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Investigating the impact of speech production problems on individuals with intellectual disability and associated neurodevelopmental disorders: Case of some children from two schools in Yaounde

A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF A MASTERS DEGREE IN LINGUISTICS
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DEDICATION

TO MY PARENTS

MR AND MRS MOYE HERMANN

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ABSTRACT

This research aimed to identify speech production problems in individuals with intellectual disability (ID) and associated NDDs, to determine the impact of these speech problems on the individuals and to suggest possible therapeutic measures used by teachers that can ameliorate their speech prowess. In carrying out this study, the researcher made use of the qualitative method whereby research instruments such as; observation checklists, interview guide and language tests were employed. The researcher made use of participant (active and passive) observation and semi-structured interviews to get better insight into the subject matter. The researcher through purposive, non-probability sampling technique, sampled fourteen participants with ID and associated NDDs both male and female ranging from nine to twenty-five years of age drawn from two schools. Meanwhile Levelt's (1989) model of speech production underpinned the study thereby facilitating the analysis of data elicited. The findings revealed that individuals with ID and associated NDDs suffer from speech problems such as, articulation disorders, (substitution and addition); phonological disorders, (deletions, cluster reduction, gliding, voicing, devoicing and denasalization); voice disorders, (hypernasality and dysprosody); fluency disorders (stuttering) and muscle speech disorders (dysarthria and apraxia of speech). The findings further revealed that the speech production problems faced by individuals with ID and associated NDDs have severe impact on their social interaction, academic performance, and overall communication abilities. The research findings also revealed some significant therapeutic measures used in the schools to enhance learning abilities. Some of the therapeutic measures employed by the teachers to ameliorate the speech abilities of the participants were; articulatory/speech therapy exercises, voice therapy and fluency therapy exercises. On the basis of the findings, the study recommends among other things early intervention of the parents and the society in ameliorating the speech of children with intellectual disability and associated NDDs and provide inclusive environments for the children. Also, educators should work hand in gloves with other health care providers in order to identify and address speech difficulties early on.

RESUME

Cette recherche visait à identifier les problèmes de production de la parole chez les personnes présentant une déficience intellectuelle (DI) et des troubles neurodéveloppementaux associés, à déterminer l'impact de ces troubles de la parole sur les personnes concernées et à suggérer des mesures thérapeutiques possibles utilisèes par les enseignants pour améliorer leurs compétences langagières. Dans le cadre de cette étude, le chercheur a utilisé une méthode qualitative avec des instruments de recherche tels que des grilles d'observation, des guides entretiens et des tests de langage. Le chercheur a utilisé l'observation participante (active et passive) et des entretiens semi-structurés pour mieux comprendre le sujet. Grâce à un échantillonnage initie par choix raisonné, non probabiliste, le chercheur a sélectionné quatorze participants, hommes et femmes, âgés de neuf à vingt-cinq ans, présentant une DI et des troubles neurodéveloppementaux associés, issus de deux écoles. Le modèle de production de la parole de Levelt (1989) a sous-tendu l'étude, facilitant ainsi l'analyse des données recueillies. Les résultats ont révélé que les personnes présentant une DI et des troubles neurodéveloppementaux associés souffrent de problèmes de parole tels que des troubles de l'articulation (substitutions et additions) ; des troubles phonologiques (suppressions, réductions de groupes consonantiques, glissements, voisement, dévoisement et dénasalisation) ; des troubles de la voix (hypernasalité et dysprosodie) ; des troubles de la fluence (bégaiement) et des troubles moteurs de la parole (dysarthrie et apraxie). Les résultats ont également révélé que les problèmes de production de la parole auxquels sont confrontées ces personnes ont un impact sévère sur leurs interactions sociales, leurs performances académiques et leurs capacités de communication globales. L'étude a également mis en évidence certaines mesures thérapeutiques significatives utilisées dans les écoles pour améliorer les capacités d'apprentissage. Parmi les mesures thérapeutiques employées par les enseignants pour améliorer les capacités langagières des participants figuraient des exercices d'orthophonie/articulatoires, de thérapie vocale et de fluence. Sur la base des résultats, l'étude recommande entre autres une intervention précoce des parents et de la société pour améliorer la parole des enfants présentant une déficience intellectuelle et des troubles neurodéveloppementaux associés, ainsi que la mise en place d'environnements inclusifs pour ces enfants. De plus,les éducateurs devraient travailler main dans la main avec d’autres prestataires de soin de santé afin d’identifier et de traiter les troubles de la parole dès le début.

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LIST OF ABBREVIATIONS

AAIDD: American Association on Intellectual and Developmental Disabilities

ADs: Articulation Disorders

AOS: Apraxia of Speech

APA: American Psychiatry Association

ASHA: American Speech-Language-Hearing Association

CAF/ CEBNF ESPOIR : Centre de Prise en Charge des Handicaps Mentaux

CEBNF : Centre d'éducation de Base Non Formelle

CNRH: National Rehabilitation Center for Persons with Disabilities

CP: Cerebral Palsy

CR: Cluster Reduction

CRPD: The United Nations Convention on the Rights of Persons with Disabilities

DS: Down Syndrome

DN: Denasalization

DV: Devoicing

FCD: Final Consonant Deletion

FDs: Fluency Disorders

G: Gliding

ICD: Initial Consonant Deletion

ID: Intellectual Disability

IPA: International Phonetic Alphabet

L: Language

MSDs: Muscle Speech Disorders

NDDs: Neurodevelopmental Disorders

n.d: No Date

P: Participant

PDD-NOS: Pervasive Developmental Disorders Not Otherwise Specified

PDs: Phonological Disorders

SD: Syllable deletion

V: Voicing

VDs: Voice Disorders

LIST OF SYMBOLS

→: Deviation

↑: High pitch

↓: Low pitch

˜: Nasalization

̥: Voiceless

#: Word boundary

/- -/: Phonological transcription

[…]: Phonetic transcription

Ø: Deletion

/: Environment of deviation

GENERAL INTRODUCTION

This general introduction outlines the background to the study, the problem statement, the objectives of the study, the research questions, the research hypotheses, the significance of the study, the scope of the study, the outline of the study and ends with a brief concluding summary of the chapter.

Background to the Study

This section presents the background to the study which is looked at from three perspectives; a historical point of view, a conceptual point of view and a contextual point of view.

Historical Background

To gain a comprehensive understanding of intellectual disability and its relationship with other neurodevelopmental disorders (NDDs), it is essential to explore the broader category of neurodevelopmental disorders. Neurodevelopmental disorders encompass a range of conditions that impact the development of the nervous system and brain, resulting in cognitive, behavioural, and social interaction difficulties (Matson & Sturmey, 2011). The recognition of these disorders dates back to the 17th century, with significant progress made in the 20th century (Falissard, 2021).

During the initial stages, the primary objective was to distinguish disabilities affecting the body from those affecting cognition and behaviour. At this juncture, neurodevelopmental disorders were commonly associated with Autism Spectrum Disorders (ASD) and Attention Deficit Hyperactivity Disorder (ADHD). In the mid-20th century, advancements in genetics and neuroimaging techniques played a pivotal role in uncovering the biological foundations of neurodevelopmental disorders (Falissard, 2021).

