MOTOR SPEECH SKILLS IN CHILDREN WITH CEREBRAL PALSY: A CASE STUDY OF KARATINA SPECIAL SCHOOL

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other university.

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DEDICATION

This thesis is dedicated to my daughter Celine Waruguru.

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ABSTRACT

This is a case study on motor speech skills in children with Cerebral Palsy (CP). The objectives of this study were to identify the types of speech impairments in children with CP, to describe the impact of impaired motor skills on speech development in the children and to analyze the effects of speech impairment on their psychosocial development. Motor Speech Theory as proposed by Lieberman and Mattingly (1985) was used to guide and explain the findings of this study. The study was done in Karatina Special School. Purposive sampling was used to select five subjects coded as CP1, CP2, CP3, CP4 and CP5. Recording, interviews and participant observation methods were used to collect data. Analysis was done qualitatively. Findings of this study were; that CP causes articulation disorders in the form of substitution, omission and insertion and that speech of CP children is characterized by notable slowness, devoicing and vowel lengthening. Further, the study showed that children whose speech is impaired by CP exhibit withdrawal, are highly irritable, dull, selfish and tend to shy off. Key implications of the study findings are the addition to the existing knowledge of Motor Speech Disorders, help in CP Care Programs and use by Speech and Language Pathologists when dealing with speech disordered children. The findings are applicable as well in identifying ways of interacting with CP children.

ABBREVIATIONS AND ACRONYMS

ACG: Anterior Cingulated Gyrus.

ASHA: American-Speech-Language-Hearing Association

CD: Communication Disorder

CP: Cerebral Palsy

K.S.S: Karatina Special School

LD: Language Disorder

MSD: Motor Speech Disorder

NINDS: National Institute of Neurological Disorders and Stroke (U.S.A)

PD: Psychological Development

SD: Speech Disorder

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DEFINITION OF TERMS

Apraxia of Speech:	Difficulty to move the speech organs to speak even though the muscles are physically able to form speech.
Apraxia:	Difficulty in making certain motor movements.
Cerebral Palsy:	Disorders of motor skills that make the individuals to have abnormal, involuntary or uncoordinated motor movements
Communication disorders:	Impairments in the ability to receive, send, process, and comprehend concepts of verbal, nonverbal and graphic systems.
Dysarthria:	Difficulty in articulation due to disturbance in form or function of the structures that produce speech.
Gesture:	Movement of speech organs to produce a speech sound.
Language disorder:	Disruptions to phonology, morphology, syntax, semantic and pragmatic aspects of communication
Language:	This is the expression of human communication through which beliefs, knowledge and experiences are shared.
Motor Skill:	Motions carried out when the brain, nervous system and muscles work together.
Motor Speech Disorder:	Impairment of the control of speech production and other actions of the muscle groups used to speak.

Motor Speech Skill: A learned/acquired capacity to make muscular movements of speech organs to articulate or use vocalizations in communication.

Neuromuscular Control System: The network of neurons and muscles involved in the control of movement and posture.

Neuromuscular Impairment: Disorder of the functioning of muscles directly or indirectly.

Neuromuscular: Relating to nerve cells responsible for movement of muscles

Psychosocial development: This is the progression from infancy to adulthood of a normally developing individual.

Speech disorder: Problems of articulation, voice and fluency in verbal communication.

Speech: Motor act of expression by articulating verbal signals.

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CHAPTER ONE

INTRODUCTION

1.0 Introduction

This chapter presents the background to the study, statement of the problem, research objectives, research questions, scope, limitations, as well as justification of the study.

1.1 Background to the Study.

Speech is vital for all human beings and its acquisition starts in early childhood. The production of speech depends upon the development of the sound system of a given language which proceeds in regular and systematic steps (Karia, 2007). One of the most important skills in human beings is the ability to control his or her vocal tract to produce speech. However, this skill is a complex multidimensional process that develops either typically or atypically. Speech is seen as the most complex mode of expression of language which requires the coordination of muscles (Gargiulo & Wadsworth 2006).

Studies have shown that speech production is a motor process that is, involving movement. Ladefoged (2006) states that most speech sounds are produced by muscle initiated movements of tongue, lips and other speech organs. These movements can be thought as gestures forming particular sounds. The gestures are made audible by pushing air out of the lungs, producing basic noise at the throat which is then modified by the actions of the muscles in the tongue and the lips.

Ladefoged did not document what happens when muscle weakness or their ineffective coordination disrupts articulator movement.

The neural control of speech in human beings is part of what makes them unique. The limbic system of the human brain, a group of neural structures, controls most vocalizations (Kent, 2004). The electrical stimulation of the anterior cingulated gyrus (ACG), considered part of the limbic system, results in oral movements (Brown, 1988). These movements are responsible for the production of most speech sounds. Kent (2004) further observes that speech is controlled by a pathway that extends from the ACG through the limbic system and midbrain peri-aquiductal gray to medullary and spinal motor neurons. Damage to the ACG results in among other things, kinetic mutism (Jurgens & Cramon, 1982). The kinetic mutism consequently leads to motor skills dysfunction. These studies did not shed light on the speech impairment types resulting from the motor skills dysfunction.

According to Robinson (2008), a child’s first muscular movements are as a result of reflexes. These reflexes end when the child develops full control over the muscles. Reflexes support two key factors for development; interaction with care givers and the child’s capacity for movement. The whole process of the baby being able to roll, sit, and move independently prior to standing and walking is supported by the appearance and inhibition of various reflexes. These reflexes are indicative of neurological health. As the brain matures, there is appearance and gradual diminishing of primitive reflexes.

There are two areas associated with language and speech in the brain; the Broca’s area (the left frontal cortex) and the Wernicke’s area (the posterior part of the left temporal lobe). Broca’s area is responsible for the process of speaking and specific parts of speech production like mouth movements. The Wernicke’s area is responsible for understanding of speech. These two areas are connected by a bundle of nerve fibers (Robinson, 2008).

CP affects part of the brain called the cerebral cortex (Plum, 1990). This is the part of brain that is responsible for movement. Therefore, it will be difficult for the vocal tract muscles to initiate any movement of speech organs like tongue, lips and glottis in children with CP. Children with CP as a result lack capacity to produce any speech or have speech that is characterized by articulation disorders, voice defects or fluency challenges. The researcher in this paper explored the specific speech handicaps that emanate from the difficulties of the vocal tract muscles to initiate movement. The first subject in this study, coded as CP1 was a case of total incapacity for speech production. The other speaking subjects had impaired speech on articulation, voice and fluency. This is illustrated in chapter four of this thesis.

Kaplan and Kaplan (1992) illustrate a child's speech development sequence as follows;

Between birth to late second month – Crying and similar vocalizations

Between end of second month to early first year- Cooing

Between mid to end of first year- Babbling (Mono-syllabic combinations)

Between end of first year to two years – True speech (comprehensible word combinations)

When speech is impaired, it means the above pattern in speech development will be delayed. For example, a child, even after the first two years may still be unable to produce a speech segment like /b/ in words like 'boy' or 'lab'. This may be caused by the fact that the child has not mastered the mechanisms of sound production by the end of first two years. It is also because the child has no capacity to perform speech tasks due to physical impairments like Cerebral Palsy as was evident in CP1 in this study.

Speech impairments are inabilities of individuals to perceive and produce speech appropriately. The impairments range from simple sound repetitions or occasional mis-articulations to total absence of speech (ASHA, 2005). These impairments result in among other things, delayed language acquisition, fluency disorders, articulation disorders and voice disorders (Karia, 2007). Speech impairments caused by CP will be described in detail by this study.

Speech can be described as a motor act (Leung & Kao, 1999) involving coordinated muscular movements of speech organs like glottis, tongue, lips, alveolar ridge etc. Its development is dependent upon neural development of the brain. The brain is made up of neurons and their connections. The main role of neurons is to process and transmit information. As explained in chapter two, neural development in the brain entails neurons (both sensory and motor) growing larger and advancing their connections (Robinson, 2008).

Kent (2004) discusses motor systems as cortical inputs to pattern generators in the brainstem. These pattern generators provide inputs to motor neuron pools generating muscle activity. Neurological development precedes motor development. This is to mean that, for any motor activity to happen, neurons in the brain must have fully been capacitated. Muscle actions that enhance motor development are controlled by neurons in the brain. This study analyzes what happens to speech ability of a child when there is a neurological disorder as in the case of CP.

Speech production involves action of muscle groups such as the respiratory, laryngeal, velopharyngeal systems, jaws, lips and tongue. If the child's motor development is atypical as in the case of CP children, speech production will be impaired. The subjects in this study had impaired speech because the speech muscle groups above could not initiate sufficient movement of speech organs in the production of speech. This will be covered later in chapter four.

When the motor process of speech production is impaired, the resulting condition is a motor speech disorder (MSD). Dysarthria is among the most common types of childhood MSDs. Dysarthria is a condition that result from disturbances affecting the execution of speech actions (Kent, 2004) for example articulation, voice and fluency. Kent (2004) further describes MSD as a condition where there is impairment of neuro-muscular system in the vocal tract responsible for the control of articulators that are used to produce speech. A child with a communication diagnosis of motor speech disorder has either a brain malformation, sustained damage or disease to the central nervous system (Kent, 2004).

MSDs may manifest in ways such as hypertonia, hypotonia, dysarthria and apraxia of speech (Hodge, Wellman, Caruso & Strand, 1999). Hypertonia can be described as a condition marked by abnormal increase in muscle tension and a reduced ability of muscles to stretch *(pathways.org*). This may lead to complete absence of speech (as was the case with CP1 in this study). This condition could be due to the stiffness of muscles of speech organs like tongue, lips and vocal folds. Hypotonia is a state of low muscle tone and often involves reduced muscle strength *(autism.wikia.com)*. As a result of hypotonia, the infant is likely to have speech fluency disorder and phonatory deficits. CP2, CP3, CP4 and CP5 in this study were noted to have fluency and voice defects.

CP is one cause of motor speech disorder. CP comes as a result of a disturbance of neurons' ability to control muscles responsible for the production of speech. Bax, Goldstein, Rosenbaum, and Leviton (2005) define CP as a well-recognized neuro-developmental condition beginning in early childhood and persisting through the life span. Plum (1990), states that CP is caused by damage to the motor area of the brain's outer layer, the part of the brain that directs movement known as the cerebral cortex. However, prior to the current study, how CP causes ineffective movement of muscles in speech organs resulting in speech handicap remained undocumented.

CP can occur before, during or after birth (Peacock, 2000). According to Gargiulo and Wadsworth (2006), CP is classified as Spastic, Athetoid, Ataxic and mixed CP depending on symptoms exhibited. Another classification of CP is based on which part of the body/limbs is affected; Hemiplegia where CP affects the right side of the body, Diplegia where legs are more involved than arms, Paraplegia where only the legs are involved and Quadriplegia where all four limbs are affected. This study, as illustrated later in chapter three, sampled subjects of mixed type, exhibiting most of general symptoms of CP including muscle weakness, exaggerated reflexes, rigidity of limbs, involuntary movements, unsteadiness, poor coordination, speech problems among others. As found by this study, all the children sampled were seen to have speech problems of various dimensions and intensities. The study sought to establish the types of speech impairments caused by CP in the subjects.

CP causes a neurological disorder. This disturbance of neurons that initiate and control muscle movement in the brain may translate to total absence of speech, delayed speech acquisition, phonation or resonation problems due to muscle deficiency in the vocal tract. For example, if the muscles responsible for closing, raising and lowering the lips are defected, the child may not produce labial speech sounds e.g. /b/, /m/ etc. There is hardly any documented study on types of motor speech skills impairment in children with CP in Kenya.

CP has some profound effects on other aspects of human development. Bax et al (2005) outline disturbances of sensation, cognition, communication, perception and/or behavior and seizure disorder as accompanying motor disorders of CP. CP may also cause difficulty in swallowing food, blindness, deafness and brain development abnormalities (*https:www.cpsk.or.ke***)**.

Besides motor development, human beings also develop psychosocially. Human beings go through hierarchical developmental stages, with each stage having a conflict to be resolved and developmental task to be mastered. These stages include; basic trust vs. mistrust, autonomy vs. shame/doubt, initiative vs. guilt, industry vs. inferiority, identity vs. role confusion, intimacy vs. isolation, generativity vs. stagnation and ego integrity vs. despair (Wallerstein,1995). It is theorized that when the conflicts are not resolved at every stage, the child is socially thrown off balance which makes it hard to solve emerging conflicts.

Typically developing children have psychosocial milestones according to their age (*https://wcwts.wisc.edu/).* For example;

0-8 weeks: - the child gazes at faces and smiles responsively

3-4 months: - the child distinguishes primary care givers from others and plays alone

6-9 months: - begins to respond to own name, seeks adult attention etc

12-15months:- shows sense of ‘me’ and ‘mine’, difficulty separating from care givers etc

15-18 months: - imitates adult activities, plays alone, interested in strangers etc

18-24 months: - plays along with other children, throws tantrums, ownership of things etc

24-30 months: - initiates own play

30-36 months: - begins play with others, likes praises, shows sympathy, pity etc

3 years: - begins to take turns, conforms to spoken word, toilets self etc.

4 years: - may be physically aggressive, has 'special friend', bosses others etc

5 years: - enjoys cooperative play, respects peers, accepts adult help and supervision etc

6 years: - very competitive, easily excited, shows jealousy of others etc

7 years: - shows independence in routines, better control of voice and temper, knows right/wrong

This chronological psychosocial development is likely to be affected in atypically developing children, especially those with speech disorders. As a consequence of speech impairment, interaction of children within and outside school will be affected (Ndambiri, 2018). Speech problems with the subjects in this study were seen to affect their social interactions and development.

Globally, all special needs education programs are informed by the principle of inclusion and the recognition of the need to work towards 'schools for all'. The Salamanca Statement (1994) declared that every education program should be designed to take into account the unique characteristics, interests, abilities and learning needs. In Kenya, Special Needs Education is recognized as crucial towards the attainment of Education for All and Millennium Development Goals (The National Special Needs Education Policy Framework, 2009). According to World Health Organization (2006), people living with disabilities make up 10% of the Kenya's total population.

Through the Ministry of Education, the Government of Kenya instituted the National Special Needs Education. Through this initiative, there have been several special needs schools and organizations started to ensure that learners with different special needs have equal access to quality inclusive education. According to a study done by Nyamwende (2018), there are 97 special schools in Kenya. There is only one such school in Karatina, where this study was done. Karatina Special School is a government institution, located in Nyeri County. It is about one kilometer from Karatina Town. The population is composed of autistic, CP and physically impaired children. The study purposively sampled Karatina Special School because the school had subjects with required characteristics. The study then drew generalizations for all CP children in Kenya.

