International Journal of Innovative Research and Advanced Studies (IJIRAS)
Volume 3 Issue 12, November 2016

ISSN: 2394-4404

Phonological Impairments In The Speech Of Cerebral Palsy Learners Of English As A Second Language

Makuto V.M

Bartoo P.

Egerton University,
Department of Language, Linguistics and Literature

Mutiti J.K

Pwani University,
Department of Language and Linguistics

Mandila lucy

Masinde Muliro University of Science and Technology,
Department of Language and Linguistics

Abstract: ***This study examined the speech of school going children in primary school between the age of 7-14 years of age suffering from Cerebral Palsy. The study sought to identify phonological impairments, and in addition to highlight the communication challenges encountered by the speakers. The speech corpus was obtained through recording of the speech of the respondents in a picture naming task whereby the speech sample was recorded and later transcribed on a score sheet. Through the use of the Optimality theory, the researcher characterised and documented the impairments found in the speech. Specifically the researcher identified consonant deletion, cluster deletion, cluster reduction, syllable reduction, fronting, deafrication and stopping as the phonological impairments found in the speech of cerebral palsy learners of English as a second language. Results from this study also show that consonant deletion was the most prevalent impairment. Whereas cluster reduction involved a deletion of a segment from a consonant cluster, substitution saw the target consonant cluster being realised as different consonant. Deaffrication involved the deletion of a stop component while stopping saw the substitution of a fricative for a stop. Notably deletion appeared to be the most common pattern appearing in consonant deletion, syllable reduction and affrication while substitution appeared in fronting and stopping. The phonological impairments led to communication challenges such as misunderstanding, confusion for the listener, unintelligibility and comprehension challenges.***

Keywords ***phonological impairments, speech, cerebral palsy, second language learners, Optimality theory***

I. INTRODUCTION

According to Paneth and Kiely, (1984). Cerebral palsy is a neurological condition with its effects, depending on the areas of the brain that are damaged but the common characteristics include include muscle weakness and or lack of control muscles especially those involved in speech production. Research and analysis of the speech of Cerebral Palsy individuals especially in adults is well established regarding assessment and management. (Hartley et al., 2003). Many studies have examined on intervention strategies such as Alternative Augmentative Communication for individuals with Cerebral Palsy. (Pennington, 2014).

According to Hustad, Gorton, & Lee, (2010) the individuals suffering from Cerebral Palsy have not only a range of deficits in gross and fine motor function but also cognitive abilities, which contribute to communication challenges. The communication challenges have been addressed with speech and language therapy with focus being on expressive communication for example the use of augmentative and alternative devices, facial and use of gestures (Pennington, Smallman, & Farrier, 2006).

Majority of the studies on individuals with Cerebral Palsy have been done in English speaking countries (Leonard, 1998). There are also studies on the speech characteristics of Cerebral Palsy individuals in languages other than English such as Mandarin (Jeng, 2000) and Cantonese (Whitehill and Ciocca, 2000). The research in these languages has shown that data is urgently needed to inform the assessment of the speech of speakers with cerebral palsy and also an investigation into different languages will allow testing of hypotheses based on English-speakers (Leonard, 1998). Notably a study on the speech characteristics of second language learners of English suffering from cerebral palsy is lacking.

II. METHODOLOGY

A. RECORDING TOOLS

The researcher encountered problems while collecting data from cerebral palsy children which included poor concentration in some children, getting exhausted after speaking at long period and involuntary body movements such as jerking, spasm and drooling. Moreover, some cerebral palsy children have a problem of reading. To cope with these problems and to have a natural speech conversation from those subjects, a simple language task was developed. The task involved showing picture plates of pictures representing a group of target words covered all consonants of English including initial, medial and final consonants and cluster consonants. The output speech sample for children was acquired though recording of the speech sample elicited from the picture naming task. In the language tasks a score sheet was used to transcribe each of the words from the speech samples of the respondents. Each word was transcribed while highlighting the target phoneme in the word weather it was in initial, medial or final position. The consonant clusters were also considered.