A significant milestone was the identification of Fragile X syndrome by J.P. Martin and J. Bell in 1943, which provided valuable insights into the genetic basis of intellectual disability (Richards, 1981). Furthermore, the emergence of neuroimaging techniques such as computed tomography (CT) and magnetic resonance imaging (MRI) enabled researchers to investigate structural and functional differences in the brains of individuals with neurodevelopmental disorders (Allen et al., 2004). It was during this period that intellectual disability became more clearly defined, and the concept of comorbidities associated with intellectual disability came to light. Intellectual disability has a longstanding history that dates back to the 13th century,

and its evolution can be studied throughout the subsequent centuries.

In the thirteenth and fourteenth centuries, the focus on intellectual disability was more on what different religious backgrounds understood about the concept. The roots of intellectual disability can be traced back to the Egyptian Papyrus of Thebes (1552 B.C.), as documented by Harris (2006). Throughout history, attitudes towards intellectually disabled individuals have evolved from concern to ostracism and abusive treatment. Different religions and regions held varying perspectives on the intellectually disabled. The ancient Greeks and Romans (1300 B.C. to A.D. 476) believed that intellectual disability was a congenital anomaly, signifying that the parents had angered the gods. In some cases, the Greeks practiced infanticide, and even Aristotle (384-322 B.C.) supported this notion, stating that "no deformed child shall be reared." However, intellectually disabled individuals from affluent backgrounds received care, and in the Roman Empire, the wealthy believed that they brought good luck (Harris, 2006).

During the Middle Ages (A.D. 476 to A.D. 1500), certain European countries regarded intellectually disabled individuals as innocent and as children of God in need of care. However, over time, disabling conditions, including intellectual disability, were attributed to demonological causes due to religious ideas surrounding exorcism and the belief that these individuals were possessed by demons. Despite these superstitious beliefs, other attitudes were present during the Middle Ages. Kroll (1973) noted that medical texts of that time did not focus on demonology but instead emphasized natural causes of intellectual disabilities and other impairments. Additionally, monastically inspired hospices were established in various countries, such as France, Syria, and Turkey, specifically to accommodate people with intellectual disabilities. Bishop Nicholas, for instance, provided care for the intellectually disabled in a hospice in Southern Turkey during the fourth century, while the Belgian village of Gheel offered family care for individuals with mental disabilities in the thirteenth century (Roosens, 1979). The Order of Bethlehem, initially a hospital opened in 1330 to care for the sick, gradually transitioned to providing care for the intellectually disabled and is now the oldest mental hospital in Europe. In the fourteenth to sixteenth centuries, there was a growing understanding that intellectual disability could be explained medically, shifting the focus from demonic possession. Physicians of the time made various efforts to cure mental disabilities, such as creating holes in the skulls of affected individuals or purging their blood to remove the supposed black bile causing their impairments (Harris, 2006).

The seventeenth and eighteenth centuries marked the Age of Reason and Enlightenment, characterized by the influence of notable thinkers like Isaac Newton (1687), John Locke (1690), and Francis Bacon (1605). During this period, new approaches to the care of people with disabilities emerged. De Condillac (1754) proposed a sensationalist theory of knowledge that laid the groundwork for psychological and intellectual interventions. He emphasized experience and reason as the primary sources of knowledge, rejecting biblical views of divine punishment as the cause of disabilities. The Age of Enlightenment advocated for the use of natural science in treating disabilities, providing extensive healthcare services and support for the intellectually disabled. Bacon, in his 1605 publication "The Advancement of Learning, Divine and Humane," challenged the belief in divine punishment as the cause of disabilities, suggesting areas of study that guided psychological research for centuries. These studies explored the interaction between the mind and body, as well as anatomical investigations and more. Through the English Poor Law, individuals with intellectual disability received support as people unable to care for themselves. During this era, there was a shift from family care to community care. In the eighteenth century, there was a heightened emphasis on respecting intellectually disabled individuals, leading to the establishment of institutes and schools with more educators and doctors, in Europe and the United States (Harris, 2006).

During the mid-eighteenth and nineteenth centuries there was an increased respect and recognition for individuals with intellectual disability and other disabilities (Kanner, 1964). Jean- Marc-Gaspard Itard played a significant role in this era by dedicating five years to teaching a cognitively disabled boy named Victor, also known as the wild boy of Aveyron (Itard, 1802). While Victor was not fully normalized, Itard's methods received high recognition from the French Academy of Sciences. Itard contributed not only to the medical specialty of otolaryngology but also to the advancement of special education, rejecting the derogatory label of "idiot." In his essay titled "Mutism Caused by a Lesion of the Intellectual Functions," Itard discussed the distinctions between intellectual disability and pervasive developmental disorders (Carrey, 1995).

During this era still, organized efforts to educate individuals with intellectual disability began in Switzerland and spread to Europe and the United States. The interest in intellectual disability was fueled by more hopeful ideas about humane interventions inspired by philosophers like Rousseau, the encyclopaedists, and Pestalozzi. Following Itard's example, Edouard Seguin dedicated himself to investigating and treating intellectually disabled individuals. He started his journey by working with an intellectually disabled boy and later

expanded his efforts to other children from the Hospice for Incurables (Kanner, 1964). Seguin introduced a comprehensive approach known as the "physiological method," which emphasized sensory-motor, academic and speech, and moral training or socialization (Simpson, 1999). This approach gained worldwide recognition in 1844. Seguin eventually moved to the United States, where he crossed paths with Samuel Gridley Howe (1848), who played a crucial role in establishing interventions for individuals with intellectual disability in America. Through his book "Idiocy and Its Treatment by the Physiological Method" (1846), Seguin advocated for institutional training to enable children with severe intellectual disability to benefit from normal classroom instruction. In 1876, Seguin became the first president of the Association of Medical Officers of American Institutes for Idiotic and Feeble-Minded Persons, now known as the American Association on Mental Retardation (Scheerenberger ,1983).

In the mid-1800s, there was a significant increase in the construction of institutions for intellectually disabled individuals. The United States opened its first institution for the intellectually disabled in 1848. Reports indicated that the training received by intellectually disabled children was successful, with many of them returning to their communities as "productive workers" (Trent, 1994). However, due to the outbreak of the Civil War and economic recessions, there was a decline in employment opportunities for intellectually disabled individuals. By 1880, training schools established by Howe and Seguin transformed into asylum centres with less emphasis on education and community integration (Wolfenberger, 1972). The public's attitude towards individuals with intellectual disability became more negative. As a result, Wilbur (1888) suggested permanent institutionalization, but Howe strongly opposed the idea, stating that the disabled should be integrated among the general population rather than segregated Wolfenberger, (1972). Despite Howe's viewpoint, states proceeded to establish more institutions, leading to the proliferation of such facilities throughout Europe and North America.