1.2 Statement of the Problem

Motor speech skills development is a very vital aspect of a child's overall development. When the motor aspects of a child's brain are impaired, motor speech disorders occur. CP is one of the known causes of motor speech disorders. Existing studies show that CP causes speech impairment. This is due to halted communication between motor neurons and the muscles. This results to muscle stiffness, coordination problems or complete inability to initiate any movement of the speech organs like lips and tongue. Articulation, fluency or voice is thus affected. This condition also leads to complete absence of speech. The specific types of motor speech impairments as a result of CP have hardly been studied in Kenya.

Impairment of speech affects other aspects of a child's development, especially psychosocially. This is as indicated by literature reviewed in this study. In Kenya, there is hardly any study documented that describes psychosocial development challenges experienced by children with CP due to their motor speech impairment. It is with this backdrop therefore that there arose need to investigate specific psychosocial development issues that children with CP exhibit due to their speech impairment.

This study is on motor speech skills in children with CP and the resulting psychosocial development issues. The researcher analyzed the extent and forms of speech impairment in CP children, focusing also on the psychosocial development challenges related to the speech handicap.

1.3 Research Objectives

This study aimed to;

a) Identify the types of impairment of motor speech skills of children with Cerebral Palsy.
b) Describe the impact of impaired motor skills on speech development in children with Cerebral Palsy.
c) Analyze the effects of speech impairment on psychosocial development in children with Cerebral Palsy.

1.4 Research Questions

This study sought answers to the following questions;

1. What types of impairment of motor speech skills manifest in children with Cerebral Palsy?
2. What is the impact of impaired motor skills on speech development in children with Cerebral Palsy?
3. What psychosocial disorders can be attributed to speech impairment in children with Cerebral Palsy?

1.5 Assumptions of the study

This study assumed the following;

1. Cerebral Palsy causes motor speech skills disorder.
2. Impairment of neuromuscular control in CP children inhibits speech development.
3. Motor speech skills impairment due to CP cause specific psychosocial disorders.

1.6 Justification and Significance

Generally, there is still more research that needs to be done in speech disorders in Kenya. The general knowledge of most speech disorders is limited (Kinyua & Ndung'u, 2009). Specifically, motor speech skills impairment in children with CP has hardly been studied in Kenya. This knowledge is vital for the determination of therapy measures that CP children should be exposed to by their teachers and care givers. This study showed the need to have more speech and language pathologists in Kenya to help CP and other speech impaired children remedy the problem. The teachers of these special needs learners require the knowledge to be able to understand and appreciate the speech of these learners.

The findings of this study may be used to enrich teaching and learning materials in the fields of special needs and speech disorders. This might help in the training of special needs teachers especially those that deal with speech impaired children. As this study described, motor speech impairment in CP children is beyond the training of the teachers entrusted with these children. The problems these children have with their motor speech skills need specialized attention by people with skills in speech therapy, phonetics and phonology. As Karia (2007) notes, therapeutic strategies in communication disorders in Kenya are insufficient. Knowledge and support of speech language pathologists is needed all for children with MSDs (Kent, 2004). Findings of this study further affirmed the above.

Psychosocial disorders in CP children due to their speech impairment, has hardly been studied in Kenya. This knowledge may help teachers of these children, parents, care givers and peers to handle them with specialized care. This is in a bid to make them better communication and interaction partners as well as make them more socially fit. As Kinyua and Ndung'u (2009) note, there is need for strategies that will take into account the two approaches to management of language and speech disorders (physical and behavioral management).

1.7 Scope and Limitations

There are many neuro-muscular diseases in Kenya. However, this study focused on Cerebral Palsy. This is because as discussed earlier, very little information exists on the types of motor speech skills impairment in children with CP. Communication disorders include both language and speech impairments. However, this study was limited to speech impairment.

Time and resources limited the researcher to study all children with CP in Kenya. This study was done in Karatina Special School in Nyeri County. Purposive sampling was done as special children are very sensitive to approach. When they are in an institution, it's easy to identify them. With consent by the National Commission for Science, Technology and Innovation (NACOSTI), the study used children with CP as subjects. Since CP is a disorder of motor skills, a generalization would be made for all CP cases not studied in this research. There are other disorders that result from CP. This study was however limited to motor speech skills related disorders.

1.8 Summary

This chapter has given the background of the study, stated the study problem, and outlined research objectives. The chapter has also justified the study as well as given scope and limitations of the study.

CHAPTER TWO

LITERATURE REVIEW AND THEORITICAL FRAMEWORK

2.0 Introduction

This chapter presents a review of related literature in the field of this study. The literature review is organized into; Speech, Cerebral Palsy, Speech disorders and Cerebral Palsy, Psychosocial Development and Speech Impairment in that order.

The chapter also presents an overview of Theoretical Framework.

2.1. Review of Related Literature

A review of existing literature is done in the categories of speech,

2.1.1 Speech

ASHA (1993) defines Speech as the verbal means of communicating. It consists of articulation (making of sound segments), voice (use of vocal cords and air to produce speech) and fluency (rhythm of speech). All normally developing children have the capacity to develop speech naturally. This happens in a step by step process. For example, speech develops through systematic stages of cooing, babbling, echolalia, jargon, words and word combinations and finally sentence formation respectively (Schwartz, 1996).Speech is seen as the expression of human language with sound (Wadsworth, 2006). It is a process that involves a coordinated activity of muscle groups used to speak e.g. the respiratory, laryngeal, velopharyngeal, jaws, lips and tongue muscles. Speech is therefore a motor skill as other muscular activities such as swallowing and breathing. Leung and Kao (1999) describe speech as a motor act of communicating by articulating verbal expressions.

Speech is dependent upon the neuromuscular maturation in children. The development of human neural and muscular control takes place in the brain. The human brain starts developing after conception with a small number of cells multiplying into billions of cells that later develop into a neural tube, with one end forming the brain and the other one forming the spinal cord (https://www.mychildatcerebralpalsy.org).

It is important to note that language, cognitive skills, movement and control over body functions (including speech) are dependent on brain maturation (Schore, 1994). The brain is what makes up the human living self. It involves connections between neurons, chemicals and transmission of electrical impulses. There are two distinct hemispheres in the brain, the left and the right. Speech production is lateralized to the left hemisphere (Robinson, 2008). The surface of each hemisphere is covered by the cortex, composed of layers of neurons. Neurons are specialized cells of the brain that transmit signals throughout the body. The major role of neurons in the brain is information processing and transmission to other parts of the body. Motor neurons for example send electrical impulses to muscles in the vocal tract for initiation and coordination of movement of speech organs responsible for speech production.

The process of development of neurons within the brain is called myelination. It involves neurons growing larger and making more connections (Robinson, 2008). As observed by Schore (1994), brain maturation happens at different periods among infants. This explains why speech development in children occurs at different rates. Motor speech skills development is determined by this neurological maturation.

Motor skills are motions carried out where the brain and muscles work together. They are grouped into fine and gross motor skills. In the case of a motor activity, e.g. the production of a speech sound, there are groups of neurons that are activated (Robinson, 2008);

i. ***Prefrontal cortex***- this is where the brain makes conscious effort to perform the task and formulates instructions to do it e.g. of making gestural movements by speech organs to produce a sound segment.
ii. ***Motor cortex***- a relay station that sends these instructions to muscles and parts performing the task. In this case, in the vocal tract we have the respiratory, laryngeal, lips, tongue muscles etc. These will be instructed by the motor cortex to initiate gestural movements responsible for production of a specific speech sound.
iii. ***Cerebellum***- this is responsible for supervision of the whole process and adjusts motor actions as necessary in response to external cues such as the linguistic environment of the speech sound being produced.

Robinson (2008) states that in case of a disturbance in any of the above or related parts of the brain, motor activities (including speech production tasks), may be difficult to carry out. This is because of the hindrance in formulating the instructions, understanding the instructions and executing the task. Immaturity in these areas also halters motor speech skills. Cerebral Palsy specifically affects the part of the brain called cerebral cortex. This is the part that directs movement (https://www.ninds.nih.gov>disorders). CP as a result causes motor speech skills impairment. Robinson (2008) did not describe how specifically speech is affected in case of a disturbance on speech related parts of the brain.

Speech in children also depends on the development of the speech production and perception apparatus (Rodman, 2011). Neurological development and physical development are linked. Physical development involves developing control over the body, particularly muscles and physical coordination. The human vocal tract must develop and assume control of movement and coordination for effective speech production. Aronoff and Miller (2003), state that speech, a motor act, is only possible with the evolution of the vocal tract and other speech organs. Motor neurons in the brain process and send electrical impulses as signals to muscles in the vocal tract to initiate movement of speech organs for effective speech production.

Neural systems and motor systems go hand in hand in child development. At birth, the only part of the brain that is myelinated (mature) is the vestibular system, the one responsible for body balance (Goddard, 2005). A new born baby starts with reflex motivated movements, e.g. sucking, grasping, startling, symmetrical tonic neck reflex etc. As the brain matures, these reflexes later diminish and are replaced by voluntary movements initiated by neurons and sensory systems (Robinson, 2008). Robinson (2008) observes that the existence of adjacent motor and sensory maps in the brain lying respectively in the motor cortex at the back of the frontal lobe and in the sematosensory cortex at the front of the parietal cortex, exemplifies the close relationship between the body, sensory systems and movement.

The primitive reflexes that initiate movement responsible for speech sounds production in new born babies diminish gradually. As the infant progresses, speech production muscles initiate voluntary and coordinated movements to articulate, produce voice and enhance fluency of speech. Speech production muscles include muscles of respiration, muscles of lip movement, muscles of mandibular movement, muscles of the tongue, soft palate, pharynx etc. These muscles are commanded by the motor neurons in the brain.

Speech is a product of coordinated neuro-muscular movements. As Laver (1991) notes, one of the most important skills learnt by human beings is the ability to control the vocal tract to produce speech. Speech is the product of the actions of a complex effecter system coordinated in the brain. The muscle systems in the vocal tract must be given specific commands by the brain to perform specific speech tasks (Laver, 1991). Some aspects of the vocal tract are seen to be more primarily concerned with the tactical control of speech. The motor neurons in the brain communicate via electrical impulses to the muscles in the vocal tract to initiate gestural movements needed in the production of speech (Robinson, 2008).

Production of speech sounds mostly involves the movement of the tongue and lips (Ladefoged, 2006). These movements are made audible by pushing air out of the lungs through the throat and vocal tract. The movement of air out of the lungs is the source of power for almost all speech sounds. The respiratory muscles are responsible for the action of pushing air out of the lungs in the process of speech production. It is therefore a motor process, which is affected when there is motor skills impairment as in the case of cerebral Palsy. The focus of this study is to establish the specific speech impairment types caused by motor impairment in CP.

Movement of air is in the respiratory tract is called airstream mechanism. Ladefoged (2009) describes three airstream mechanisms;

a) *Pulmonic airstream mechanism:* - movement/pushing of air out of the lungs.
b) *Glotallic airstream mechanism*: - movement of air by the action of closed glottis.
c) *Velaric airstream mechanism:* - movement of the body of air in the mouth.

According to Ladefoged (2006) speech sounds are either voiced or voiceless. Voiced sounds are produced when the vocal folds are close together. This hinders the air from the lungs from passing freely producing a breathy voice. Voiceless sounds on the other hand are made with an open glottis such that the air passes freely. When there is muscular impairment, as in the case of CP, these actions of the vocal folds (closing and opening) will be hindered hence impairing voice. This paper exemplifies that in chapter four and chapter five.

The movement of air in the vocal tract is set into vibration by the action of the vocal folds. Every time the vocal folds open and close there is a puff of air from the lungs. This vibration of air produces waveforms which is what we hear as acoustic signals (Ladefoged, 2006). The muscles in the vocal folds initiate these vibrations. This process is halted in case of motor skills impairment leading to distorted acoustic signals. The researcher in this study set out to investigate this further.

Speech production is a gestural process i.e. involving phonetic gestures. According to Browman and Goldstein (1989), phonetic gestures are the coordinated movements of the vocal tract (e.g. movement of upper lip and lower lip in articulation of bilabial sounds). Ladefoged (2006) describe phonetic gestures as movement of articulators to produce speech sounds. These gestures are made audible by pushing air out of the lungs producing a noise in the throat. This basic noise is changed to speech sounds by the actions of the speech organs in the mouth e.g. tongue and lips. For example, in the production of the voiced alveolar stop /d/ in the word ‘duck’, as the air passes through the mouth from the lungs, the speaker must make a complete momentary contact at the alveolar ridge with the tip of the tongue. In case the speaker has motor speech impairment, this contact is hindered leading to omission of that particular sound. This will be detailed later in this study.

Gesture is not the movement of individual articulators. For example, the production of /m/, a bilabial stop involves one gesture, a complete stop involving the movement of three articulators; the jaw and the two lips (Galantucci, Fowler & Turvey, 2006). The actions of the speech organs are initiated by their respective muscles following motor commands in the brain.

Coordination of speech muscles is vital in articulation. Karia (2014) states that gestures are activated at different time intervals. The movement of the speech organs (in articulation), as described above, is a complex action of the motor neurons in the brain and speech muscles along the human vocal tract. Therefore, articulation gestures will be affected when there is a disruption of this neural and muscular action that is exhibited in CP.

There are three aspects of speech production; articulation, voice and fluency. Articulation refers to the use of tongue, lips, teeth and mouth to produce recognizable speech sounds. Voice involves the coordination of the lungs, larynx, vocal cords and nasal passage to produce recognizable sounds. Fluency is described as appropriate pauses and hesitations that result in recognizable speech sounds (Kinyua & Ndung'u, 2009).

2.1.2 Motor Impairment in Cerebral Palsy

CP is one of the most common lifelong developmental disabilities among autism and mental retardation (Sankar & Mundkur, 2005). According to Sankar and Mundkur (2005), CP refers to non-progressive, but often changing, motor impairment syndrome secondary to lesions or anomalies of the brain. The brain is made of special types of cells called neurons. These neurons are responsible for a majority of information processing in the brain. Development of the brain means that the neurons grow in size and make more connections. The neuron has three parts; the cell body (responsible for the cells survival), the dendrites (that receive and organize incoming information) and the axion (that sends information to other neurons). Neurons communicate via electrical impulses and chemical messages by the help of neurotransmitters (Robinson, 2008).