B. SUBJECTS

The sample comprised of 27 second language learners of English diagnosed with Cerebral Palsy. The subjects ranged in age from 7 to 14 with a mean of 11.0 years. There were nine males and nine females. All speakers were students from St Martins Deporres School for cerebral Palsy (a school for children diagnosed with Cerebral Palsy).

C. MATERIALS

The study consisted of 60 words covering all the possible 77 phonemes in the English language, however, only 20 phonemes were selected for constructing language tasks of the target words using the criteria that every word was a single syllable word and was able to be represented by a picture.

D. PROCEDURE

Recoding was carried out in a quiet classroom with the door without additional soundproofing materials. Subjects were instructed to speak each word in isolation. During the recording, the speech stimuli (the target picture) was presented to the subjects. In the case of unknown the target picture, the target words will be told and those pictures will be repeated after some pre-setup order.

Each child's speech was digitally recorded with a SONY ECM-MS907 recorder held within 16 inches of the child's mouth. All children were recorded in two sessions on consecutive days. Recording each child in two separate sessions enabled us to collect multiple productions of a large number of target clusters. Each session lasted 20– 40 minutes and took place in school.

E. TRANSCRIPTION

The recorded speech samples were transcribed on a score sheet by the researcher. After tape recording and later transcribing the speech sample of the respondents. The researcher also tape recorded the focus group discussions. The process of analysis of the speech samples from the respondents started with the preparation stage which was the selection of units of analysis (Guthrie, et al, 2004.) A unit of analysis can be a word or theme (Polit and Beck, 2004). In this study the units of analysis were words, sentences, narrative retellings and focus group discussions session.

The next stage was the analysis stage which involved the researcher analysing the manifest content. At this point the researcher organised the qualitative data. This process involved open coding, creating categories and abstraction. In open coding the researcher created headings as observed from the data. Then, the list of categories were grouped under high order headings (Mc cain, 1988, Burnard, 1991).

In order to reduce the number of categories the researcher collapsed those that are similar and those that are dissimilar. By creating the categories, this provided a means of describing the phenomenon to increase understanding and to generate knowledge (Cavanagh, 1997). The last stage was the abstraction stage. Each category was named using content characteristic words. Subcategories with similar events and incidents were grouped together as categories and categories grouped together as main categories.

III. RESULTS

PHONOLOGICAL IMPAIRMENTS

In this study we note that Cerebral palsy children have phonological impairments that bring difficulty with development of the speech sound system. This difficulty results in errors affecting entire classes of sounds, these impairments are in identifiable patterns (Gierut, 1998). In the sound system of the children with Cerebral Palsy, it was observed that there was a problem in the production of sounds that are classified as "fricatives." In order to solve this problem, it was noted that the children substituted fricative sounds with "stops" (such as "t" for "s"). This pattern is called *stopping of fricatives* (Gierut, 1998).In other cases there was substitution of a velar sound such as "k" with alveolar sound "t" resulting in what is called *velar fronting*. In both examples, the child was substituting "t" for another sound. Further, some

children were observed to have difficulty producing certain sound sequences. For example, they deleted final consonants or omitted one element of a consonant cluster. The following patterns of phonological impairments were identified in the speech of the respondents with CP in this study.

A. CONSONANT DELETION

The deletion occured in the final consonant or consonant cluster in a syllable or word. (Grunweel, 1997). The following words as shown below have their final consonant deleted

a. GREEN

The above single syllable word has a CVC structure. In this study the researcher was keen on the [n] in final position of the word. The output representation in the speech of the respondents was observed to have an unmarked CV structure as in [gri:]. The final consonant [n] in the syllable structure did not surface in the output.