During this era again, there was also a struggle to classify and understand the causes of intellectual disability. John Langdon Down, in his essay "Observations on an Ethnic Classification of Idiots" (1866), distinguished various types of intellectual disabilities, including Ethiopian, Malay, Negroid, Aztec, and Mongolian intellectual disabilities. In 1880, Désiré-Magloire Bourneville identified tuberous sclerosis complex as a cause of severe intellectual disability. Jean-Étienne Dominique Esquirol, in his work "Mental Maladies: A Treatise on Insanity" (1865), classified intellectual disability into two levels: "idiot" and "imbecile." According to Esquirol, imbeciles were individuals who were near normal in

intelligence but failed to reach expected levels of knowledge for their age, education, or social relationships. Idiots, on the other hand, had almost no intellectual faculties and could not control their senses or understand, think, desire, or communicate (Scheerenberger, 1983). Seguin (1846) discussed four levels of intellectual disability: idiocy (possibly moderate, severe, and profound ID), imbecility (mild-to-moderate ID with social behaviour deficits), feeblemindedness, and superficial retardation with slowed development.

By the nineteenth and twentieth centuries institutions for intellectual disability were firmly established and operational. In 1904, Barr wrote the first textbook on intellectual disability, conducting an international survey that identified 171 institutions in 21 nations, with 25 of those institutions located in the United States. The classification of intellectual disability became possible with the advent of intelligence tests at the beginning of the 20th century. In 1905, French physicians Alfred Binet and Theodore Simon developed psychometric tests to select children for special education based on their abilities. Henry Goddard introduced these tests in the United States in 1912, primarily for diagnosing intellectual disability. This led to the introduction of the intelligence quotient (IQ) as a measure of intelligence. The IQ test replaced individualized clinical evaluations. Goddard proposed a tripartite classification in 1912, distinguishing between idiots (mental age < 2 years), imbeciles (mental age < 7 years), and morons (mental age < 12 years) as defined by the committee on the classification of the feeble-minded of the American Association of Mental Deficiency.

In the 1900s, intelligence quotient tests were used to identify children with intellectual disability and place them in special classes for better education. However, these tests were biased and often used to classify poor Americans and immigrants as intellectually disabled. From 1907 to 1949, the eugenics movement advocated for the institutionalization of individuals with mild intellectual disability, considering them a danger to society. Researchers like Goddard suggested a link between intellectual disability and criminality. By the 1950s, intellectually disabled individuals faced segregation and mistreatment, including exposure to chemicals used in scientific research and the hepatitis virus. They were deprived of basic rights. However, in the late 1900s, a movement against segregation began, leading many intellectually disabled individuals to leave institutions. In 1990, the Americans with Disabilities Act was passed, improving the rights of intellectually disabled individuals in the United States and later influencing global policies. Many institutions were closed down, and intellectually disabled individuals gained more freedom. Monetary support from the state was provided by the end of the 20th century (Harris, 2006).

Since then, various acts have been passed to protect the rights and improve the lives of people with intellectual disabilities. The most recent significant event is the 1994 Salamanca conference, also known as the World Conference on Special Needs Education. Organized by UNESCO in collaboration with the Spanish government, the conference aimed to promote inclusive education for people with disabilities. It brought together representatives from 92 governments and 25 international organizations to discuss and advocate for inclusive education as a means to ensure equal access to education for all children, regardless of their physical, mental, or social conditions. The Salamanca Statement and Framework for Action on Special Needs Education were produced during the conference, reaffirming the commitment of participating countries to inclusive education. This conference served as a foundation for the advancement of inclusive education worldwide. In 2016, UNESCO launched the Education 2030 initiative, which aims to provide inclusive and equitable quality education and promote lifelong learning opportunities for all (UNESCO, 1994) and (UNESCO, 2016).

All through history, several authors have pointed out the fact that language plays a vital role in the lives of individuals with ID and associated NDDs. Most authors have leaned on the fact that, due to the intellectual handicap some individuals have, they are unable to use language effectively. While other authors use language to be able to diagnose or identify individuals with ID since to them, language is linked to reasoning or intellectual development and the lack of linguistic abilities lead to a handicap in reasoning. This is backed by authors like; Itard (1801-1806) whose work on Victor "The Wild Boy of Aveyron" emphasized the role of language in intellectual development. He believed that language acquisition was crucial for cognitive and social growth and he attempted to teach Victor to communicate using spoken language. Although his efforts yielded no fruits, his work laid a foundation for future research on language and intellectual development. Itard's student Seguin (1812-1880) further emphasized the significance of language in ID. He developed the "psychology method" which integrated sensory stimulation and language training as essential components of education for individuals with ID. He believed that language was essential for cognitive development and that sensory experiences could support language acquisition. Binet & Simon (1905) developed the Binet- Simon intelligence scale later revised as Standford-Binet Scale which was aimed to assess intellectual abilities including language skills. Piaget (1896-1980) and Vygotsky (1896-1934) contributed to the understanding of cognitive development and the role of language in learning and intellectual functioning. The aforementioned authors paved the path to the linking

of ID to language forming the basis of the current research.

Conceptual Background

The notion of intellectual disability has gone through a lot of reformations due to changing expectations of an evolving society over the course of time. According to Scheerenberger (1983), "intellectual disability" has been around since the earliest days of society based on the observation that some individuals are more capable while others are less capable. Harris (2006), stipulates that the earliest reference to this condition dates back to the Egyptian Papyrus of Thebes in approximately 1500 B.C. "Intellectual Disability" is the term in current use and the principal reason for its implementation is to minimize the stigma and abuse often associated with the previous terminology (imbecile, idiot, mental retardation, mental deficiency etc).

The concept "intellectually disability" was hitherto known under several labels such as; mental retardation, mental deficiency, cretin, idiot, imbecile, moron, feeble-minded just to name a few. These terminologies and their significance are briefly discussed in the following lines detailing the evolution of the concept over the years. For several years, people with low intellectual and social capabilities were broadly classified under three main categories namely; feeble-minded, imbecile and idiot. The term feeble-minded originated from the Latin word flebilis meaning "to be lamented" and was used to denote a mild form of intellectual disability. Here the mental defects did not amount to imbecility however it was sufficiently pronounced that they require care, supervision, and control for their own protection or for the protection of others (Harris, 2006).

The term imbecile was used to characterize those whose development were lower than that of a feeble-minded but higher than that of an idiot. It was used to denote a category of people with moderate to severe intellectual disability.

Lastly, the term idiot which signified the most profound mental deficiency was used to characterize individuals with a mental age of 2 or younger. The use of the above terminologies continued right up to the 1900s and it was around this period that Henry H. Goddard, an American psychologist and an advocate of the eugenics movement, proposed replacing the current vernacular with the term "moron" which was a Greek term meaning "foolish". This label was used to denote people who had a mental age of 8 to 12 years and who could not develop beyond adolescence due to faulty genes resulting in low intelligence. Goddard went ahead to propose a classification system for mental deficiency based on the intellectual traits presented by an individual during assessment (Idiots for individuals with an

IQ below 25 or 30, who require constant care and supervision. Imbeciles for individuals with an IQ between 25 or 30 and 50 or 55, who can learn some basic self-care and vocational skills but require assistance with daily living. And morons for individuals with an IQ between 50 or 55 and 70 or 75, who can learn to read, write, and perform simple arithmetic, and can acquire some vocational skills with training and supervision) Harris (2006).

