds, and a CP child is not skilled enough to do this kind of activity.
- What is more essential and most significant to an observer is the fact that the moderate to severely impaired CP child will neither produce all the sounds usually produced in a single breath, nor can the affected child produce all the sounds normally produced following a single mode of articulation. For example, Hindi has five stops: [T], [t], [c], [p] and [k]. A medium to severely defected CP child exposed to Hindi language environment will not acquire all these stops.
- Hindi has two velar stops [k, g] as well as a velar nasal [N] in its normal use. The moderate to severely impaired CP child acquires the aspirated voiceless and voiced velar stops [k, g] but not the velar nasal [N].
- In the present study, there were many pronunciation-related issues observed at many places in the speech of CP affected children. Bilabial sounds are more freely learned than other sounds. These are other sounds, such as dental sounds [t, d], velar sounds, and semivowel sounds that require less effort during their articulation. The articulation of the retroflex and pharyngeal sounds was too difficult for the CP-affected children.

The following changes in pronunciation were noticed in the CP subjects exposed to the Hindi environment. These are:

- Stops are frequently acquired than the other sounds. However, among the stop consonants, only the differentiation between verbal and non-verbal skills was acquired, not the quality of aspiration.
- Nasals were also found.
- Semivowels are learned.
- Laterals are acquired to some extent.

However, CP children speaking other languages (such as those of Tibeto-Burman, and Austro-Asiatic languages) may or may not share this acquisition in their speech.

The neuromuscular distinction established between spastic, athetoid, and ataxia is not easy to identify or establish at the speech level. It is not surprising when we consider the fact that a large number of CP patients identified predominantly as spastics or athetoid are found. Likewise, a large number of athetoid subjects show the features of spasticity. Mecham et al., (1960), and several others before them, pointed out that 'speech characteristics are highly uncertain, both within the

affected children with CP from one time to another. Investigators generally agree that although we may be able to differentiate between spastic, ataxic, and athetoid speech, the problems in any one type of cerebral palsy are so diverse that it is practically impossible to draw a single or composite picture of cerebral palsied children.

Spastic speech is recognized by its slow rate and labored production. A spastic child faces grave articulatory problems because of the child's inability to form fine synchronous movements of the tongue, lips, palate, and jaw. The child also exhibits a lack of vocal inflection, has a guttural or breathy voice, uncontrolled volume, and abrupt change in pitch.

These characteristics are shared also by athetoid and ataxia subjects. For this reason, the finer distinctions we wish to make in the speech forms of the subtypes of cerebral palsy may not have any direct consequence for diagnosis and therapy of the neuromuscular subtypes of CP. The parents/caregivers and the therapists must, first of all, work out a profile of speech sounds already in place in the CP child, and then find out whether any pattern in the acquisition of speech sounds can be identified.

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