As cited in Robinson (2008), in any motor activity, there is a group of neurons activated in the following parts of the brain;

1. *Prefrontal cortex* (where the brain makes conscious effort to perform an activity)
2. *Motor cortex* (relay station that sends instructions to the muscles in the organ performing the task)
3. *Cerebellum* (that supervises the process and adjusts actions accordingly)

The cerebellum is the part of brain that directs muscle movement. This is what is affected by CP. (*https//www.pathways.org*). This disorder may make the individuals have abnormal, involuntary or uncoordinated motor movements. Plum (1990) indicates that CP may appear during birth or the first two to three years of life. CP is marked by poor muscle coordination, stiff muscles, weak muscles, tremors, problems with sensation, hearing, vision, swallowing, speaking. These symptoms are notable as early as one year (Sankar & Mundkur, 2005).

Gargiulo and Wadsworth (2006) classify CP based on symptoms exhibited as follows;

a) *Spastic CP*– stiffness of muscles and exaggerated movements.
b) *Athetoid CP* – writhing movements.
c) *Ataxic CP* –poor coordination of movements.
d) *Mixed CP* – a mixture of the above.

Sankar and Mundkur (2005) give the topographic classification of CP as follows;

a) *Monoplegia*- only affects one leg or one arm. (uncommon)

e) *Hemiplegia*- where either the left or right side of the body is involved. (20-30%)

b) *Diplegia* -where legs are more involved than arms. (30-40%)

c) *Quadriplegia*- where all the four limbs are involved. (10-15%)

This study sampled subjects of mixed type of CP as highlighted in chapter three. Among the symptoms noted with the subjects in this study (coded as CP1, CP2, CP3, CP4 and CP5) include exaggerated reflexes, involuntary movements, poor coordination of muscles and speech problems.

In Kenya, CP is one of the major causes of physical disability (Levitt, 2010). According to the Cerebral Palsy Society of Kenya (CPSK), CP causes impaired movement associated with exaggerated reflexes, floppiness, rigidity of limbs and trunk, abnormal posture, involuntary movements or unsteadiness while walking (www.cpsk.or.ke). Sankar and Mundkur (2005) state that problems associated with CP can be more disastrous for a child than the motor problem. The associated problems include speech deficits (due to bilateral corticobulbar and oromotor dysfunctions), visual impairment and hearing impairments (due to muscular deficiency), epilepsy (due to a neural disturbance in the brain), and nutritional problems (due to poor muscle strength in the mouth leading to feeding hardships).

Sankar and Mundkur (2005), note that 38% of children with CP have articulation disorders and impaired speech. This could be due to oromotor dysfunction. Oromotor dysfunction can be described as the incapacity of organs in the mouth (including tongue and lips) to make articulator movements in production of quality speech. Sankar and Mundkur however did not document the particular types of impairments of speech caused by CP. This study set out to fill this gap.

The first subject sampled in this study (CP1) for example could not make any movement of speech organs in the mouth. He did not have muscles strong enough to produce speech sounds. Amateshe (2011) did a descriptive study on speech development and intervention techniques in children with Down syndrome and Cerebral Palsy. The study's focus was on speech ability of children with Down syndrome and CP, relationship between age of the children and their speech development and intervention methods used to remedy speech impairments in children with the two disorders. This study showed that both Down syndrome and Cerebral Palsy lead to speech problems. The subjects studied produced defective and incomplete structures. Down syndrome and CP as the study suggested may result in articulation problems e.g. omissions, insertions and substitution. Amateshe (2011) observed that speech (a motor skill) may be affected by any motor dysfunction due to difficulties in coordination of muscles that control the sound making process. Besides articulation, speech production also includes voice and fluency. The current study further describes specific motor speech impairment types in CP, not just on articulation but also on voice and fluency. The researcher exemplifies the impact of impaired motor skills on speech development and analyzes the psychosocial challenges CP children experience as a consequence of the speech impairment.

Kent (2004) notes that when there is damage to the central or peripheral nervous system, speech production and subsequent actions of the muscle groups will be impaired. For effective speech development, a child must have adequate control of muscles used in speaking (that is, muscles in the respiratory, laryngeal, velopharyngeal systems, jaws, lips and tongue). CP causes motor impairment syndrome such that there is no control of these muscles (Sankar & Mundkur, 2005). This hinders voluntary movements of speech organs leading to speech impairment which forms the focus of this study.

2.1.3 Speech Disorders and Cerebral Palsy

A disorder can be seen as a deficiency in functioning of something**,** absence of order or a malfunction. Karia (2007), in his descriptive study on cleft lip and cleft palate patients in Kenyatta National Hospital, notes that although human beings have high ability to produce speech, a number of people have some speech and language disorders. Karia (2007) based his study on cleft palate, one of the physical disabilities that cause speech disorders in children. The current study is on CP and the resulting motor speech skills impairment.

Armstrong and Ferguson (2009) describe disordered speech as being qualitatively different from that of either same aged persons or same language-age peers. For example, the child may have misarticulations e.g. substitutions, insertions, ellipses etc., difficulty in fluency of speech e.g. stammering, or breathy voice. Children with CP have speech that is different from age mates with normal development.

ASHA (1993) describe speech disorders as impairments of articulation of the speech sound, fluency and/or voice. They classified speech disorders as follows;

a) *Articulation disorders*- atypical production of speech sounds characterized by substitutions, omissions, additions or distortions that interfere with intelligibility.
b) *Fluency disorders*- interruption of the flow of speaking characterized by atypical rate, rhythm, repetitions in sounds, syllables, words and phrases.
c) *Voice disorders* – abnormal production and/or absence of vocal quality, pitch, loudness, resonance and/or duration which is inappropriate for an individual’s age/sex.

Impairment of speech can also described as motor speech disorder, owing to the fact that speech is a motor skill (Kent, 2004). MSDs can be caused by physical phenomena such as cleft palate, CP, stroke and in some cases may have no known origin.

According to Kent (2004), MSDs in children appear as a result of sustained damage to the central or peripheral nervous system or to muscle tissue. This impairs control of speech production and other actions of the muscle groups used to speak. These muscle groups include those of respiratory system, larynx, lips, tongue, jaw, soft palate etc. The damage to the peripheral nervous system defects the skeletal, muscular and sensory structures of the vocal tract. Damage to the central nervous system affects the neural networks of the brain and the nerves connecting it to the peripheral anatomy of the vocal tract (Laver, 1991). When there is no effective communication between the neurons in the brain and muscles in the vocal tract due to neurological impairments like in CP, the speech organs will have difficulties producing normal speech.

Amateshe (2011) found that CP results in motor speech problems. These problems probably arise from the difficulty such children have in moving speech production organs. As noted earlier, CP affects the cerebral cortex in the brain, the part responsible for directing movement. This results in a disruption of the motor neurons processing and transmission of instructions (in form of electrical impulses) to the speech muscles in the vocal tract. Consequently, the speech organs are unable to initiate or coordinate gestures in the process of speech production.

Karia (2014) used a Gestural approach to study dysarthric speech (in both adult and teen age patients) after traumatic brain injury. The study combined the evaluation of consonant production with measures of the prosodic deviations in dysarthric speech of these patients who have undergone traumatic brain injury. The study found that motor speech disorder in the subjects was as a result of neuromotor impairment. Dysarthric speech following traumatic brain injury results in loss of voicing (due to lack of coordination between oral and glottal gestures), prevalence of falling tone in most phrase boundaries (due to poor breath control), slow speaking rate (due to weak articulator movement) and failure to mark final lengthening (due to lack of intragestural and intergestural coordination) (Karia, 2014).

Traumatic brain injury is one of the causes of MSDs among neurological disorders like CP, stroke, brain tumors or other conditions causing facial paralysis, tongue or throat muscle weakness. The injury causes a disturbance in the neural workings of the brain. The current study is on CP and the resulting speech disorder.

2.1.4 Psychosocial Development and Speech Impairment.

Human development can be classified as intellectual, emotional, physical and psychosocial. Psychosocial development occurs in a hierarchical order (as shown in the table below). Every stage in psychosocial development is important. There are factors however, that may hinder this order, leading to for example, stagnation or failure to adapt to subsequent stages. These factors include conditions like neurological disorders, physical disabilities, intellectual impairments, speech and language disorders etc. As Kinyua and Ndung'u (2009) notes, human beings are social and first learn how to communicate in a social set up e.g. with friends and family. When their speech is disordered, human beings are likely to experience problems in their psychosocial development.

Erikson (1994) theorized that human beings go through crises or conflict in each stage of life. These conflicts must be resolved at each stage, failure to which a social imbalance will be created. The following table shows the human psychosocial development stages as illustrated by Erikson (1994) adapted from Wallerstein (1995);

Table 2.1 Human Psychosocial Development Stages

Stage	**Conflict to be resolved**
Infancy 0-1 years	Basic trust versus mistrust
Toddler 1-3years	Autonomy versus shame/doubt
Preschool 3-5 years	Initiative versus guilt
Elementary school 5-12 years	Industry versus inferiority complex
Adolescence 12-20 years	Identity versus role confusion
Early adulthood 20-40 years	Intimacy versus isolation
Middle adulthood 40-60 years	Generativity versus stagnation
Late adulthood 65 and above	Ego integrity versus despair

According to the above illustration, the first stage of human psychosocial development matches the pre-speech years of a childhood i.e. 0-18 weeks. All the other stages of psychosocial development correspond to speech years of a human being. Therefore, speech plays a major role in the human psychosocial development. It is an important skill in a child's life and hence any disorder can have profound effects on all aspects of a child's life (Gargiulo & Wadsworth, 2006). Such impairments of speech, for example stammering, may make the child have withdrawal symptoms, due to shyness and feeling socially unfit among peers. Speech disorders may hinder the child's personal development and make them unable to achieve their goals (Kinyua & Ndung'u, 2009).

The psychosocial development of children with MSDs may be affected because of the limitations in social interactions (Hodge et al., 1999). The limitations may include the inability of the child to express their needs in a social, family or school setting, difficulty in engaging in social activities such as play games that involve vocal activity like singing, hesitation to answer questions in class for fear of being mocked in case of a speech defect like stammering etc. Speech disorders disadvantage children in every day communication which in turn affects their socialization. These children might seclude or isolate themselves from others (Kinyua & Ndung'u, 2009).

Social problems associated with speech disorders include rejection, being objects of pity and source of humor (Gargiulo & Wadsworth, 2006). These problems may halt the general psychosocial development of the child. If not known by the peers, care givers and teachers, it may be difficult to relate with speech impaired children. For example, Kinyua and Ndung'u (2009) observe that children with speech fluency disorder speech are often mishandled at home, school or in public places and making the individual withdraw. In most times, this may have far reaching consequences on the side of the children. The children with speech impairment need to feel socially fit despite their handicap.

Poor speech in CP children consequently impairs communication. Majority of people tend to mistake speech disorder for a sign of cognitive impairment. This can be frustrating to the children (*www.ninds.nih.gov/disorders/cerebral_palsy/cerebral_palsy.htm*). Due to the stigma associated with speech impairment, the children are likely to experience psychosocial development challenges. Jardine Mwangeka, the CEO of Cerebral Palsy Society of Kenya (since 2006) (*www.standardmedia.co.ke/mobile/article/20001254/journey-of-hope-for-cerebral-palsy-children-as-clinic-offers-free-therapy*), notes that children with CP go through social challenges like rejection (e.g. from peers) and care (e.g. from parents, teachers and government). This rejection may lead to deficits in psychosocial development of these children.

When these children are alienated in a school setting for example, it will be difficult for them to develop social interaction skills as normally developing children. This may cause traumatic consequences both to the child and parents. Speech being one of the social interaction and communication tools, its impairment may further aggravate this problem.

As noted by Sankar and Mundkur (2005), CP may result in behavioral problems. These problems are likely to occur in the process of learning, playing, communication and interaction with peers. Speech impairment as a result of CP, as was discovered by this study, is likely to negatively affect psychosocial development of children.

2.2. Theoretical Framework

This study used Motor Theory of Speech Perception as proposed by Liberman and Mattingly (1985). The theory was applicable primarily because of the important role it assigns to movement and gestural perception. The theory suggests that speech is perceived as a specialized 'module' that detects the intended gestures of the speaker that are basic for production of speech sounds. Unique to the theory is the relation between speech perception and production (Liberman & Mattingly, 1985). The two main tenets of the theory include (Galantucci et al., 2006);

1. Perceiving speech involves perceiving the intended vocal tract gestures of the speaker.
2. Speech perception and speech production are intimately linked to the motor system.

The first claim suggests that speech is perceived as the specific pattern of intended gestures of the speaker in the brain as invariant motor commands that call for movement of articulators (Liberman & Mattingly, 1985). This claim helped to explain what happens in CP1, CP2, CP3, CP4 and CP5. The motor commands in the brain of these children are disrupted due to their neurological dysfunction. CP, as earlier discussed damages the motor control function in the Broca's area of the brain (cerebral cortex). Consequently, the lack of communication between the motor neurons in the brain (both effector and affector neurons) and the speech muscles in the vocal tract resulted in motor speech impairment in the subjects studied.

The second tenet of the theory links speech perception to production. As noted earlier, speech production mostly involves gestures forming particular sounds made audible by pushing air out of the lungs making noise in the throat. This basic noise is changed to speech sounds by the action of respective organs of the vocal tract for the speech sound. What we hear is the waveforms generated by the vibration of vocal folds which form acoustic signals (Ladefoged, 2006). For example, in the production of voiced bilabial stop /b/, the vibration builds up at the larynx by the action of vocal cords coming together to hinder smooth passage of air. The vibration is further intensified by the momentary contact of the lips. By the time the air is released out of the mouth, it forms wave forms that acoustically signal the speech sound /b/.

What is perceived as acoustic signal, according to motor theory of speech perception, translates automatically to what is produced by the speaker. The automaticity of this relation may be halted by a motor skills disorder as in the case of CP. For example, in the above illustration for the production of the voiced bilabial stop /b/, the CP child may perceive it correctly. However, in an attempt to produce the same, the vocal cords may fail to approximate due to the ineffective coordination of the muscles therein, thus losing voice. Further, the labial muscles may not initiate movement of lips to make the momentary contact needed to produce a plosive consonant.