In 1933, the American Association for the Feeble-minded (now known as AAIDD), changed its name to American Association on Mental Deficiency in order to incorporate the new term "mental deficiency". When the first international professional society on the scientific study of intellectual disability was founded in 1964, it was created under the name "International Association for the Scientific Study of Mental Deficiency" (Clarke et al. 1985) this led to the standardization of the new term "mental deficiency". However, the term "mental deficiency" was not well received by the scientific community and was replaced by the term "mental retardation".

Mental retardation springs from a Latin word "retardare" meaning to make slow. This term was used to replace "mental deficiency" for it had received a lot of negative reaction from the society. For more than 50 years, this term was in use in the United States (Wolfenberger, 2002) though still operating under the name of American Association for Mental Deficiency (now AAIDD), the term being used in their 5th edition of their terminology and classification manual is "mental retardation" Heber (1959). It was in this publication that they introduced the diagnostic criteria of mental retardation such as; sub average intellectual functioning, impairment in adaptive behavior and the onset occurring during the developmental period. In 1990, it became evident that this term left from a sterile medical label to judgmental slang used in the society to insult individuals with mental retardation. This realization led to the "End of Word" movement spearheaded by Special Olympics and Best Buddies organizations bringing an end to the term "mental retardation". Following the Rose Law in America in 2010, the term "intellectual disability" was introduced to replace "mental retardation".

The advent of research shifting to studying the interaction between people and their environment (AAIDD, 2010) brought about the redefining of the fundamental concepts of intellectual disability. In addition to the fact that concepts were redefined, deinstitutionalized mechanisms of the government were implemented with the aims of bringing an end to the segregation of individuals with ID (Tremain, 2015). This implementation required intervention models based on the principles of normalization (Burrell & Trip, 2011) which had as goal to accept valued social roles. In recent times, there has been a great movement regarding the rights of individuals with ID some of the movements are: the Montreal Declaration on Intellectual

Disability (WHO & Pan American Health Organization, 2004) (Lecompt & Mercier, 2007) and the United Nations Convention on the Rights of Persons with Disabilities UN (2006) emphasize on "the need to respect the dignity, integrity, and right to self- determination of persons" with ID. However, although all the above have been put in place, huge inequality still affects individuals with ID. It is important to note that most of the above classifications were carried out primarily based on the language capabilities of the individuals because at that time, language was the only medium of thought assessment (reasoning capability of an individual) as a result, the severity of an individual's case was strongly correlated with the severity of the impairment of their language faculties which can include components such as; memory, articulation and comprehension just to name a few.

By this note, this study makes use of the term intellectual disability (ID) which is a term referring to "impairments in both cognitive functioning and adaptive skills whose onset is noticed during the developmental period of an individual's life. It is a developmental, intellectual, and cognitive disability" (Harris, 2006). This term is used in the present study in order to reflect current perspectives and also because it better captures the ideas of language and reasoning that form the basis of intelligence. The American Psychiatric Association (APA) (2013) however, sees no difference between the terms "mental retardation and intellectual disability" and uses them interchangeably. The World Health Organization (WHO) (2014) proposed the term "Intellectual developmental disorder" which reinforced the fact that the American Psychiatric Association classifies ID as a neurodevelopmental disorder. ID is a cognitive disability that affects many linguistic levels such as: language, memory and speech. The current study is out to throw more light on the speech disturbances individuals with ID and associated NDDs face.

Contextual Background

The concept of intellectual disability has faced challenges in Africa, including Cameroon, due to cultural beliefs, stigma, and limited acceptance of individuals with intellectual disability (ID). In the African context, intellectually disabled individuals have often been associated with demonic influence or considered as individuals who do not belong on Earth. Studies conducted in Africa, including Cameroon, have focused on understanding the perception and societal reactions towards individuals with ID. Some studies have explored the various appellations used to identify individuals with ID in different African languages. For example, studies by Tchable (2012) and Tsala Tsala (1989 cited in Tchable 2012, p. 119) examined the appellations used in the Moba and Beti languages respectively with Tsala Tsala

(1989) presenting the different appellations given to individuals with ID in the Beti language (Cameroon) such as; “Akut” which means an individual without intelligence, “okukut” which means an unstable or confused person, and “nduduman” which means someone with poor behaviour. These appellations often carry negative connotations, such as denoting a lack of intelligence or poor behaviour.

In the Cameroon context, as a means to fight against the discrimination of persons with ID, the National Committee for the Rehabilitation of Persons with Disabilities was established in 1971. This institution had as aim to develop policies and programs for the betterment of people with disabilities in Cameroon (Centre National de Réhabilitation des Handicapés, n.d.). However, challenges persisted for people with intellectual disability in Cameroon as they continually face exclusion in the society. Hence, to fight against this ostracism and neglect of persons with disabilities, the United Nations Convention on the Rights of Persons with Disabilities (CRPD), effective from 2008 was convened. This has played a significant role in improving the rights and dignity of persons with disabilities worldwide, including African nations like Cameroon.

Cameroon has made efforts to enhance the rights of disabled persons by signing agreements and enacting laws for their protection. This can be seen with the Minister of Social Affairs and the Director of CNPS (Caisse Nationale de Prevoyance sociale) signing an agreement in 2006 aimed at improving assistance of disabled persons and victims of industrial accidents (International Disability Alliance, n.d.). Also, Act No. 83/013 of July 1983 that elaborates on the protection of persons with disabilities in Cameroon was given more attention after the CRPD convention as a joint circular letter No. 34/06/LC was signed on the 2nd of August 2006 by the Minister of Secondary Education and Social Affairs. This was with the aim of facilitating the enrolment of children with disabilities into public schools and exempt them from the payment of registration fees (International Disability Alliance, n.d.). Initiatives such as the Cameroonian Federation of Sports for the Intellectually Disabled (FECASDI) created in 2010 and Community Based Inclusive Development (CUBID) aim to include individuals with ID in societal activities and create inclusive societies. The law N0 2010/002 of April 2010 was passed to fight against the excluding of the intellectually disabled in social affairs in Cameroon (Cameroon Tribune, 2022). The National Committee for the Rehabilitation of Persons with Disabilities was established in 1972 to develop policies and programs for the betterment of people with disabilities in Cameroon (Centre National de Réhabilitation des Handicapés, n.d.). However, challenges persist for people with intellectual disabilities in Cameroon. They still

face exclusion from education and employment opportunities, and specialized services and support for them and their families are lacking. In recent years, there has been a growing recognition of the importance of inclusive education and the need to provide resources and support to families and communities to better understand and assist people with intellectual disabilities. The adoption of the 2010 Law on the Protection and Promotion of Persons with Disabilities in Cameroon has provided legal protections and support for people with disabilities.

In Cameroon, the available statistical data on those with intellectual disability as well as its prevalence is minimal (Nguimabou & Tsala, 2021) proving that a lot is yet to be covered in this domain. Although not much research data is available on the prevalence of ID, these individuals are not completely neglected in terms of caregiving. There exist three modes of care given to individuals with ID in Cameroon namely, traditional medicine or the cultural heritage of Africans, medicine of Western origin, and spiritual treatment through churches (Nguimabou & Tsala, 2021). Intellectual disability has been looked upon in the medical, (causes and treatments), social (how the society perceives these individuals) and educational (how this disability affects the learning capacities of these individuals) veins (Mbom, 2012) but it is still known as a rare phenomenon that has as source, demonic operations.