Input output
Green [gri:n] → [gri]
*MAX

Green [gri:n]	CODA	MAX
A [Gri:n]	*!	
B [Gri:]		*

CODA>>MAX

Table 1: Green → [gri:]

From table 1 the constraint CODA prohibits syllables from being closed by consonants. CODA is ranked higher than the markedness constraint MAX. The output B is taken as the optimal candidate since it violates the lowest ranking constraint MAX. In this example the input word /green/ had the output word as [gri:]. The final consonant [n] was deleted in the pronunciation of the word. The output therefore violated the consonant MAX which requires states that all segments be parsed that is input representation should surface in output representation. The output however obeys the constraint CODA which prohibits closed syllables. In OT grammar ranking of CODA higher than MAX makes it better for an open syllable to occur than it is for segments to be parsed.

B. CLUSTER REDUCTION

This is the phonological impairment that involved the deletion of one or more consonants from a two or three consonant cluster. From the speech of the respondents in this study, the following words were observed to exhibit this impairment.

a. SPOON

In this single syllable word the researcher was keen on the consonant cluster [sp] in the initial position of word. In the speech of the respondents the word was realised as [pu:].

Input output
Spoon [pu:]

The target word spoon [spu:n] has a consonant cluster [sp] this is the marked form. In the output form in the speech of the respondents, the word spoon has the realisation [pu:] and this is the unmarked form

Spoon / pun/

Spoon	COMPLEX	MAX
A spu:n	*!	
B pu:n		*

COMPLEX>>CODA

Table 2: Spoon → [pu]

A look at table 2 above shows candidate B as the optimal candidate. The output obeys the faithfulness constraint COMPLEX which requires all outputs to be unmarked and therefore prohibit forms with consonant clusters. The output representation (candidate B) however, violates the lower ranking constraint MAX because it does not segmentally correspond to the input. From the table COMPLEX is ranked highly than MAX. In OT grammar, this ranking ensures a candidate that violates the high ranking constraint COMPLEX incurs a fatal violation if it has a consonant cluster in the output. For this particular impairment it is a less serious violation to delete segment than for a consonant cluster to occur.

C. SYLLABLE REDUCTION

The impairment involved the deletion of a syllable from a word containing two or more syllable. This deletion was found to have occurred in the unstressed syllable. Data from this study shows that some segments in the output were undergoing sound changes whereby one sound class replaced another class of sounds. In this impairment the / r/ became / w/ and /l/ became / w / or / j/. The following two words found in the speech of the respondents demonstrate this-

a. RABBIT

For the purposes of this study, the researcher was keen on the initial consonant of the word. Rabbit. The word rabbit has two syllables with the CV structure. The phonetic realisation of the word rabbit is / rabit/. In the speech of the respondents the word had the phonetic realisation as / waebi /.

Input output
Rabbit waebi

Rabbit	CODA	IDENT PLACE	MAX
A rabit	*!		
B waebi		*	*

CODA>> IDENTPLACE, MAX

Table 3: Rabbit →[waebi]

Table 3 shows the relationship between the faithful candidate A which incurs a fatal violation of complex since the segment /t/ occurs in the output in the second syllable. Candidate B emerges as the optimal output since it violates the lower ranking constraints. An examination of the output shows that it violated has violated the constraint IDENT in terms of the featural faithfulness by substituting the initial consonant / r / with / w /.The consonant /r/ consonant is a Voiced
Fricative
labiodental
While the /w/ consonant is a voiced
Bilabial

fricative

In the first syllable, the output violates the constraint IDENT PLACE in terms of place of articulation since /r/ is labiodental while /w/ is a bilabial. The output also violated the consonant MAX in the second syllable by the deletion of the final consonant / t/. The output however obeys the higher ranking constraint CODA which prohibits syllables from being closed by consonants. In OT grammar the ranking of CODA before IDENT PLACE and MAX makes it a less violation for an output to delete a segment than for a syllable to have CODA.