Speech perception and speech production processes as the theory suggest involve the motor system. This shows that the role of the motor speech system is not only to produce speech articulations but also to perceive them. Motor system is the physical manifestation of the laws that coordinate action or muscle activities. It is the combination of cortical inputs to pattern generators in the brain stem which provide input to motor neuron pools for the generation of muscle activity (Galantucci et al., (2006).

In the production of a speech segment like /m/ in the word ‘mouth’, the brain’s motor cortex sends an electrical impulse via motor neurons to initiate motor movement of muscles in the vocal tract. Specifically, the muscles in the diaphragm press the lungs to eject air (eggressive airstream mechanism); muscles in the larynx press the vocal cords together (producing a voiced segment); muscles in the velum lower it (producing a nasal sound); muscles in the lips press the lips together momentarily (producing a bilabial sound). Therefore, the motor speech system can be seen as the coordination of muscle activities in the vocal tract that initiate movement of articulators to produce speech. When this process is dysfunctional, a motor speech skills disorder may result as evident in all the subjects under study.

Findings of this study showed that subjects failed to initiate coordinated movement of articulators in speech production, hence the speech impairment. Motor theory of Speech Perception was used by this study to account for speech impairment in CP.

2.3 Summary

The chapter has reviewed literature related to this study. It also looked briefly at the Motor Theory of Speech Perception that guided the study. The following chapter is on research methodology.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Introduction

This chapter is organized into research design, study location, target population, sampling procedure, data collection methods and ethical considerations.

3.1 Research Design

A research design is a blue print of the research. Research design shows how the data that was used to investigate the research questions was collected and analyzed. This study used a qualitative research design. The collected data was analyzed descriptively.

3.2 Site of the Study

The study was done in Karatina Special School in Kenya, Nyeri County, Mathira District, Karatina Ward. It is located 1km from Karatina town. The school had a total population of sixty two pupils at the time of study. CP children were only 10 out of the population, the others being autistic, mentally and physically impaired. The school is organized in classes as follows;

a) Nursery School (A and B) - the children in this class are taught basic motor activities like feeding and toilet training.

b) Primary Class- Children are taught advanced motor skills like manipulating with toys and team play. They are also introduced to simple speech and writing tasks.

c) Intermediate Class- the children are taught language that is, reading, writing, listening and speaking. They are also taught basic arithmetic and color manipulation.

d) Vocational Class- the children join various vocations (skill based training) depending on their observable abilities. The vocations include tailoring, masonry, carpentry and farming.

The study used subjects in primary and intermediary classes. This is because at these levels, the children are taught and exposed to speech tasks.

3.3 Target Population

This study targeted all children with CP. Since it’s not possible to study all CP children in Kenya, the study used a representative sample of mixed type CP in Karatina Special School.

3.4 Sampling Techniques and Sample Size

This study used purposive sampling in order to identify subjects with the required characteristics. There are the 97 special needs schools in Kenya (Nyamwende, 2018). Karatina Special School is in Mathira District in Nyeri County. It is a public school with a population of 62 pupils with various special needs at the time of study. 10 pupils had CP, 20 were autistic, 19 were mentally handicapped and 13 with general physically impairment. This study sampled CP only subjects in line with the study scope. Only 5 CP children were suitable for this study because they were in classes that involve speech learning in the school. The subjects were coded CP1, CP2, CP3, CP4 and CP5.

CP1 was male; 14 years and in Primary class. CP2 was male; 13 years and in intermediary class. CP 3 was male; 13 years in intermediary class. CP4 was female; 13 years in Primary class. CP5 was female; 14 years in Primary class (See Appendix 2).

3.5 Research Instruments

Tape recording was used to collect speech samples of the five study subjects. The study used interviews on teachers and care givers to collect data on psychosocial development challenges of the CP children. Participant observation was used to gather data on psychosocial traits of the subjects as well as note their speech usage during social interactions. .

3.6 Data Collection Procedures

Qualitative data was collected using audio recording, interview and observation. Speech samples were recorded from the children with CP and transcribed before being analyzed. The study used a speech test adapted from Alpha Test of Phonology (See Appendix 3). It was administered by the teachers with guidance of the researcher. The children felt more comfortable responding to the teachers because of familiarity. This helped elicit more natural speech samples. The speech test comprised of 30 words. The words were names of objects the learners could identify with. It took approximately 30 minutes for the test to be administered on every study subject. Each subject was asked to repeat the words in a dictation. The speech samples were audio recorded. The test was done in a closed room isolated from any noise distractions. Three trials were made by each subject to confirm consistency in the speech samples.

Interviews were done on teachers and care givers to collect data on the children's psychosocial challenges as a result of the speech impairment (See Appendix 1). The study also used participant observation to collect data on how these learners interact with one another as well as with normally developing children in a natural setting. Their behavior patterns were recorded on an observation guide (See Appendix 11, 12, 13, 14 and 15). Participant observation helped take care of observer's paradox.

3.7 Data Management and Ethical Considerations

Before embarking on research, an authorization letter from Kenyatta University Graduate School was sought. National Commission for Science, Technology and Innovation (NACOSTI) was also contacted to give permission for the research. After being informed on the objectives of the study, the parents and guardians of the learners to be used as subjects were requested to sign consent forms. They were also assured of confidentiality of any personal information gathered in the study. The study did not use the real names of the subjects. The subjects were coded as CP1, CP2, CP3, CP4 and CP5 for anonymity.

The parents/guardians, teachers and the caretakers were assured that no harm would be done on the children under study. The researcher explained to them that the findings of this study would help such children in remedy of their challenges especially speech problems and psychosocial issues.

3.8 Summary

This chapter has discussed the research design that was adopted, location of the study, target population, sampling procedure and size. It also contained the data collection methods, analysis and ethical considerations in the study.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND DISCUSSION

4.0 Introduction

This chapter comprises of the study's data presentation. It also gives an analysis of the data. The presentation of study results is guided by the research objectives.

4.1. Speech Impairments in Children with CP

The following table presents data on presence and absence of speech among the subjects under study.

Table 4.1 Presence and absence of speech in the Subjects studied

SUBJECT	PRESENCE OF SPEECH
CP1	×
CP2	√
CP3	√
CP4	√
CP5	√

Note: the √ in table 4.1 above means presence of speech and × means absence of the same

As noted in the table above, all the subjects apart from CP1 could speak, though impaired. Representing the first finding of this study, total absence of speech is an extreme case of speech skills impairment as a result of Cerebral Palsy. The child was notably silent during play and social interaction. The child also minimally exhibited other motor skills like walking, hand movements, chewing and swallowing.

Speech being a motor act (Leung & Kao, 1999), the absence of it thereof is attributed to the extreme impairment of the motor skills ability of this child. The muscular control from the lungs to oral and nasal speech organs is halted as a result of Cerebral Palsy. CP caused a defect in ability of the motor neurons in the brain to initiate movement of the speech muscles in respective speech organs in the subjects studied. This resulted in absence of speech as evident in CP1. According to Amateshe (2011), the absence of speech could also be as a result of paralysis of speech muscles. This means that the subject is unable to initiate and coordinate any movement of speech organs to form phonetic gestures.

Findings show that although CP2, CP3, CP4 and CP5 had speech, their speech was impaired in varying intensities. The table 4.2 below presents a transcription of speech output by CP2, CP3, CP4 and CP5 after the articulation test was administered.

Table 4.2 Transcribed Speech Output for CP2, CP3, CP4 and CP5.

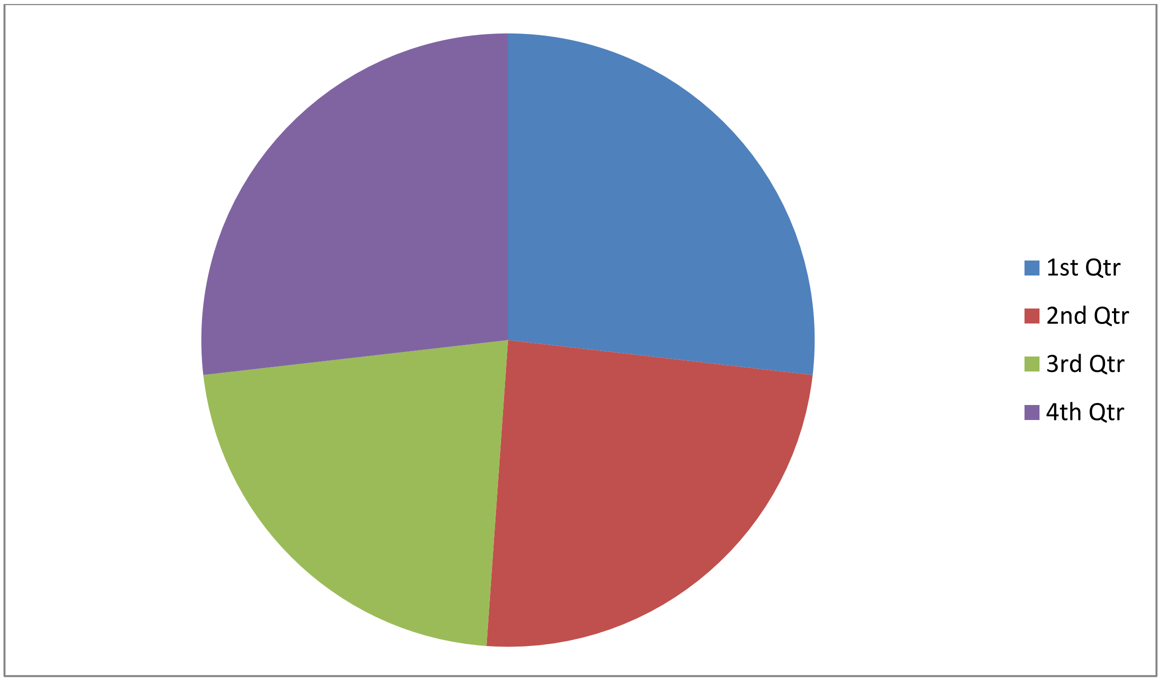
INPUT WORD	STANDARD TRANSCIPTION	OUTPUT BY SUBJECTS UNDER STUDY (FINAL SPEECH SAMPLE)			
		CP2	CP3	CP4	CP5
1.chair	/ʦeə(r)/	/əa/)	/ʦIə/	/ʦa:/	/ʦa/
2. mouth	/maʊđ/	/au/	/ma:Ɵ/	/ma:Ɵ/	/auƟ /
3.nose	/nəuz/	/ɔ:s/	/nɔ:Ɵ/	/ɔ:s/	/ɔs/
4. bus	/bʌs/	/a:s/	/bʌs/	/pʌs/	/ba:s/
5. Tomato	/tə’ma:təu/	/tətu/	/ətɔ:/	/a:tə/	/ta:tə/
6. Duck	/dʌk/	/a:k/	/a:k/	tʌk	/tʌk/
7.Calendar	/kælIndə(r)/	/enda:/	/kenda:/	/ka:lta:/	/ænda:/
8. Goat	/gəut/	/ɔ:t/	/gɔ:t/	/kɔ:t/	/kɔ:t/
9. Shop	/ʃɒp/	/a:p/	/ʃɔ:/	/ʃɔ:pu/	/ʃɔ:p/
10. Fish	/fIʃ/	/fi:/	/f:ʃ/	/i:ʃ/	/i:ʃ/
11. Fan	/fæn/	/fa:nI/	/fa:n/	/a:n/	/a:n/
12. Van	/væn/	/fa:nI/	/fa:n/	/a:n/	/fa:n/
13. Sad	/sæd/	/sa:n/	/sa:n/	/sa:t/	/sa:d/
14. Zoo	/Zu:/	/su:/	/su:/	/su:/	/ʃu:/
15. That	/đæt/	/tat/	Ɵat	/Ɵa:/	/Ɵa:t/
16. House	/həuz/	/aus/	ha:s	/aus/	/aus/
17. Watch	/wɒʦ/	/wɒʃ/	wɒʃ	/ɔ:t/	ɔ:ʦ
18. Yard	jæ:(r)d	/a:n/	/a:n/	/a:t/	/a:t/

19. Yarn	/jæ:(r)n/	/a:n/	/a:n/	/a:n/	/a:n/
20. Rabbit	/ræbIt/	/a:pIt/	/a:pi:t/	/a:pIt/	/a:pIt/
21. Love	/lʌv/	/a:f/	/la:f/	/ʌf/	/lʌf/
22. Lake	/leIk/	/ek/	/lek/	/le:k/	/le:k/
23.present	/prezənt/	/e:nt/	/puresen/	/resen/	/e:nt/
24. Train	/treIn/	/teIn/	/tIreIn/	/turen/	/ti:rein/
25. String	/strIŋ/	/si:n /	/stIrIn/	/tIrIn/	/sItIrIn/
26. Drink	/drIŋk/	/di:k/	/dIrIk/	/tIrIk/	/durInk/
27. Cry	/krəI/	/ka:I/	/kIraI/	/a:e/	/kərae/
28. Black	/blæk/	/ba:k/	/bula:k/	/ba:k/	/ba:k/
29. Plant	/plænt/	/pa:nt/	/pula:nt/	/pa:n/	/pa:t/

From table 4.2, this study notes that CP children exhibit speech impairments like omission, substitution, insertion, devoicing and vowel lengthening. The speech impairments are however in varying degrees. Speech is produced by the actions of speech organs initiated by the respective muscles following motor commands in the brain. The researcher attributes these articulation impairments of the subjects to the neuromotor Dysfunction in Cerebral Palsy subjects (Sankar & Mundkur, 2005).

The chart below presents the various intensities of speech impairment among the speaking the subjects (CP2, CP3, CP4 and CP5).

Chart 4.1 Degree of speech impairment in CP2, CP3, CP4 and CP5



Note;

1st quarter represents CP2 *2nd quarter represents CP3*

3rd quarter represents CP4 *4th quarter represents CP5.*

From chart 4.1 above, CP2 and CP5 were the most affected in their speech impairment followed by CP3 and CP4 respectively. The types of speech impairments exhibited by each of the speaking subjects are presented and discussed below. The analysis is based on sub-categories of articulation, voice and fluency disorders.

4.1.1 Articulation Impairments

Articulation impairment in this study refers to atypical production of speech sounds characterized by substitutions, omissions, insertions or distortions that interfere with intelligibility (ASHA, 1993). Types of articulation impairments exhibited by CP2, CP3, CP4 and CP5 under this study include omission, substitution, insertion and vowel lengthening. The specific articulation impairments for the various subjects under study are presented and discussed below.

Table 4.3 Frequencies of Articulation Impairments in CP2, CP3, CP4 and CP5.