Current research in Cameroon is focusing on communal attitudes toward persons with ID, the burden of disability, and the treatment of individuals with disabilities after the signing of the UN convention. Some research done include, a cross-national study by Opoku et al. (2021) examining communal attitudes toward persons with intellectual disabilities in Cameroon and Ghana. Another study was carried out by Douryang et al. (2022) discussing the burden of disability in Africa and Cameroon and calling for optimizing education in Physical and Rehabilitation Medicine. Opoku et al., (2016) carried out a study on the lives of persons with disabilities in Cameroon after the CRPD with the aim of examining how these individuals have been treated in Cameroon after the signing of the UN convention.

The above studies illustrate trend of current research governing the notion of disabilities specifically intellectual disability in Cameroon. The trend shows a focus towards clinical and social characteristics of disabilities with little to no importance given to the linguistic aspects of this phenomenon. Hence the basis of the current study.

Problem Statement

The presence of speech problems is a significant aspect of intellectual disability (ID), as it directly influences how individuals with ID and associated NDDs are perceived intellectually. Language proficiency is often used as a measure of a person's intellectual capacity, making it crucial for parents and society to understand the nature of speech problems and their impact on individuals with ID and associated NDDs. In Cameroon, research on intellectual disability has predominantly focused on clinical and psycho-social aspects, including causes (Mbom, 2012), consequences and care (Douryang et al. 2022), management (Mbom, 2012), psychological factors as well as educational impact (Mbom, 2012), and social acceptance (Opoku et al. 2021). However, despite the prevalence of speech production problems among individuals with ID and associated NDDs, very limited research attention has been directed towards these production problems. The existing linguistic research on speech impairments in ID is scarce and lacks data on the nature and impact of communication. Communication is essential for daily functioning in society underscoring the urgent need for linguistic investigations specifically addressing speech production problems in individuals with ID and associated NDDs. The lack of understanding among parents and society about these speech impairments highlights a clear knowledge gap that needs to be filled. Hereby, motivating the current research endeavour.

Research Objectives

This section targets a main objective and three specific objectives

Main Research Objective

To identify speech production problems and their impact on individuals with intellectual disability and associated neurodevelopmental disorders and to propose possible therapeutic measures that can be used to ameliorate their speech prowess.

Specific Research Objectives

1. To identify speech production problems in individuals with intellectual disability and associated neurodevelopmental disorders.

2. To determine the impact of speech production problems on individuals with intellectual disability and associated neurodevelopmental disorders.

3. To suggest possible therapeutic measures that can alleviate or lighten speech production problems in individuals with intellectual disability and associated neurodevelopmental disorders.

Research Questions

This section presents a main research question and three specific research questions.

Main Research Questions

What are the speech production problems and their impact on individuals with intellectual disability and associated neurodevelopmental disorders and what are the possible therapeutic strategies that can ameliorate speech production?

Specific Research Questions

1. What are the speech production problems in individuals with intellectual disability and associated neurodevelopmental disorders?
2. What are the impacts of speech production problems on individuals with intellectual disability and associated neurodevelopmental disorders?
3. What are the possible therapeutic measures that can be used to address the speech production problems in individuals suffering from intellectual disability and associated neurodevelopmental disorders?

Research Hypotheses

This section suggests a main research hypothesis with three specific hypotheses

Main Research Hypothesis

Individuals with intellectual disability and associated neurodevelopmental disorders have articulation, phonological, voice, fluency and muscle speech disorders that greatly impact their speech negatively and which could be ameliorated thanks to some therapeutic measures.

Specific Research Hypotheses

1. Individuals with intellectual disability and associated neurodevelopmental disorders have varying speech production problems

2. Speech production problems have negative impacts on individuals with intellectual disability and associated neurodevelopmental disorders.
3. Speech and language therapies can be used to ameliorate the speech production prowess of individuals with intellectual disability and associated neurodevelopmental

disorders.

Significance of the Study

This study holds significant importance for various stakeholders in society, including parents, the society as a whole, the educational milieu, and the field of science. Here are the key benefits and implications of this study for each of these stakeholders:

To begin, the study serves as a valuable source of information and awareness for parents of individuals with ID and associated NDDs. By providing scientific explanations for the speech deficits associated with intellectual disability, it demystifies the condition and dispels any supernatural beliefs or stereotypes. The results can help combat stigmatization and help parents better understand their children's communication challenges, leading to improved support and care.

Regarding the society as a whole, the study acts as an educational tool for society, increasing awareness and understanding of the difficult communication tendencies of individuals with intellectual disabilities. It helps to bridge the knowledge gap and dispel misconceptions, enabling the public to comprehend and appreciate the speech difficulties faced by these individuals. This can lead to more inclusive and empathetic interactions, reducing social barriers and promoting acceptance within the community.

In the educational milieu, the study has implications for teachers working with children with intellectual disability. It raises awareness about the various speech production problems that these students may experience. This will enable teachers to identify and address these specific challenges effectively. This understanding can facilitate improved communication and learning outcomes in the classroom, as teachers can tailor their instructional strategies to accommodate the specific speech needs of their students.

In the scientific domain, and the clinical field, the study contributes to the scientific knowledge base, particularly in the field of medical science. By delving into the linguistic intricacies of speech production problems in individuals with intellectual disabilities, it provides valuable data that can inform the development of more effective therapeutic interventions. This research serves as input for the advancement of clinical knowledge, leading to better solutions and improving the lives of individuals with intellectual disability.

Lastly, in the academic and research community, this study represents an additive contribution to the existing body of research on intellectual disabilities, specifically focusing

on the linguistic aspects. By adopting a linguistic approach, it fills a knowledge gap and offers deeper insights into the relationship between language and intellect. This holistic perspective enhances the overall understanding of intellectual disabilities and can stimulate further research, leading to the development of improved strategies, theories, and devices aimed at enhancing the lives of individuals with intellectual disabilities.

In summary, this study benefits parents by providing understanding and combatting stigmatization, the society by promoting awareness and acceptance, the educational milieu by facilitating effective communication and learning, and the fields of science and research by advancing knowledge and informing therapeutic interventions. Hence, Understanding the speech production problems in individuals with ID and associated NDDs is crucial for developing tailored interventions that can enhance their communication abilities, facilitate social integration, and optimize academic performance. The results gotten from this study will be published in academic journals and articles, presented in conferences and workshops as well as online platforms in order for it to be at the reach of all stakeholders concerned.

Scope of the Study

This study focuses solely on speech production problems in individuals with intellectual disability and associated neurodevelopmental disorders. It looks specifically at articulation, phonological, voice, fluency and muscle speech disorders. It does not encompass other aspects of language such as syntax, semantics, pragmatics, or morphological deficits. Therefore, the comprehensive language abilities of individuals with intellectual disability are not fully explored.

Regarding the neurodevelopmental disorders associated with intellectual disability, the study only includes conditions such as; Microcephaly, Macrocephaly, Cerebral Palsy, Pervasive Developmental Disorders-Not Otherwise Specified and Down syndrome.

In terms of the severity of ID associated with other NDDs, this study is limited to mild and moderate cases.