D. FRONTING

The error pattern involved dorsal segments being replaced by coronal that is the substitution of sounds in the front of the mouth, usually alveolar, for velar or palatal sounds. In the speech of the respondents with CP in this study the following words were observed to undergo this phonological impairment.

a. KEY

The word key which has a phonetic realisation as /ki/ is a single syllable word with the structure CV. In this word the researcher targeted the phoneme /k/ in initial position. The phoneme has the properties – velar
Voiceless
Plosive

In the speech of the respondents the word was realised as /ti/. An examination of the output representation shows that the output phoneme is /t/ -alveolar
-voiceless
- Plosive

Input Ki /Ki/ output [ti] /ti/

Key /ki/	DORSAL	IDENTPLACE
A ki	*!	
B ti		*

DORSAL>>IDENT PLACE

Table 4: Ki→[ti]

Table 4 above illustrates this relationship for the target word key. By ranking *DORSAL above IDENT PLACE the grammar ensures that the less marked form candidate B is picked as the optimal output. An examination between candidate A and B also shows that the faithful candidate A incurs a fatal violation of the high ranking constraint DORSAL because a dorsal segment /k/ is found in the output. The output however satisfies IDENT PLACE because all the segments retain their corresponding place of articulation as their input counterparts. Candidate B on the other hand satisfies the high ranking constraint DORSAL because the /k/ does not occur in its output. However the candidate violates the constraint IDENT PLACE since /t/ does not correspond to /k/ in terms of place of articulation.

E. DEAFRICATION

This type of phonological impairment involved the deletion of a stop component from an affricate leaving only the continuant aspect. From the speech of the respondents, the following words were found to undergo this impairment. The words are as follows:

a. CHAIR

In the target word chair /fleo/ the researcher targeted the phoneme /s/ in initial position. The target phoneme is /f/ has the following properties:

- ✓ Voiceless
- ✓ Plosive
- ✓ Palatial

In the speech of the respondents the word chair was realised as /sea/

The target phoneme /ts/ which the researcher targeted in the initial position was realised as /s/.

Input phoneme /ts/ Plosive Voiceless Palatial output phoneme s fricative voiceless labiodentals

Input Chair output shea

chair	MAX	IDENT PLACE
Chea	*!	
Shea		*

Table 5

In the output we can see that the output violated the following constraints:-

- ✓ INDENT- MANNER.
  The input is a plosive /ts/s while the output is a fricative.
- ✓ INDENT –PLACE
  The input is a palatal while the output is a labiodental.

b. STOPPING

This is the substitution of a fricative or an affricate for a stop consonant. Several words in the speech of respondents were observed to undergo this impairment.

a. KNIFE

In this single syllable word with a CVC structure, the researcher targeted the final consonant/phoneme /f/. The phonetic realisation of the respondent the word knife is /naïf/. In the speech of the respondents, the word knife/naïf/ was realised as /naip/.

Input /f/ /naïf/ -voiceless -fricative -labiodental output /p/ /naip/ voiceless plosive bilabial

Knife /naïf/ /naip/

Knife	FRICATIVES	IDENT PLACE	IDENT MANNER
A naïf	*!		
B naip		*	*

FRICATIVES>>IDENT PLACE, IDENT MANNER

Table 6: Knife → [naip]

Table 6 above shows the constraint ranking of FRICATIVES over IDENT PLACE and MANNER. Candidate B [naip] is taken as the harmonic optimal candidate compared to candidate B because it is more important for fricatives to be prevented from surfacing than it is for manner and place of articulation to be preserved as dictated by the constraint ranking. From the table we can clearly see candidate A incurring a fatal violation of the high ranked constraint. The table further shows that the output violates two faithful constraints:- featural faithfulness. IDENT- MANNER whereby the input is a fricative while the output is a plosive and IDENT-PLACE since the input is a labiodental while the output is a bilabial.

IV. DISCUSSION

Phonological impairments were categorised into identifiable patterns that include consonant deletion, cluster reduction, syllable reduction, fronting, deafrication and stopping.

Consonant deletion involved a deletion of a consonant in initial, medial or final positions. In this study consonant deletion occurred mostly in final position of words as compared to medial and final positions. A finding that is similar from studies done in English speaking countries.