CP2	**ARTICULATION IMPAIRMENT**	**OMISSION**	**INSERTION**	**SUBSTITUTION**	**VOWEL LENGTHENING**
	FREQUENCY	24	1	25	10
	PERCENTAGE	40	2	42	17
CP3	**ARTICULATION IMPAIRMENT**	**OMISSION**	**INSERTION**	**SUBSTITUTION**	**VOWEL LENGTHENING**
	FREQUENCY	12	7	20	16
	PERCENTAGE	22	13	36	29
CP4	**ARTICULATION IMPAIRMENT**	**OMISSION**	**INSERTION**	**SUBSTITUTION**	**VOWEL LENGTHENING**
	FREQUENCY	23	3	28	16
	PERCENTAGE	33	4	40	23
CP5	**ARTICULATION IMPAIRMENT**	**OMISSION**	**INSERTION**	**SUBSTITUTION**	**VOWEL LENGTHENING**
	FREQUENCY	16	5	22	17
	PERCENTAGE	27	8	37	28

Table 4.4 above presents frequencies of articulation impairments in CP2, CP3, CP4 and CP5 as drawn from table 4.2. The percentages were obtained from dividing the frequency of specific articulation impairments for each subject by the total number of articulation disorders and multiplying the answer by 100.

CP2 evidently had substitution as the highest articulation impairment, followed by omission, vowel lengthening and insertion being the lowest. The highest articulation disorder in CP3 was substitution followed by vowel lengthening, omission, and insertion in that order.CP4 had substitution as the highest articulation impairment, followed by omission, vowel lengthening and insertion respectively. The highest percentage of articulation impairments in CP5 was substitution, followed by vowel lengthening, omissions and insertion in that order.

Summary of the articulation impairments for all the subjects is presented in the following table. This is done by contrasting the articulation impairments frequencies of all the subjects.

Table 4.4Summary of Articulation Impairments in the Subjects

ARTICULATION DISORDER	OMISSION	INSERTION	SUBSTITUTION	VOWEL LENGTHENING
FREQUENCY	75	16	95	59
PERCENTAGE	31	7	39	24

The total frequency of each of the articulation impairments in table 4.4 above was obtained by adding the frequencies of the articulation impairments in individual subjects. The percentage was obtained from dividing the frequency of each of the articulation impairments by the total number of articulation impairments in all the subjects, answer multiplied by 100.

The notable trend in the above table presentation is that the CP children studied generally had substitution as the most frequent articulation disorder, followed by omission, vowel lengthening with insertion as the lowest.

This researcher analyzed articulation impairments in the subjects studied with regard to how frequent they occur in the subjects. Illustrations, phonological rules and processes are given as well as discussion on each of the articulation impairments. They are analyzed in the order of omission, insertion, substitution and vowel lengthening.

4.1.1.1 Omission

Omission in this study refers to the articulation impairment where a sound segment is left out in the process of saying a word. As noted in the transcribed speech test samples, (Table 4.2), all the speaking subjects studied, were found to omit sounds in various word positions with varying percentages. An analysis of omissions is presented in the table below with regard to word initial position (WI), word medial position (WM) and word final position (WF). See the following table;

Table 4.5Presentation of Omission

Word Position	WI	WM	WF
Omissions	43	26	6
Percentage	57	35	8

From the table**,** the CP subjects studied omitted sounds in word initial position the highest (57%), followed by word medial position (35%) and word final position (8%) in that order.

The percentage was obtained from taking the total omissions in each word position, divided by the total omissions multiplied by 100.

E.g. for WI → (43÷75) ×100=57%.

Table 4.6 Order of Omission frequency and percentage in the subjects

SUBJECT	CP2	CP4	CP5	CP3	CP1
OMISSIONS	24	23	16	12	------
PERCENTAGE	32	31	21	16	------

CP2 had the highest percentage of omissions, followed by CP4, CP5 and CP3 in that order as presented in table 4.6.

Examples and illustrations of omissions;

Example 1

Input (chair) CP2 output CP5 output

/tʃeə(r)/ /eə/ /tʃa/

In attempt to articulate the word /tʃeə(r)/, CP2 said /eə/. The voiceless palatal affricate sound /tʃ/ in the word initial is omitted. This is described by the phonological process below;

/tʃ/ →/**ø/** # —

CP5 omits the vowel /e/ in an attempt to articulate the word ‘chair’ as seen the articulation test output transcription above.

Voiceless palatal affricate /tʃ/, is produced as a result of two phonetic gestures; the coming together of the tongue blade and the palate, the stopping of airstream, and the obstructed release of the two articulators causing friction. CP2 as a result of weak speech muscles in the tongue could not stop the air at the palate hence the omission. The researcher attributed the weakness in the speech muscles to the neurological disorder cause by CP.

By omitting the low front vowel /e/, CP5 reduces the glide /eə/. According to the study, this is because of the inability for the subject to coordinate the speech muscles in the mouth to form a smooth transition of the phonetic gestures involved in the glide articulation. The subject perceived the phonetic gestures involved in the glide (/eə/) formation by the speaker, but the automatic motor execution of speech muscles to produce the perceived sound segment as explained in the Motor Theory of Speech Perception (Liberman & Mattingly, 1985) is halted.

Example 2

Input	CP2 output	CP5 output
/maʊð /	*/aʊ/*	/auθ /

In above, the voiced bilabial nasal is omitted by CP2 and CP5 in word initial position as illustrated with the following phonological process;

/m/ →[**ø**]   # —

The phonetic gesture in the production of the bilabial nasal /m/ involves the coming together of the lower lip and the upper lip to completely stop the air flow, the release the contact of the two lips to release the air flow, and the lowering the velum so that there is a nasal passage of air. CP2 and CP5 due to the weakness of the speech muscles in the lips and the velum were not able to make the gestural movements and coordinate the speech organs to produce the speech sound hence the omission. This weakness was attributed to the neurological dysfunction as a result of CP.

CP2 also omits the voiced dental fricative /ð/ in the word final position. This is illustrated by the phonological rule below;

/ð/ →**[ø]** —#

According to the researcher, this was because of lack of muscle strength in the production of the dental voice fricative as a result of motor skills deficiency caused by CP.

Example 3

Input	CP2 output	CP4 output	CP5 output
/nəuz/	*/ɔ:s/*	*/ɔ:s/*	*/ɔs/*

In this word, CP2, CP4 and CP5 omit the voiced alveolar nasal in word initial position. The following is the phonological process involved;

/n/ →**[ø]** # —

The coordination of the speech muscles in the tip of the tongue to make contact with the alveolar ridge and the velar to lower so that the air from the lungs can have nasal escape after the constriction at the alveolar ridge in the production of /n/ is halted by the motor skills deficiency in the subjects.

Example 4

Input	CP2 output	CP3 output
/dʌk/	*/a:k/*	*/a:k/*

In example 4, the voiced alveolar stop is omitted by CP2 and CP3 in word initial position. The researcher noted that this was due to the weakness of the speech muscles at the tip of the tongue caused by CP. This made the subjects not able to stop the air at the alveolar ridge to produce that sound segment as illustrated by the phonological process below;

/d/ →[**ø**] # —

Example 5

Input	CP2 output
/gəut/	*/ɔ:t/*

CP2 in this example omits the voiced velar stop in word initial position. The phonetic gesture in the production of the voiced velar stop /g/ involves the movement of the velum towards the back of the tongue, making momentary constriction and release to let the air out. There is also the movement of the vocal cords to make a vibration at the glottis. Irrespective of the subject having perceived that phonetic gesture correctly, the researcher noted that the subject was not able to automatically transition to the production of the sound segment. This is what caused the omission, owing to the deficiency in the actions of motor neurons in the brain.

The phonological rule below illustrates this process;

/g/ →**[ø]** # —

Example 6

Input	CP2 output	CP5 output
/fIʃ/	*/fi:/*	*/i:ʃ/*

The voiceless palatal fricative is omitted by the CP2 in word final position. This is illustrated below;

/ʃ/ →**[ø]** —#

While trying to articulate the same word, CP5 omits the voiceless labio-dental fricative as illustrated below;

/f/ →**[ø]** # —

Example 7

Input	**CP2 output**	**CP3 output**	**CP4 output**	**CP5output**
/prezənt/	*/e:nt/*	*/puresen/*	*/resen/*	*/e:nt/*

From the speech outputs above, the following happen;

i) CP2, CP4 and CP5 omit the voiceless bilabial stop at word initial as shown in the following phonological process.

/p/ →**[ø]** #—

ii) CP2 and CP5 omit the voiced alveolar trill in word medial position. This is described with the following phonological process;

/r/ →[**ø**] **─**#CP2 and CP5 omitted the voiced alveolar fricative at word medial position as illustrated phonologically below;

/z/ →[**ø**] **─**#**─**

As noted above, Motor theory of speech associates speech perception with intended gestures of the speaker which translates automatically to what is produced as speech segments (Galantucci et al., 2006). According to this study, this automaticity is halted in the subjects studied due to CP.

4.1.1.2 Insertion

Insertion in this study refers to articulation impairment where a subject adds a speech segment in the process of articulating a word. From the articulation test administered; all the CP subjects studied were noted to have cases of insertion. An analysis of insertions by the subjects is done with regard to word initial (WI), word medial (WM) and word final (WF) as shown in the table below;

Table 4.7Presentation of Insertion

Word Position	WI	WM	WF
Insertions	0	13	3
Percentage	0	81	19

Table 4.7 shows that the CP children studied inserted sound segments in words. This articulation impairment is most prevalent in word medial position. The following is the order of insertion per subject from highest to lowest;

Table 4.8 order of Insertion frequency and percentage in the Subjects

SUBJECT	CP3	CP5	CP4	CP2	CP1
OMISSIONS	7	5	3	1	---------
PERCENTAGE	44	31	19	6	---------

As evident in the table above, CP3 had the highest number of insertions and CP2 the lowest. Therefore, speech impairment in CP children varies among subjects.

Examples of Insertion;

Examples 1

Input **CP2 output**

/fɑɒn/ */fa:nI/*

/vɑɒn/ */va:nI/*

CP2 inserts the front high short vowel /I/, in word final position when trying to articulate the two words above. The process is illustrated by the phonological rule below;

[ø] → /I/ —#

Example 2

Input	**CP3 output**
/prezənt	*/puresen/*

CP3 inserts the back high vowel /u/ immediately after articulating the voiceless bilabial stop /p/ so that the consonant cluster /pr/ is broken. This is illustrated below;

[ø] → /u/ —#—

Example 3

Input	**CP3 output**	**CP4 output**	**CP5 output**
/treɪn/	/tɪreɪn/	/turen/	/ti:reɪn/

CP3, CP4 and CP5 break the consonant cluster /tr/ in the word present by adding sound segments that were not in the input word. CP3 inserts the short front mid-high vowel /ɪ/. CP4 inserts the short back high vowel /u/. CP5 inserts the long front high vowel /i:/. These processes are illustrated phonologically below in the respective order;

[ø] → / ɪ / —#—

[ø] → /u/ —#—

[ø] → /i: / —#—

Example 4

Input	**CP3 output**	**CP4 output**	**CP5 output**
/drɪnk/	/dɪrɪk/	/tɪrɪk/	/durɪnk/

In this word CP3 and CP4 insert the short front mid-high vowel /ɪ/, while CP4 inserts the short back high vowel /u/. This breaks the consonant cluster /dr/. The following are the respective phonological representations;

[ø] → /ɪ / —#—

[ø] → /u / —#—

This study noted that the reason the CP subjects added speech sound segments in words as illustrated in the examples above was to make articulations easier. This is owing to the motor skills weakness and poor coordination of articulators. Notably, it's easier for some CP subjects to articulate words in syllable segments than in single consonant segments.

CP2 in example 1 above inserted the front high short vowel /I/ in word final position when trying to articulate the words 'fan' and 'van' to make the words disyllabic for easy articulation.

CP3 in example 2 added a back high vowel /u/ between the voiceless bilabial stop /p/ and the voiced alveolar trill /r/. This is in effort to break the double consonant /pr/ which makes it easier to articulate the word. The strength of the speech muscles in the respective speech organs in the subjects is not enough to articulate a consonant cluster, due to the neurological deficiency caused by CP.

The same happens for CP3, CP4 and CP5 in their attempt to articulate the words ‘train’ and ‘drink’. Notably, the consonant clusters /tr/ and /dr/ are broken by inserting the vowels /I/ and /u/ as illustrated in example 3 and 4 above.

According to the Motor Theory of Speech Perception, speech is perceived as a specialized module that detects the intended gestures of the speaker basic for the production of speech sounds (Liberman & Mattingly, 1985). This means that a speaker perceives speech as the intended movements of articulators (gestures) and translates that into formation of the gestures involved in speech production. CP causes weakness in muscles responsible for movement of articulators to form speech sounds in specific words. The resulting effect is articulation impairment like insertion as has been discussed here.

4.1.1.3 Substitution

The term substitution is used in this study to refer to articulation impairment where the subject replaces a speech segment with another. CP2 exhibited the following examples of substitution.

Findings of this study show that substitution had the highest dominance among other articulation impairments. The subjects studied substituted sounds for others in various word positions as shown in the following table;

Table 4.9 Presentation of substitution

Word Position	WI	WM	WF
Substitution	15	50	30
Percentage	16	53	32

As table 4.9 shows, subjects substituted speech sound segments in word initial, medial and final positions. It's noted that most substitutions occurred in word medial position. The following table presents the order of substitution frequency per subject from highest to lowest;

Table 4.10Order of Substitution frequency and percentage in the subjects

SUBJECT	CP4	CP2	CP5	CP3
SUBSTITUTION	28	25	22	20
PERCENTAGE	29	26	23	21

From the table above, CP4 had the highest number of substitutions, followed by CP2, CP5 and CP3 respectively.