Geographically, the study is conducted in Cameroon, specifically in Yaoundé, and is based on data collected from two special education schools: The National Centre for the Rehabilitation of persons with Disabilities (CNRH) and Centre de Prise en Charge des Handicaps Mentaux (CAF/CEBNF ESPOIR).

Outline of the Study

This study consists of a general introduction, which presents the background to the study, the problem statement, the objectives of the study, the research questions, the research hypotheses, the significance of the study, the scope of the study, the outline of the study, and a chapter conclusion. The general introduction is followed by three chapters of the work and ends with a general conclusion. Chapter one is titled theoretical framework and literature review. It opens with the theoretical framework followed by a literature review which begins with a conceptual review and ends with an empirical review of literature and lastly the definition of operational terms. A chapter two titled research methodology which elaborates on the methodology of the study. A third chapter which has to do with data presentation and analysis. And a general conclusion that discusses the research findings and recommendations for further research.

Conclusion

This chapter paved the way to the study and gave a general overview of key points surrounding the research such as the background, problem statement, research objectives, research questions, research hypotheses, significance of the study, outline of the study and a chapter conclusion.

Chapter One: Theoretical Framework and Literature Review

This chapter presents the theoretical framework which helps in analysing data for the research.

It presents a detailed review of related literature and ends with the definition of operational terms.

1.1 Theoretical Framework

This study makes use of Levelt's (1989) model of speech production, a world of research in psycholinguistics which seeks to better explain how language production and comprehension function in the human brain. The advent of psycholinguistics has given rise to a number of language production models that strife to account for how language moves from the mind to the articulatory organs. Generally, many linguistic models base explanations on three levels; the conceptualization, formulation and articulation. Models of language production have been divided into two principal groups; the modular and non-modular with the Levelt's model being a member of the modular group that illustrates different levels of language production processing and differs from the non-modular that is based on the notion that there is no interaction between the stages of language production processes (Blanken et al. 1993). Levelt's 1989 model of speech production enables the researcher analyze how individuals with ID and associated NDDs face challenges at each stage of speech production; from conceptualization, where they struggle to generate and organize ideas; to formulation, where they encounter difficulties in constructing grammatically correct sentences; and finally to articulation, where they often have issues with clear pronunciation and motor execution of speech.

1.1.1 Levelt's (1989) Model of Speech Production

Levelt's model is a language and speech production model which brings to light invisible mechanisms involved in speech articulation. It provides a comprehensive framework for understanding the cognitive processes involved in speech production. This model enables one to identify which parts of the human body comes into play for effective communication. This model is also centred on the notion of lexical access which has to do with the ability of the human brain to select words in the mental lexicon in the process of communication. The speech production chain advanced by Levelt in (1989), is made up of "autonomous components" which are responsible for the different levels of speech production. They include; the conceptualizer; a component that is responsible for generating and monitoring messages;

the formulator, in charge of giving grammatical and phonological shape to messages and which feeds on the lexicon; the articulator, which specializes in the motor execution of the message; an audition or acoustic-phonetic processor, which transforms the acoustic signal into phonetic representations; and the speech comprehension system, which permits the parsing or processing of both self-generated as well as other-generated messages (Levelt, ibid). Though this model touches both the speaker and the listener, the current study only focuses on the speaker highlighting the speech production process so as to be able to clearly pick out speech production problems in individuals with intellectual disability and associated NDDs. In the following lines, the speech production processes that Levelt presents in (1989) are well elaborated.

1.1.1.1 Processes of the Levelt's (1989) Model

This model has to do with how messages are conceived in the brain. This model makes use of a good number of linguistic, cognitive and motor processes that enable communication to take place. According to this model, speaking involves a speaker conceiving an idea, selecting information necessary in the realization of this idea and putting this message in a linguistic form wherein, he is pushed to select lexemes needed in his mental lexicon and assign various grammatical and phonological roles to them in what is called "preverbal message" Blanken et al. (1993, p.2). The speaker then calculates phonetic specifications to the message and uses the phonetic specification to guide the articulation of the message leading to the production of the message. Following the above explanation, one realizes that it is a multi-step process. Levelt groups the many steps involved in speech production into three main levels which are: the level of conceptualization, the lexical level and the phonological level. These steps are very important for effective communication to take place. This model, is therefore suitable for exploring the speech production shortcomings that individuals with ID and associated neurodevelopmental disorders face in their daily communication. Levelt's communication model can be presented diagrammatically as seen below.