Cluster reduction involved a deletion of a segment from a consonant cluster. The consonant clusters that were used in this study were pl, bl, tr, sp, sw, gr, fl, br, dr, kr, and tl all the consonants are found in initial position of the words except for tl which is found in final position for the word little. From the consonant clusters the following were the findings:

In a consonant cluster involving a fricative and a plosive, the fricative was deleted. Therefore the consonant reduction affected fricatives a s compared to plosives. The consonant clusters underwent error patterns that were categorized as reductions and substitutions. Whereas reductions involved the target consonant cluster being realized as a consonant (for example, /fr/ → [f] in the word frog which was pronounced as [fog] and /blue/→/b/ as in the word [blue] which was pronounced as [bu].

Substitutions saw the target consonant cluster being realized as another totally different consonant or another consonant cluster altogether. (for example, /thr/→[c]). A comparison of the percentages between reductions and substitutions show reductions being the most common error pattern as compared to substitutions in this study.

In this study syllable reduction involved the deletion of a syllable from a word containing two or more syllable. This deletion was found to have occurred in the unstressed syllable. Data from this study shows that some segments in the output underwent sound changes whereby one sound class replaced another class of sounds. In this study two phonemes /l/ and /r/ show this impairment. Another error pattern involved dorsal segments being replaced by coronals that is the substitution of sounds in the front of the mouth, usually alveolar, for velar or palatal sounds. In this study three phonemes /k/,/g/ and /b/ were observed to undergo this impairment.

Deaffrication involved the deletion of a stop component from an affricate leaving only the continuant aspect. Affected by this impairment were affricatives tʃ and dz examples of words affected were chair which was pronounced as /shea/ and dz in the word jumping which was pronounced as /shumping/

Lastly stopping involved the substitution of a fricative or an affricate for a stop consonant. In this study it was observed to be the most common of the impairment in phonological processes in the speech of the respondents with Cerebral Palsy in this study. Affected by this impairment were fricatives in final position of words.

Notably deletion appeared to be the most common pattern appearing in consonant deletion, syllable reduction, and affrication while substitution appeared in fronting and stopping. The most affected class of sounds in the speech of children with Cerebral Palsy was fricatives

A comparison on the impairments in the speech across gender reveals that boys were most affected compared to the girls in terms of the impairments made in speech. A finding that is in agreement with studies done on Cerebral Palsy in languages such as Cantonese, Mandarin and English.

REFERENCES

[1] Duffy, J. (2005).*Motor speech disorders: Substrates, differential diagnosis, and management* (2nd ed.) Missouri: Elsevier Nosby.
[2] Hartley, C. L., N. Grove, J. Lindsey, and T. Pring. 2003. Treatment effects on speech production and speech intelligibility of dysarthric speech in children with cerebral palsy. In *Cornite Permanent de Liaison des Orthophonistes-Logopedes (CPLOL) Conference Proceedings*.
[3] Heinz J. and Giegerich (1992) English phonology: An introduction lexical strata in English, metical phonology structure, Cambridge university press
[4] http://www.btinternet.com/~ted.power/clu stersindex.html
[5] Jeng, J. 2000. *Intelligibility and acoustic characteristics of the dysarthria in Mandarin speakers with Cerebral Palsy*. Ph.D. Thesis, University of Wisconsin.
[6] Leonard, L. B. 1998. *Children with Specific Language Impairment*. Cambridge, MA: MIT Press.
[7] Manochiopinig et al (2008) Articulation analysis of Thai Cerebral palsy children with dysarthric speech. disability rehabilitation: assistive technology 3
[8] Platt, L. J., G. Andrews, M. Young, and P. T. Quinn. 1980b. Dysarthria of adult cerebral palsy II: Phonemic analysis of articulation errors. *Journal of Speech and Hearing Research*,23(1):41{55.
[9] Peter Roach (2002) A little encyclopaedia of phonetics. Cambridge university press
[10] San Duanmu (2008) Syllable structure: the limits of variation: oxford university press