Examples of Substitution;

Example 1

Input	CP2 output	CP3 output	CP4 output	CP5 output
/nəuz/	*/ɔ:s/*	*/nɔ:θ/*	*/ɔ:s/*	*/ɔs/*

CP2, CP4 and CP5 substituted the voiced alveolar fricative /z/ for the voiceless counterpart /s/ in word final position while CP3 substituted the same sound for the voiceless dental fricative /θ/. This is illustrated by the following phonological process;

/z/ →/s/**— #**

/z/ →/θ/**— #**

Example 2

Input	CP2 output	CP3 output	CP5 output
/væn/	/fa:nɭ/	/fa:n/	/fa:n/

CP2, CP3 and CP5 in the word above substituted the voiced labio-dental fricative for the voiceless counterpart in word initial position. This is described phonologically below;

/v/ →/f/# ─

Example 3

Input	CP2 output	CP3 output	CP4 output
/sæd/	/s**a:n/**	/s**a:n/**	/s**a:t/**

The voiced alveolar stop /d/ was substituted for the voiced alveolar nasal in word final position by CP2 and CP3 and replaced with the voiceless alveolar stop /t/ by CP4. The phonological rule below describes this;

/d/ →/n/─ #

/d/ →/t/─ #

Example 4

Input	CP2 output	CP3 output	CP4 output	CP5 output
/zu:/	/su:/	/su:/	/su:/	/ʃu:/

In an attempt to articulate this word, CP2, CP3 and CP4 substituted the voiced alveolar fricative /z/ for the voiceless counterpart /s/ in word initial position. CP5 replaced the same sound with the voiceless palatal fricative /ʃ/. This is phonologically illustrated below;

/z/ →/**s**/─ #

/z/ →/ʃ/─ #

Example 5

Input	CP2output	CP3 output	CP4 output	CP5 output
/ðæt/	/tat/	/θat/	/θa:/	/θa:t/

CP2 substituted the voiced dental fricative /ð/ for the voiceless alveolar stop /t/ in word initial position. CP3, CP4 and CP5 replaced the voiced dental fricative /ð / with the voiceless counterpart /θ/. The subject also substituted the front low vowel /æ/ for the central low vowel / **a/** in word medial position. These illustrations are given by the following phonological rules;

/ð/ →/**t**/# ─

/ð/ →/θ/# ─

/æ/ →/**a**/─ # ─

As noted by the researcher, substitution occurred in these subjects because of occurrence of sound segments that required more coordination of speech organs, more air pressure, or more speech muscle strength. In the process of the subjects articulating these words, they substituted the sound segments for others that fitted to their neuromuscular ability.

For instance, CP2, CP4 and CP5 could not articulate the voiced alveolar fricative /z/ in the word ‘nose’ instead they substituted it for the voiceless alveolar fricative as illustrated in example 1. CP2, CP3, CP4 and CP4 substituted /z/ for /s/ in the word ‘zoo’ as illustrated in example 4 above. This is because the subjects did not have enough muscle strength in the larynx to draw the vocal cords closely together so that the air passes with some vibration for the production of the voiced sound. This phonetic gesture did not occur as it had been perceived by the subject probably due poor coordination of the motor neurons to create voice. In the same way, CP2, CP3 and CP5 substituted the voiced labio-dental fricative /v/ for the voiceless counterpart /f/ and lost the voicing as illustrated in example 2.

CP3 substituted the voiced alveolar fricative /z/ for the voiceless dental fricative **/θ/** as shown in the transcribed output in example 1 above. The production of the voiced alveolar fricative required more energy in the respiratory muscles to initiate a higher pressure of air than in the production of the voiceless alveolar dental.

In example 3, CP2 and CP3 substituted the voiced alveolar stop /d/ for the voiced alveolar nasal /n/. The production of the voiced alveolar stop requires more energy than the production of the voiced alveolar nasal. This explains why the subjects opted for /n/ in place of /d/. The two sounds involve two different phonetic gestures, one that was perceived by the subjects and the one they made in the articulation. According to the Motor Theory of Speech, the perceived phonetic gesture should automatically translate to phonetic gesture involved in the production of the same sound. Speech perception and production are linked in the motor system (Galantucci et al., 2006). CP halts this automatic co-relationship between speech perception and speech production resulting to this articulation impairment.

4.1.1.4 Vowel lengthening

Vowel lengthening in this study refers to articulation impairment where the subject makes a vowel longer than it ought to be on a particular word. The subjects studied were noted to lengthen vowels abnormally in different word positions in their articulations. The frequencies and percentages of this disorder are presented as follows;

Table 4.11 Presentation of Vowel lengthening

Word Position	WI	WM	WF
Vowel lengthening	0	42	17
Percentage	0	71	29

This study showed that vowel lengthening was more evident in word medial position in the subjects' utterances. The following table presents the order of vowel lengthening per subject from highest to lowest;

Table 4.12 Order of Vowel Lengthening frequency and percentage in the subjects

SUBJECT	CP5	CP3	CP4	CP2
VOWEL LENGTHENING	17	16	16	10
PERCENTAGE	29	27	27	17

CP5 had the highest percentage of cases of vowels lengthening. CP3 and CP4 had the same percentage of vowels lengthening. CP2 had the lowest percentage.

Examples of Vowel Lengthening;

Example 1

Input	CP2 output	CP3output	CP5 output
/bʌs/	/a:s/		/ba:s/
/dʌk/	/a:k/	/a:k/	
/lʌv/	/a:f/	/la:f/	

CP2 and CP5 in the test word ‘bus’; CP2 and CP3 in the test words ‘duck’, love’, misarticulated the central mid-low short vowel /ʌ/ and produced it as a central low long vowel /a:/. This is illustrated by the following phonological rule;

/ʌ/ →/a: /─ # ─

Example 2

Input	CP2 output	CP3 output	CP4 output	CP5 output
/gəut/	/ɔ:t/	/gɔ:t/	/kɔ:t/	/kɔ:t/

All the speaking subjects changed the diphthong /əu/ and produced it as a long back mid-low vowel /ɔ:/ as illustrated with the following phonological rule;

/əu/ →/ɔ:/─ # ─

Example 3

Input	CP2 output	CP3 output	CP4 output	CP4 output	CP5 Output
/fIʃ/	**/fi: /**	**/fi:** ʃ/	**/fi:**ʃ/	**/i:**ʃ/	**/i:**ʃ/

The short front high vowel /I/ in the word above is articulated as long front high /i:/ by all the speaking subjects studied as illustrated by the phonological process below;

/I/ →/i: /— # —

Example 4

Input	**CP2 output**	**CP 3 output**	**CP4 output**	**CP output**
/fæn/	*/fa:ni/*	*/fa:n/*	*/a:n/*	*/a:n/*
/væn/	*/fa:ni/*	*/fa:n/*	*/a:n/*	*/fa:n/*
/sæd/	*/sa:n/*	*/sa:n/*	*/sa:t/*	*/sa:d/*
/blæk/	*/ba:k/*	*/bula:k/*	*/ba:k/*	*/ba:k/*
/plænt/	*/pa:nt/*	*/pula:nt/*	*/pa:n/*	*/pa:t/*

In the words, fan, van, sad, black and plant as transcribed above, the subjects misarticulated the front low vowel /æ/ as a long central low /a:/. This is illustrated below with a phonological rule;

/æ/ →/a:/— # —

Speech calls for precise movement and coordination of articulators. According to Liberman and Mattingly (1985), there are mechanisms in the brain (invariant motor commands) that call for coordinated movement of articulators to produce specific speech sounds. These movements have to be well coordinated such that if the subject for instance is articulating the mid central short vowel /ʌ/ in the word ‘bus’ in example 1 above, the phonetic gesture will be very accurate as to avoid the unnecessary lengthening of the sound. This precise coordination of speech muscles in the articulators is a result of the brain neuro-motor mechanisms. CP causes a disruption of these motor commands in the brain and this explains why these subjects were not able to produce the short vowels correctly.

The subjects might have perceived the sounds correctly as the intended phonetic gestures of the speaker but were unable to automatically form the perceived gestures to produce the sounds correctly. This led to the speech impairment attributed to the neuro-motor deficiency caused by CP in the subjects.

This study showed that articulation impairments occurred mostly in word medial positions. This is as noted in all articulation impairments discussed above apart from omission which occurred more in word initial position.

4.2 Voice Impairment in Children with CP

According to ASHA (1993), speech impairment also takes form of voice disorder characterized by abnormal vocal quality, loudness, resonance or duration which is inappropriate for an individual’s sex or age. Findings of this study show that CP children have speech that is characterized by breathy voice and loss of voice (see appendix 10, 11, 12, 13, 14 and 15). Loss of voice is also termed as devoicing in this study.

4.2.1 Breathy Voice

Breathy voice in this study refers to voice impairment where a subject has speech that is accompanied by audible breath or a rather hoarse voice.

The following table presents data from on the subjects with regard to voice (see appendix 11, 12, 13, 14 and 15);

Table 4.13 Presence and absence of breathy voice in the subjects

SUBJECT	BREATHY VOICE
CP1	—
CP2	√
CP3	√
CP4	√
CP5	—

Note; √ means presence of breathy voice and — means normal

CP2, CP3 and CP4 were noted to speak in a breathy voice. Speech is a consequence of an airstream mechanism. Speech sounds are mostly produced by the movement of the tongue and the lips, made audible by pushing air out of the lungs through the throat and the vocal tract (Ladefoged, 2009). Air is pushed out of the lungs by the motor action of respiratory muscles. The air stream must be controlled and coordinated in order to correctly produce specific speech sound segments. This air control is coordinated by muscles in the respective articulators along the vocal tract. The researcher noted that this motor process is affected as a result of neurological deficiency in the CP subjects studied. When the speech muscles in the articulators are not strong or their coordinating action is not sufficient enough to control the airstream mechanism, the result is noisy voice or breathiness. This is what happens in CP2, CP3 and CP4.

4.2.2 Loss of Voice

Loss of voice is one of the characteristics of voice disorders as noted by ASHA (1993). Findings of this study show that CP children devoice speech segments while speaking (See Appendix 10). CP3 had the highest percentage of loss of voice as a voice impairment followed by CP2, CP4 and CP 5 respectively. This is as presented in table 4.21 below.

Table 4.14 Presentation of Loss of Voice in the subjects

SUBJECT	CP2	CP3	CP4	CP5
FREQUENCY	5	6	4	3
PERCENTAGE	28	33	22	17

The percentage is obtained from taking the frequency of devoicing for each subject, dividing by the total instances of loss of voice for all the subjects and multiplying the answer by 100.

Examples of loss of voice by specific subjects;

Example 1

In attempt for CP3, CP4 and CP5 to articulate the word ‘mouth’, the subjects devoiced the dental fricative in word final position as shown below;

Input	CP3 output	CP4 output	CP5 output
/maʊð/	*/m:θ/*	*/m:θ/*	*/au:θ/*

[+voice**]** →[-voice]─ #

The same process happens when the all the speaking subjects attempted to articulate the test word ‘that’ in word initial position as shown in the following illustration;

Input	CP2 output	CP3 output	CP4 output	CP5 output
/ðæt/	*/tat/*	/θa*t/*	/θa:*/*	/θa:*t/*

[+voice**]** →[-voice]# ─

Example 2

In an attempt to articulate the test word ‘bus’, CP4 changes the voiced bilabial stop /b/ to the voiceless counterpart /p/ in word initial position.

Input	CP4 output
/bʌs/	*/pʌs/*

[+voice**]** →[-voice]# ─

Example 3

CP4 and CP5 are not able to voice the alveolar stop in the word ‘duck’ as illustrated below;

Input	CP4 output	CP5 output
/dʌk/	*/tʌk/*	*/tʌk/*

[+voice**]** →[-voice]# ─

Example 4

In an attempt to articulate the test word 'goat', CP4 and CP5 lost voice in the velar stop /g/ as illustrated below;

Input	CP4 output	CP5 output
/gəut/	*/kɔ:t/*	*/kɔ:t/*

[+voice**]** →[-voice]# ─

Example 5

CP2, CP3 and CP5 lost voice in the labio-dental /v/ in the word 'van' as shown below;

Input	CP2output	CP3 output	CP5 output
/vən/	*/fa:ni/*	*/fa:n/*	*/fa:n/*

Voice in speech is as a result of the motor mechanism of the vocal folds in the larynx. In production of voiced sounds, the vocal cords are drawn together (Ladefoged, 2006) by the action of laryngeal muscles. As the air from the lungs pushes them apart repeatedly as it passes through, a vibration (voice) is created. The impairment of the neuro-motor control in the laryngeal muscles results to loss of voice as the action of drawing the vocal cords together is halted. In this case, the vocal folds remain open leading to voiceless outputs even when voice is required. This gestural process is halted in case of neuromotor disorder like in CP. Karia (2014) noted that loss of voice in Dysarthric Speech is a result of lack of coordination between oral and glottal gestures. The researcher found that this is what happens in the CP children studied.

4.3 Fluency Impairment

The following table presents data from the subject's observation check lists (Appendix 11, 12, 13, 14 and 15) with regard to their speech rate;

Table 4.15 Speech Rate

SUBJECT	SLOW SPEECH RATE
CP1	—
CP2	—
CP3	√
CP4	√
CP5	√

Note; √ means presence of slow speech rate and — means normal speech

Fluency impairment refers to the interruption to the flow of speaking characterized by atypical rate, rhythm or repetition of sounds and words (ASHA, 1993).

As noted, CP3, CP4 and CP5 (60% of the total subjects studied) had rather very slow speech rate. This is discussed here as the most notable fluency impairment in the subjects studied. This impairment makes the subjects unfit for normal conversational interactions with their peers. The subjects also had abnormal intra-sentential pauses that led to communication breakdown. According to Sankar and Mundkur (2005), one of the symptoms of CP is weakness of muscles. This muscle weakness causes consequential weakness in articulators' movements. Since speech is a gestural process (Browman & Goldstein, 1989), articulators muscle weakness delays their movements to form phonetic gestures responsible for fluent speech. The affected subjects have to take time to gather strength to articulate the next speech sound, word, or sentence hence the abnormally slow speech evident in CP subjects studied.

4.4 Psychosocial Development Challenges in CP Children

The following table presents the most observed psychosocial issues with the subjects under study. This study showed that these issues emanated from their speech impairment. The data is extracted from the observation check lists (Appendix 11, 12, 13, 14 and 15).

Table 4.16 Psychosocial Development Issues

	BEHAVIOR OBSERVED					
SUBJECT	WITHDRWAWAL	HIGH IRRITABILLITY	DULLNESS	SHYING OFF	SELFISHNESS	MOOD SWINGS
CP1	√	√	√	√	×	√
CP2	×	√	√	√	√	√
CP3	√	√	×	×	×	×
CP4	√	×	×	√	√	√
CP5	×	√	√	×	×	×

Note: The tick means presence of the trait and × means absence of the trait

Findings of this study show that CP children exhibit withdrawal, high irritability, dullness, shying off, selfishness and mood swings. These traits were as observed during play and social interaction.