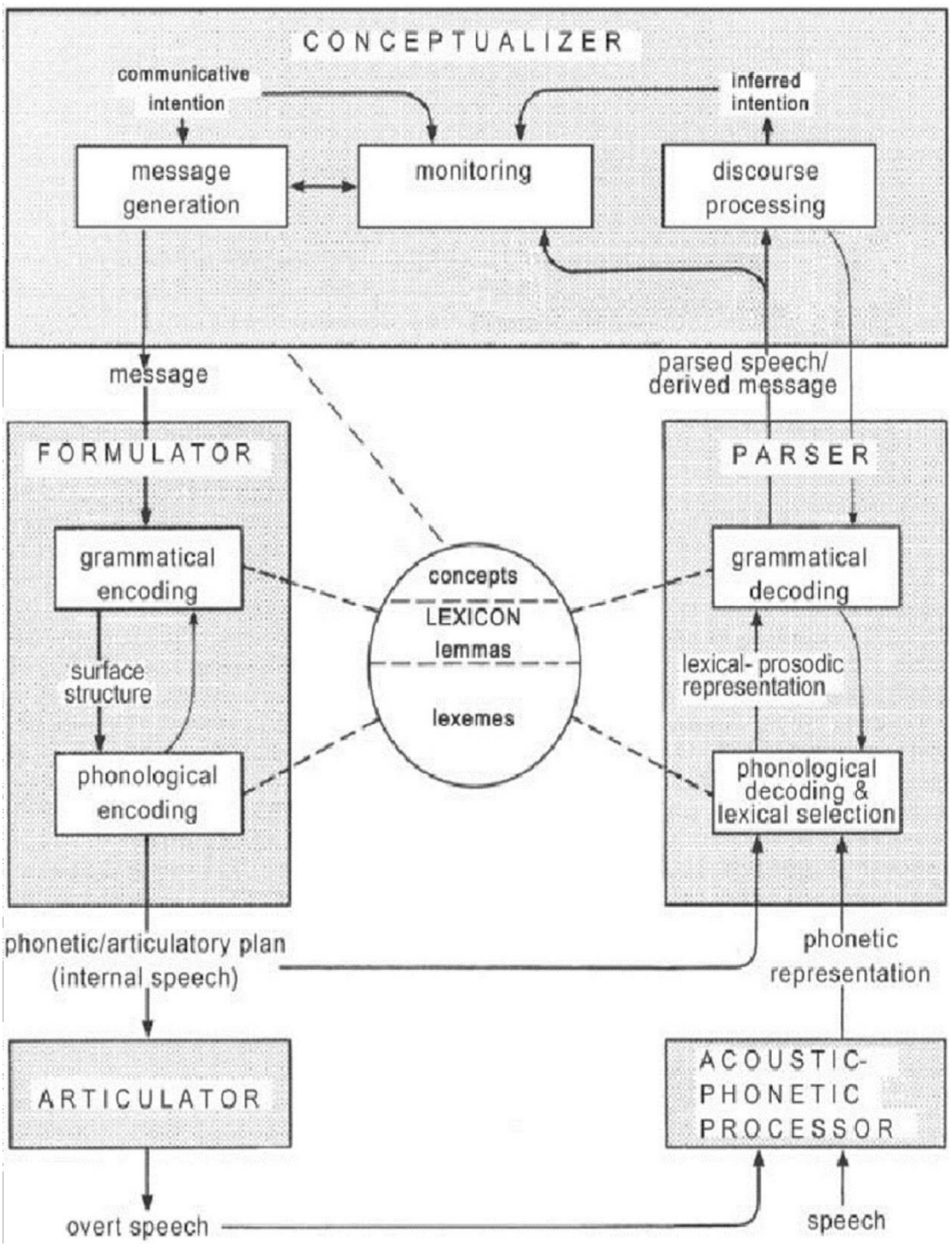


Figure 1: A diagrammatic representation of Levelt (198Model of Speech Production Source, Blanken et al. (1993).

Levelt et al. (1999, p.1) state that "real word production begins when the child starts connecting some particular babble… to some particular lexical concept… Hence word production emerges from a coupling of two initially independent systems, a conceptual system and an articulatory motor system". Levelt (1989 & 1999) emphasize on the fact that speech production is a whole process which begins with conceptual preparation to the actual articulation. The various steps peculiar in the speech production process includes three main levels as earlier said.

1.1.1.1.1 Conceptualization

Levelt (1989, p.10) states that "Talking as an intentional activity involves the conceiving of an intension, selecting the relevant information to be expressed for the realization of this purpose, ordering this information for expression, keeping track of what was said before…" this explains the fact that, in order for production to take place, the speaker needs to think of an idea, monitor what he is saying and the manner in which he is saying it. All these mental processes boil down to conceptualizing. The various activities occurring in the conceptualizer handle the preverbal message. Speaking revolves around a speaker obtaining a communicative intention that he/she wants the listener to hear and select appropriate information in his/her mind whose expression can help them realize this purpose. At this point, the speaker makes usage of his working memory in order to get the instant information needed to express an idea. The speaker also gains access to his long-term memory at that time in order to get "declarative knowledge" that is, knowledge which has built up through life (knowledge of the world, of themselves and the person they are addressing). All this processing helps to create the preverbal message that acts as input for the formulator (Levelt 1989, p.10).

Levelt (ibid) makes mention of two stages in the planning of a preverbal message- the macro planning and the micro planning. Blanken et al. (1993, p.1) intimate that "Conveying an intention may involve the planning of a sequence of speech acts" a speaker will have to handle a lot of sequencing in order for their message to be understood. The conceptualizer entails two micro-processes that controls the word choice and topicalization of the sentence and these are; macro-planning and micro-planning (Blanken et al. 1993, p.2). Macro-planning has to do with the speaker organizing his ideas as goals and sub goals and selecting appropriate information that will enable them express these goals. The speaker therefore plans a speech act, selects relevant information to express his intention and linearly present the information. Micro-planning looks into how the speaker gives propositional knowledge to the selected information that is, it gives it contextual relevance before the formulator takes over. The output of this

component is called a “message” which serves as input to the next component. This component holds relevance to this study because it provides clear insight into the various macro and micro preparations that take place before speech is realized. Any misstep in these processes could significantly alter the speakers intended message. Having an understanding on how speech is conceived goes a long way in helping the researcher in identifying and diagnosing speech problems.

1.1.1.1.2 The Formulator

Blanken et al. (1993, p.4) postulate that “the formulator maps messages onto linguistic form” this means that, it gives grammatical and phonological forms to the already conceived message. It is the stage in speech production where linguistic structures and plans are transformed into motor commands. It bridges the gap between the conceptual level, where the speaker generates the intended message, and the articulator level, where the actual movements for speech production occur. At this level, the main processes involved are the grammatical and phonological encoding processes.

Grammatical Encoding:

This process has to do with procedures for accessing lemmas, and of syntactic building. Levelt (1989, p.11) states that “The speaker’s lemma information is declarative knowledge which is stored in his mental lexicon”. At this level, a message which acts as an input is given a surface structure as output. This is done by segmenting syntactic structures phrases (head words, subjects, direct objects etc.) with lowest elements being lemmas (lexical elements without phonological attributes yet). This level gives meaning to the lemma. Levelt (ibid) further states that “…a lemma will be activated when its meaning matches part of the preverbal message. This will make its syntax available, which in turn will call or activate certain syntactic building procedures”. These procedures consist of information about its grammatical category, position and role in a sentence. The resultant surface structure serves as data for the phonological encoder.

Phonological Encoding:

The construction and retrieval of a phonetic or articulatory plan for each lemma and the entire utterance, based on the surface structure, is crucial. Initially, the phonological specification, or "lexeme," of each lemma is obtained from the mental lexicon. This stage involves encoding the message with phonological features necessary for articulation. Without these features, the articulators cannot convey the previously conceptualized message, and any disruption at this level significantly impairs communication accuracy.

Levelt's (ibid) formulator level of speech production emphasizes the hierarchical organization of linguistic structures and the transformative processes involved in generating speech. This level underscores the interplay between various linguistic representation levels and the progressive conversion of abstract representations into concrete motor commands. The model offers a framework for comprehending how speakers plan and produce speech in real-time, considering the cognitive processes involved in the formulator stage. Following this stage, the articulation level ensues.

1.1.1.1.3 Articulation

When the message has been encoded and put in a phonetic buffer which acts as a phonetic plan, the buffer helps in the storing of the incoming phonetic message so as to control the order in which articulation takes place. This is because, all speech cannot come out at once so they are placed in this buffer for orderly articulation. This phonetic plan is prepared by the formulator which delivers it for organized articulation (Blanken et al. 1993, p.5).

According to Levelt (1989, p.12), "Articulating is the execution of the phonetic plan by the musculature of the respiratory, the laryngeal, and the supralaryngeal systems". The rate at which internal speech occurs is different from the rate at which overt speech occurs. Internal speech is said to occur at a faster rate than overt speech which if not handled might cause severe articulation disorders. Hence, because of this difference in speech there is need for a storage device to temporally store the phonetic plan delivered by the formulator and this temporal storage device is known as the articulatory buffer (Levelt 1989). Thus, "The articulator retrieves successive chunks of internal speech from this buffer and unfolds them for execution" (Levelt, 1989; 17).