CP may result in behavioral problems occurring in the process of learning, playing, communication and interaction with peers (Sankar & Mundkur, 2005). The subjects under this study were observed in their natural environment including classroom and in the field. The subjects' teachers, caregivers and peer guides were also interviewed to gather data on their psychosocial issues.

The frequency of occurrence of each behavior is also calculated and converted in percentage to determine their degree of dominance in the subjects. The percentage is calculated by taking the number of subjects in whom each behavior is noted over the total subjects multiplied by 100. This is presented in the following table;

Table 4.17 Psychosocial Development Issues Occurrence Percentages

Behavior	Withdrawal	High Irritability	Dullness	Shying Off	Selfishness	Mood Swings
No. of subjects in which the behavior was noted	3	4	3	3	2	3
Percentage	60%	80%	60%	60%	40%	60%

From the table above, high irritability was the most observed psychosocial trait in the subjects studied. Selfishness was the least evident. The psychosocial traits tabulated above are exemplified and discussed below;

4.4.1 Withdrawal

Withdrawal in this study means the tendency of the subjects to isolate themselves from the others in the process of social or classroom interaction. As noted in table 4.19 above, 60% f the CP subjects studied exhibited withdrawal symptoms. CP1, CP3 and CP4 tended to isolate themselves the most. These subjects seemed to disregard calls to cooperate with peers in play activities both in the classroom and in the field.

In the classroom, these subjects were mostly noted to prefer sitting alone and sometimes literally walked away when paired by the teacher. In the field, when others are playing, these children were in most occasions noted to isolate themselves either at the far end of the field or retreat to the classrooms. The researcher attributes this behavior to the subjects' speech impairment. Speech being a vital tool of communication and socialization, its impairment will inhibit social interaction between speech impaired and normal speech individuals. This is alleviated by the fact that the subjects are not able to articulate their needs when in social interaction settings. CP1 for example who exhibited total absence of speech at the time of study was always alone. This is because he could not hold a conversation with his peers.

Subjects like CP3 and CP4 most time used gestures and facial expressions to supplement their speech for communication. They quite often avoided being in settings where they were required to sustain conversations either in the field or in classroom. This prompted their isolation. CP3 at some point was seen to get worked up easily when forced to participate in group play. Sometimes the interaction partners of the CP subjects, for lack of knowhow do not handle them appropriately forcing them to want to be alone most of the time. As Kinyua and Ndung'u (2009) observed, children with fluency disorder are often mishandled at home, school and public places making them to withdraw.

4.4.2 High Irritability

High irritability in this study is used to mean the tendency to be easily irritated or infuriated. From the table 4.19 above, 80% of subjects studied showed signs of high irritability, specifically, CP1, CP2, CP3 and CP5. These children tended to be impatient with their communication partners. As noted by the researcher, this was because of their inability to catch up with the speech rate and speed of their normal speech interaction partners. In classroom, CP2 and CP3 were particularly angered when told to repeat their verbal expressions by the teacher. At one point, CP3 walked out of the classroom in angered protest when he was told to articulate a word for the second time. This is attributed to the fact that the child felt embarrassed of his condition and used the angered protest as a defense mechanism.

Further, the subjects used anger to compensate for their motor speech impairment to show the others that they were ‘abled’ physically if not speech wise. This happened in CP5. CP1, who had total absence of speech expressed anger through crying uncontrollably when talked to. This happened most especially when responses are ‘demanded’ by the speech partner.

CP2 and CP5 sometimes refused to talk entirely when engaged in a conversation. The researcher attributed this behavior to the low self-esteem these motor speech impaired children have. CP5 once slapped a fellow boy when playing for asking him to repeat a statement. This is extreme show of temper and irritability. The subject felt that his play mate was making fun of his condition. As Gargiulo and Wadsworth (2006) noted, social problems associated with speech disorders include rejection, being objects of pity and source of humor. This contributed to the high emotional reactions observed in the subjects under this study.

Most of the subjects studied tended to feel like their social interaction partners were not accommodative hence sometimes get worked up for no apparent reason. Speech is mostly used to communicate one's needs at every stage in the process of human psychosocial development. Once it's impaired, there occurs stagnation with regard to the psychosocial development as noted in subjects under this study.

The subjects studied had varying ways of expressing the anger or irritation. For example, CP1 cried and sometime withdrew from peers; CP5 resulted to violence and bullying; CP3 resulted to self-destruction and use of abusive words with total disregard of the age of the target person, etc. At some point, CP3 knocked herself on a locker injuring her head out of anger when the teacher insisted on her saying a word in class. She probably felt like the teacher was up to embarrassing her in front of the others since the teacher 'knew' she could not articulate the word correctly.

The extremities of emotional irritation are attributed by this study to the ineffectiveness of the subjects to use speech for communication. The teachers and caretakers when interviewed on how they deal with the heightened temper of the subjects highlighted the following;

1. Being patient with the children and giving them time to 'cool off' their anger.
2. Withdrawing favors especially to violent and abusive subjects as punishment.
3. Guidance and counseling.

4.4.3 Dullness

Dullness in this study is used to mean showing signs of boredom of disinterest. CP1, CP2 and CP5 were noted to most often be dull and disinterested in most surrounding happenings. This accrued to 60% of the subjects studied. (See table 4.16)

The dullness was attributed by the researcher to the inability of the children to hold sustainable speech for communication with peers. CP1 who had total absence of speech exhibited the most extreme level of dullness. The child was not at any time observed to smile throughout the entire of study.

One of the teachers during an interview, in relation to the dullness in CP2 and CP5 had this to say;

> These children are very hard to deal with. They are mostly dull and one can never know what is bothering them. Even when you crack a joke in class they are not amused at all. It's hard to know what excites them.

According to this study, this show of disinterest occurred because other peers sometime did not engage them in social activities for the lack of knowledge of how to handle them. Thus, they feel rejected and sidelined because of their condition which makes them dull and non-cooperative during play or classroom activities.

4.4.4 Shying off

For the purposes of this study, shyness means showing signs of feeling embarrassed and timid. Findings of this study showed that 60% of the subjects had signs of shyness (See table 4.16). Particularly, CP1, CP2 and CP4 were mostly shy especially when talked to in public or by strangers like the researcher. Shyness in these subjects is attributed to the low self-esteem of the subjects studied as a result of their speech impairment. The speech impairment at times attracted ridicule from peers. CP1 and CP4 for example avoided direct eye contact with anyone who tried to engage them in a conversation. This low self-esteem led most of them to isolation. CP could not interact with any stranger including the researcher. When ‘forced’ into interaction, the child resulted to crying.

Because of the subjects’ ineffectiveness to use speech for communication, being laughed at, feeling rejected and sometimes ridiculed by their peers (Gargiulo & Wadsworth, 2006), they tended to feel embarrassed in front of other people. As noted, they had varied ways of showing the embarrassment. This indicates that speech impairment results in varied ways of expressing psychosocial development challenges.

4.4.5 Selfishness

For the purposes of this study, selfishness means the unwillingness of the subjects to share items, whether own or communal, with others. Two subjects showed signs of selfishness, CP2 and CP4. This is 40% of the total subjects studied (See table 4.19). This condition is attributed to the need for the subjects to compensate for the social gaps they have due to their motor speech skills impairment. The children felt that what they have in their hands at any time should belong to them only. This is because in most circumstances they are not able to verbally express what they need like their speech abled counterparts.

These children tended to suffer from the ‘me’ and ‘mine’ syndrome where they wanted to own up everything. The researcher noted that it was also due to the children’s low self-esteem. Most of the time the subjects, particularly CP4 was in isolation and this further aggravated the selfishness tendency.

In an interview with the teachers of these subjects, they confessed that sometimes they are forced to provide learning and play equipment to all the learners since they tended to own up what they had at any particular time. This makes learning and social play difficult.

4.4.6 Mood swings

Mood swings is used in this study to mean unpredictability of emotions. 60% of the CP subjects studied showed mood swings as recorded in the observation check list. The analyzed data in table 4.18 show that, specifically CP1, CP2 and CP4 were noted to irregularly show swings of various levels of emotions. CP2 was for example observed to change from extreme excitement to extreme anger and disinterest. CP4 was at one point seen crying and the next minute was laughing.

One of the caregivers had the following to say in an interview;

> Some of these children portray very irregular patterns of emotions that are solely dependent on their ability to verbally express their needs in particular situations. As caregivers, sometimes we are forced to adapt to these impromptu shifts of emotions or mood swings since there is little we can do.

Like it was highlighted by the caregiver, these mood swings can be attributed to the inability for the subjects to use speech effectively for communication and expression of their needs in social and class settings. Also, the ridicule sometime these subjects get from peers owing to their speech impairment could also be a contributing factor to the emotional swings.

As noted in the literature review, the psychosocial development of children with motor speech disorders is affected because of the limitations in social interactions (Hodge et al., 199). This is what was evidently noted in the CP subjects studied here as discussed above. Clearly, these speech impairments were seen to hinder the children’s personal development as had been noted by Kinyua and Ndung’u (2009). This condition makes the children unable to achieve their goals.

4.5 Summary of the Chapter

This chapter has presented, analyzed and discussed the motor speech impairments categorized under articulation, voice and fluency impairments. A discussion of psychosocial development challenges observed in the CP subjects has also been given. The following chapter presents summary, conclusion and recommendations of the study.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

The objectives of this study were to identify the types of motor speech skills impairment in children with Cerebral Palsy, to describe the impact of the impaired motor skills on speech development of children with Cerebral Palsy and to analyze the effects of the speech impairment on the psychosocial development of children with Cerebral Palsy

This chapter presents the summary of findings, implications and recommendations of the study as well as suggestions for further research. The findings are arranged according to the study objectives.

5.1 Summary of Findings

The first finding of this study was that CP causes total absence of speech in children. This was noted in CP1. In cases where CP children have speech, the study found that the speech was impaired. This was the case in CP2, CP3, CP4 and CP5.The impairment is precisely on articulation, voice and fluency. Articulation impairments in CP children as noted in the subjects under study included omission, insertion, substitution and vowel lengthening.

Voice impairment in the subjects was noted to be in the form of breathy voice and loss of voice in their articulations. Fluency impairment in the subjects was found to be in form of slow speech rate.

The analyzed data found that impaired motor skills in children with Cerebral Palsy affected speech development in the children. The above outlined types of speech skills impairment were noted to be as a result of the motor skills handicap caused by CP in the subjects. The neuromotor deficiency caused by Cerebral Palsy halted the muscular initiation and coordination of movement of articulators to form phonetic gestures in the process of speech production.

The study further found that speech impairment in Cerebral Palsy children has specific effects on the psychosocial development of the subjects. From the analyzed data, the study noted the following psychosocial development challenges associated with their speech impairment;

a) *Withdrawal.* The subjects preferred being in isolation to being with peers in social interactions settings and class learning activities.
b) *Irritability.* The subjects were observed to be highly tempered and reacting quickly to simple deeds that they perceived as offences by peers, teachers and care givers.
c) *Dullness.* Most of the subjects were noted to be bored, disinterested in the surrounding happenings and expressed minimal excitement in circumstances that called for such.
d) *Shying off*. The subjects felt embarrassed in front of communication partners especially to strangers. The children could not hold candid conversations as a result of that.
e) *Selfishness.* The subjects were observed to own up items during peer interaction. They showed no interest in sharing anything with others.
f) *Mood swings.* The CP children portrayed varied extremities and shifts of emotions. This made them highly unpredictable and challenging to handle them.

Several explanations have been given in the analysis as contributing factors to psychosocial development challenges in speech impaired CP children;

1. Ineffective capacity of the CP children to use speech for communication of their physical, emotional and social needs. This hinders their social interaction skills.
2. Ignorance on how to deal these speech impaired children by their peers, teachers and care givers. They ended up sidelining them or mishandling them.
3. Ridicule by peers and other social interaction partners. This made the speech impaired children use some of the expressed psychosocial issues as defense mechanisms.
4. Being viewed as objects of pity further aggravates this problem. The children felt more incapacitated when their peers reminded them that they are less abled than them. This made them even more psychosocially unfriendly.
5. Low self-esteem caused by the feelings of inadequacy. This also caused the subjects to exhibit psychosocial challenges like withdrawal and shying off.

5.2 Conclusion

This study purposed to investigate motor speech skills in children with CP. Motor theory of Speech Perception (Mattingly & Liberman, 1985) links Speech Perception and Speech Production. For there to be automatic translation of what is perceived by a child as a sound segment and what the child actually produces, other factors must come to play. These factors include (but not limited to) neural and motor development of a child. This study concludes that neuro-deficiency in CP children halts motor coordination of speech organs that result in inability of a child to produce perceived speech segments.

In summary, speech development of children with Cerebral Palsy is affected on articulation, voice and fluency. It can also totally incapacitate a child's speech ability. Majorly, speech impairment in CP children is on articulation. Articulation impairment caused by CP in the subjects studied is mostly evident in the form of substitution, followed by omission, vowel lengthening and insertion respectively. Therefore, this study confirms Sankar and Mundkur (2005) claim that children with CP may have impaired speech.

This study also sought to analyze the effects of the speech impairment on the psychosocial development of children with Cerebral Palsy. The findings above support the claim by Kinyua and Ndung'u (2009) that psychosocial development of children with motor speech disorders may be affected due to limited social interactions. We can conclude therefore, that the psychosocial issues exhibited by subjects under this study were a consequence of speech impairment.

5.3 Implications of the Study

The findings of this study indicate that Cerebral Palsy affects speech development of children. Evident in the analyzed data is that these children need a multidisciplinary approach to intervention. Teachers, caregivers, psychologists, linguists and speech language pathologists need to work together for the remedy of the speech impairment and related psychosocial issues in children with CP.

The study findings also imply that more speech therapists are needed in Kenya. This will ensure institutions that deal with speech impaired children get frequent speech therapy services. This would be to complement the remedial efforts employed by the teachers and care givers of these children. The findings also imply the need for proper sensitization on the types of motor speech impairment and related psychosocial issues to parents, teachers and peers of children with CP.

5.4 Recommendations

This study makes the following recommendations.

Firstly, Kenya Institute of Curriculum Development may need to introduce capacity building and in-service training for teachers of special schools that deal with speech impaired CP children. The training on the types of motor speech skills impairment as well as related psychosocial development challenges is vital for these teachers. This will enable them to handle these children appropriately, conveniently and effectively. Speech is very essential to a child's development and it's needful for the government to take its remedy crucially.

Secondly, the study recommends more speech language pathologists in Kenya. The challenge of speech impairments and communication disorders as a whole is on the rise in Kenya. More professional intervention is therefore a necessity. This could be achieved through ensuring institutions of higher learning introduce speech language pathology as a course. In addition, career guidance to students in secondary schools is needed for them to consider speech language pathology as careers.

The study further suggests complementary input of linguists (phonologists) working closely with speech language pathologists and teachers of the speech impaired CP children. This is because linguists understand the phonological processes involved in speech impairment. They are also more familiar with the mechanisms of both typical and atypical speech production.

Lastly, this study recommends the intervention of psychologists and counselors with a background of speech pathology for CP children. This is because, going by the findings herein, there are specific psychosocial challenges that CP children face as a result of their speech impairment. The kind of counseling that these children, their teachers and care givers need is not the mainstream one, rather speech impairment specific challenges. This could be achieved by organizing seminars for the already available psychologists as well as offering training units for psychology students in institutions of learning on speech impairment related psychosocial developmental challenges.

5.5 Suggestions for Further Study

This study focused on types of motor speech skills impairment in general. A more specific study could be done on any of the speech impairments for instance voice impairment, with focus on vocal quality, pitch, resonance, voice onset time etc.

A comparative study could be done on CP subjects who are not in a school system in view of determining any co-relationship between speech impairment in CP children and formal schooling.

More study on psychosocial developmental challenges of children with speech impairment as a result of CP could be done focusing on therapy strategies.

Further research could also be done on the relationship between speech impairment in CP children and academic performance.

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APPENDICES

A 1: INTERVIEW GUIDE

The information gathered by the following voluntary interview will be used only for the purposes of this study.

Kindly cooperate.

1. How many of your learners have Cerebral Palsy?
2. Do the learners with CP in your class exhibit speech problems?
3. Do you engage your Cerebral Palsy learners in social activities?
4. Describe the social interaction behavior of your Cerebral Palsy learners.
5. Give a general description of the psychosocial challenges of your CP learners.
6. Describe the self-esteem of your Cerebral Palsy learners?
7. How do you deal with the psychosocial issues of your Cerebral Palsy learners?
8. How would you describe the speech used by the learners with Cerebral Palsy?
9. Do you have difficulties communicating with the Cerebral Palsy learners?

A 2: DATA OF SUBJECTS

SUBJECT 1.

Code: CP1

Age: 14 years

Gender: Male

CP type: Mixed

Class: Primary Level

SUBJECT 2.

Code: CP2

Age: 13 years

Gender: Male

CP type: Mixed

Class: Intermediary Level

SUBJECT 3.

Code: CP3

Age: 13 years

Gender: Male

CP type: Mixed

Class: Intermediary Level

SUBJECT 4.

Code: CP4

Age: 13 years

Gender: Female

CP type: Mixed

Class: Primary Level

SUBJECT 5.

Code: CP5

Age: 14 years

Gender: Female

CP type: Mixed

Class: Primary Level

A 3: SPEECH TEST (MODIFIED FROM ALPHA TEST OF PHONOLOGY)

1. Chair
2. Mouth
3. Chair
4. nose
5. Bus
6. Tomato
7. Duck
8. Calendar
9. Goat
10. Shop
11. fish
12. Fan
13. Van
14. Sad
15. Zoo
16. That
17. House
18. Watch
19. Yard
20. Yarn
21. Rabbit
22. Love

23. Lake

24. Present

25. Train

26. String

27. Drink

28. Cry

29. Black

30. Plant

APPENDIX 4: CONSENT FORM 1 (PARENT/GUARDIAN FOR CP1)

A4 CONSENT FORM 1 (PARENT/GUARDIAN FOR CP1)

This letter is to acknowledge:

1. I am the parent/guardian of the research subject coded as CP2 in this study
2. I am aware of the objectives of the study
3. I hereby give consent to the child under my care to be this study's subject

Signed……………………………………………………………………………..

For Parent/Guardian

Date……10/06/18……………………………………………………………..

APPENDIX 5: CONSENT FORM 2 (PARENT/GUARDIAN FOR CP2)

A5 CONSENT FORM 2 (PARENT/GUARDIAN FOR CP2)

This letter is to acknowledge:

1. I am the parent/guardian of the research subject coded as CP2 in this study
2. I am aware of the objectives of the study
3. I hereby give consent to the child under my care to be this study's subject

Signed……………………………………………………………………..

For Parent/Guardian

Date…10/06/18……………………………………………………………..

APPENDIX 6: CONSENT FORM 3 (PARENT/GUARDIAN FOR CP3)

A6 CONSENT FORM 2 (PARENT/GUARDIAN FOR CP3)

This letter is to acknowledge:

1. I am the parent/guardian of the research subject coded as CP2 in this study
2. I am aware of the objectives of the study
3. I hereby give consent to the child under my care to be this study's subject

Signed…J Wanugunu……………………………………………..

For Parent/Guardian

Date……10/06/2018…………………………………..

APPENDIX 7: CONSENT FORM 4 (PARENT/GUARDIAN FOR CP4)

A7 CONSENT FORM 2 (PARENT/GUARDIAN FOR CP4)

This letter is to acknowledge:

1. I am the parent/guardian of the research subject coded as CP2 in this study
2. I am aware of the objectives of the study
3. I hereby give consent to the child under my care to be this study's subject

Signed..

For Parent/Guardian

Date.......10/06/2018..

APPENDIX 8: CONSENT FORM 5 (PARENT/GUARDIAN FOR CP5)

A8 CONSENT FORM 2 (PARENT/GUARDIAN FOR CP5)

This letter is to acknowledge:

1. I am the parent/guardian of the research subject coded as CP2 in this study
2. I am aware of the objectives of the study
3. I hereby give consent to the child under my care to be this study's subject

Signed………………………………………………………………………..

For Parent/Guardian

Date………10/08/2018……………………………………..

A 9: TRANSCRIPTION OF CP2, CP3, CP4 AND CP5 SPEECH SAMPLES

INPUT	CORRECT TRANSCIPTION	SUBJECTS' OUTPUT (FINAL SAMPLE)			
		CP2	CP3	CP4	CP5
1.chair	/ʦeə(r)/	/əa/	/ʦIə/	/ʦa:/	/ʦa/
2. mouth	/maʊđ/	/au/	/ma:Ɵ/	/ma:Ɵ/	/auƟ /
3.nose	/nəuz/	/ɔ:s/	/nɔ:Ɵ/	/ɔ:s/	/ɔs/
4. bus	/bʌs/	/a:s/	/bʌs/	/pʌs/	/ba:s/
5. Tomato	/tə'ma:təu/	/tətu/	/ətɔ:/	/a:tə/	/ta:tə/
6. Duck	/dʌk/	/a:k/	/a:k/	tʌk	/tʌk/
7.Calendar	/kælIndə(r)/	/enda:/	/kenda:/	/ka:lta:/	/ænda:/
8. Goat	/gəut/	/ɔ:t/	/gɔ:t/	/kɔ:t/	/kɔ:t/
9. Shop	/ʃɒp/	/a:p/	/ʃɔ:/	/ʃɔ:pu/	/ʃɔ:p/
10. Fish	/fIʃ/	/fi:/	/f:ʃ/	/i:ʃ/	/i:ʃ/
11. Fan	/fæn/	/fa:nI/	/fa:n/	/a:n/	/a:n/
12. Van	/væn/	/fa:nI/	/fa:n/	/a:n/	/fa:n/
13. Sad	/sæd/	/sa:n/	/sa:n/	/sa:t/	/sa:d/
14. Zoo	/Zu:/	/su:/	/su:/	/su:/	/ʃu:/
15. That	/đæt/	/tat/	Ɵat	/Ɵa:/	/Ɵa:t/
16. House	/həuz/	/aus/	ha:s	/aus/	/aus/
17. Watch	/wɒʦ/	/wɒʃ/	wɒʃ	/ɔ:t/	ɔ:ʦ
18. Yard	jæ:(r)d	/a:n/	/a:n/	/a:t/	/a:t/

19. Yarn	/jæ:(r)n/	/a:n/	/a:n/	/a:n/	/a:n/
20. Rabbit	/ræbIt/	/a:pIt/	/a:pi:t/	/a:pIt/	/a:pIt/
21. Love	/lʌv/	/a:f/	/la:f/	/ʌf/	/lʌf/
22. Lake	/leIk/	/ek/	/lek/	/le:k/	/le:k/
23.present	/prezənt/	/e:nt/	/puresen/	/resen/	/e:nt/
24. Train	/treIn/	/teIn/	/tIreIn/	/turen/	/ti:rein/
25. String	/strIŊ/	/si:n /	/stIrIn/	/tIrIn/	/sItIrIn/
26. Drink	/drIŊk/	/di:k/	/dIrIk/	/tIrIk/	/durInk/
27. Cry	/krəI/	/ka:I/	/kIraI/	/a:e/	/kərae/
28. Black	/blæk/	/ba:k/	/bula:k/	/ba:k/	/ba:k/
29. Plant	/plænt/	/pa:nt/	/pula:nt/	/pa:n/	/pa:t/

A 10: OBSERVATION CHECK LIST 1

DATE: 11/03/2018.

PLACE: PLAY GROUND

TIME: 2-3.30PM

Subject	CP type	Behavior	Observed(tick)
CP1	MIXED CP	a) Withdrawal from peers	√
		b) Irritability	√
		c) Shying off	√
		d) Abnormal slow rate of speech	×
		e) Stammering	×
		f) Breathy voice	×
		g) Difficulty in coordination of limbs while playing	√
		h) Feeding/swallowing problems	√
		i) Dullness	√
		j) Selfishness	×
		k) Mood swings	√

A 11: OBSERVATION CHECK LIST 2

SUBJECT: CP2

DATE: 12/01/2018

PLACE: CLASSROOM

TIME: 9-10.30 AM

Subject	CP type	Behavior	Observed(tick)
CP2	MIXED	a) Withdrawal from peers	×
		b) Irritability	√
		c) Shying off	√
		d) Abnormal slow rate of speech	×
		e) Stammering	×
		f) Breathy voice	√
		g) Difficulty in coordination of limbs while playing	√
		h) Feeding/swallowing problems	√
		i) Dullness	√
		j) Selfishness	√
		k) Mood swings	√

A 12: OBSERVATION CHECK LIST 3

SUBJECT: CP3

DATE: 15/01/2018

PLACE: PLAYING GROUND

TIME: 3-4PM

Subject	**CP type**	**Behavior**	**Observed(tick)**
CP3	SPASTIC	a) Withdrawal from peers	√
		b) Irritability	√
		c) Shying off	×
		d) Abnormal slow rate of speech	√
		e) Stammering	×
		f) Breathy voice	√
		g) Difficulty in coordination of limbs while playing	√
		h) Feeding/swallowing problems	√
		i) Dullness	×
		j) Selfishness	×
		k) Mood swings	×

A 13: OBSERVATION CHECK LIST 4

SUBJECT: CP4

DATE: 18/01/2018

PLACE: PLAY GROUND

TIME: 2.30-3.45PM

Subject	**CP type**	**Behavior**	**Observed(tick)**
CP4	SPASTIC	a) Withdrawal from peers	√
		b) Irritability	×
		c) Shying off	√
		d) Abnormal slow rate of speech	√
		e) Stammering	×
		f) Breathy voice	√
		g) Difficulty in coordination of limbs while playing	√
		h) Feeding/swallowing problems	×
		i) Dullness	×
		j) Selfishness	√
		k) Mood swings	√

A14: OBSERVATION CHECK LIST 5

SUBJECT: CP5

DATE: 19/01/2018

PLACE: CLASSROOM

TIME: 11 AM -2.30 PM

Subject	CP type	Behavior	Observed(tick)
CP5	MIXED	a) Withdrawal from peers	×
		b) Irritability	√
		c) Shying off	×
		d) Abnormal slow rate of speech	√
		e) Stammering	×
		f) Breathy voice	×
		g) Difficulty in coordination of limbs while playing	√
		h) Feeding/swallowing problems	×
		i) Dullness	√
		j) Selfishness	√
		k) Mood swings	×

A15: KENYATTA UNIVERSITY GRADUATE SCHOOL RESEARCH PERMIT

KENYATTA UNIVERSITY
GRADUATE SCHOOL

E-mail: dean-graduate@ku.ac.ke
Website: www.ku.ac.ke

P.O. Box 43844, 00100
NAIROBI, KENYA
Tel. 8710901 Ext. 57530

Our Ref: C50/CE//25959/2014

DATE: 9th November, 2017

Director General,
National Commission for Science, Technology and Innovation
P.O. Box 30623-00100
NAIROBI

Dear Sir/Madam,

RE: RESEARCH AUTHORIZATION FOR ROBERT GATOHO MWANGI – REG. NO. C50/26695/2013.

I write to introduce Mr. Robert Gatoho Mwangi who is a Postgraduate Student of this University. He is registered for M.A degree programme in the **Department of English and Linguistics.**

Mr. Robert Gatoho intends to conduct research for a M.A Project Proposal entitled, **"Motor Speech Skills in Children with Cerebral Palsy; A Case Study of Karatina Special School".**

Any assistance given will be highly appreciated.

Yours faithfully,

MRS. LUCY N. MBAABU
FOR: DEAN, GRADUATE SCHOOL

EM/lnn

A16: NACOSTI RESEARCH PERMIT

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

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2241349,3310571,2219420
Fax:+254-20-318245,318249
Email: dg@nacosti.go.ke
Website : www.nacosti.go.ke
When replying please quote

NACOSTI, Upper Kabete
Off Waiyaki Way
P.O. Box 30623-00100
NAIROBI-KENYA

Ref. No. **NACOSTI/P/18/39091/25148**

Date: **21st September, 2018**

Robbert Gatoho Mwangi
Kenyatta University
P.O. Box 43844-00100
NAIROBI.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***"Motor speech skills disorders in children with cerebral palsy, a case of Karatina Special School"*** I am pleased to inform you that you have been authorized to undertake research in **Nyeri County** for the period ending **20th September, 2019.**

You are advised to report to **the County Commissioner and the County Director of Education, Nyeri County** before embarking on the research project.

Kindly note that, as an applicant who has been licensed under the Science, Technology and Innovation Act, 2013 to conduct research in Kenya, you shall deposit **a copy** of the final research report to the Commission within **one year** of completion. The soft copy of the same should be submitted through the Online Research Information System.

DR. MOSES RUGUTT, PHD, OGW
DIRECTOR GENERAL/CEO

Copy to:

The County Commissioner
Nyeri County.

The County Director of Education
Nyeri County.