The stage of articulation involves motor execution that is, the coordination of a set of muscles to produce speech. Blanken et al. (1993, p.6) state that "The respiratory system provides the acoustic energy for speech by controlling the steady outflow of air" the altering of this system will lead to respiratory problems which in turn affects speech production leading to prosodic impairments. In addition, they assert that "The laryngeal system, with the vocal folds as their central part, controls voicing and loudness in speech". (Blanken et al. ibid). This shows that the laryngeal system plays a big role in the enunciation of speech sounds by enabling the production of both consonant and vowel sounds with their phonological features through its role of giving voicing and loudness qualities to speech sounds. An alteration on this particular system, brings about serious voice disorder and the advent of laryngeal dystonia also known as spastic dysphonia. The third system is the supralaryngeal system or vocal tract. This

system is subdivided into three cavities namely; the oral, nasal and pharyngeal cavities. These cavities play a major role in controlling the timbre of vowel and consonants. Blanken et al. (1993) looks at this system and posits that "The vocal tract can be constricted in different places… and there are different manners in which these constrictions can be released…" The combinations of both the place and manner of articulation provides the variation of speech sounds we have in the world's languages. The hampering or alteration of any of these muscles will lead to serious damage to articulatory prowess. Levelt in this step shows that if the organs or muscles needed to execute articulation are altered, an individual will most likely suffer from speech defect. After the articulation level, we have the overt speech wherein the articulated speech is transmitted as acoustic signals for the listener to decode.

1.1.2 Reasons for Using the Levelt (1989) Model

The principal reason for using Levelt (1989) model in the present study is that the model is used to encapsulate in detail the processes involved in thinking right down to the articulation of speech as well as its comprehension of the idea expressed. Applied to the current study, it facilitates the understanding of the cognitive stages or malfunctions as well as articulatory challenges faced by individuals with intellectual disability and associated neurodevelopmental disorders and this in turn enables the researcher to better explain the phenomenon under study. Although the model was not developed for pathological speech but rather to ascertain the speech of "normal" individuals, it is still very helpful in deriving symptoms or symptom clusters in speech pathology by enabling the researcher know or detect exactly where a speech pathology occurs. This implies that any malfunctioning at any level of the chain points to an abnormality.

Also, the Levelt (1989) model is more detailed for it goes beyond a mere enumeration of stages and gives explicit accounts of the sub-processes of interest for the current study. This model does not only show the process of language and speech production in normal people but also, it enables one to identify the disorders in the production chain in the case of a pathology. This helps one to see the differences that govern the articulation of speech between normal people and those suffering from intellectual disabilities. Furthermore, it has been well-validated by research; Levelt's model has been tested and refined over many years, and it is now widely accepted as an accurate representation of the speech production process (Blanken et al. 1993). Using such a well-grounded model for the current study improves the validity and reliability of this study.

From the foregoing, Levelt (1989) model seems to be a more appropriate model that can

help to better explain the data obtained for this study as compared to Garrett (1975) model of speech production. Reasons being that Garrett's model focuses primarily on the syntactic and phonological processes without at much emphasis on initial ideation stage this makes Levelt's model more suitable for comprehensively studying speech production problems in the research participants. Levelt's model presents all the necessary stages that the researcher needs to know about normal speech production and paints a good picture on which disorder might occur if a stage is altered. The three listed stages above are very important in exploring speech production problems commonly identified in individuals with intellectual disability and associated neurodevelopmental disorders though the model has other stages regarding speech comprehension and decoding which are not important in the present study.

1.2 Literature Review

This section first focuses on the conceptual review before looking at the empirical review related to the study.

1.2.1 Conceptual Review

This section handles the concepts related to the issue under discussion here. Some of the concepts include: intellectual disability, speech disorders/communication disorders and neurodevelopmental disorders.

1.2.1.1 Intellectual Disability (ID)

The concept of intellectual disability has been the subject of several studies. Bhaumik and Alexander (2020) provide a comprehensive examination of intellectual disability (ID), addressing its defining characteristics, prevalence, assessment procedures, comorbidities, and causes. They emphasize that ID is characterized by low IQ, limitations in adaptive skills, and communication problems. The prevalence of ID is higher in children and young people, with a higher occurrence in males and in low-income countries. The current study's focus on speech production problems in individuals with ID and associated NDDs aligns with Bhaumik & Alexander (2020) emphasis on communication difficulties as a defining feature of ID. Additionally, the authors' exploration of assessment procedures, including communication skills evaluation, provides valuable insights for the current study's methodology.

The authors further highlight comorbidities in individuals with ID, such as dementia and mental disorders. Although the current study does not specifically address mental illnesses, understanding the prevalence of comorbidities in individuals with ID contributes to a comprehensive understanding of their overall challenges and informs potential therapeutic

interventions. The authors' examination of possible causes of ID, including prenatal, perinatal, and postnatal factors, provides a foundation for understanding the multifaceted nature of the condition and its potential impact on speech production. Finally, Bhaumik and Alexander's (ibid) observation of shorter life expectancy and increased mortality rates in individuals with ID emphasizes the importance of investigating speech production problems as they relate to the overall well-being and quality of life of this population.

Gentile et al. (2019) delve into the assessment levels, comorbidities, and syndromes associated with intellectual disability (ID), providing insights that are relevant to the present study. They categorize ID into profound/severe, moderate, and mild levels, shedding light on the communication abilities and dependency ratios of individuals with ID.

In addition, Gentile et al (ibid) emphasize the significance of psychiatric and medical assessments in individuals with ID. Psychiatric assessments consider genetics, non-psychiatric medical conditions, and medication adherence, while medical assessments involve a comprehensive evaluation of diseases and bodily systems. These assessment procedures provide a foundation for understanding the holistic needs and potential comorbidities in individuals with ID, including the neurological conditions mentioned by the authors, such as seizures, dementia, ADHD, and Tic disorders. These insights are highly relevant to the present study's exploration of speech production problems and their associations with comorbidities in individuals with ID. Also, the authors address syndromes associated with ID, such as fetal alcohol syndrome, autism spectrum disorder (ASD), Down Syndrome (DS), William Syndrome (WS), Fragile X Syndrome (FXS), and Prader-Willi Syndrome (PWS). Understanding these syndromic associations contributes to a broader understanding of comorbidities observed in individuals with ID. However, the current study diverges from this focus on mental illnesses and instead concentrates solely on speech deficits, excluding mental disorders as a specific factor of interest.

Shree and Shukla (2016) on their part provide a comprehensive overview of intellectual disability (ID), focusing on its definition, classification, and characteristics. They define ID as the level of cognitive functioning exhibited by certain children, highlighting the difficulties these children face in problem-solving, processing information, and adapting to their environment. The authors present various definitions of ID from different sources, including the American Association on Intellectual and Developmental Disabilities (AAIDD), which emphasizes the coexistence of below-average intellectual functioning and deficits in adaptive

behaviour that adversely affect a child's educational performance. Similar consequences are likely to surface in case of language disorders that go with ID as learning goes through language.

In addition, the authors also discuss the causes of ID, pointing out that they involve chromosomal abnormalities, metabolic disorders, mental infections, environmental conditions, gestational disorders, infections, intoxicants, and environmental factors. They classify ID into four categories: mild, moderate, severe, and profound. Furthermore, they highlight general characteristics associated with ID, such as cognitive impairments, learning and memory difficulties, limited attention span, poor adaptive skills (particularly in severe and profound ID), and speech and language impairments. However, it is important to note that Shree and Shukla's study focuses primarily on providing an understanding of the concept of ID, with little attention given to linguistic impairments in individuals with ID. This paves a way for the current study which specifically investigates the linguistic impairments that affect people with ID.

1.2.1.2 Speech/communication disorders

Wilkinson and Hennig (2007) discuss the use of technological gadgets to enhance communication abilities in children with intellectual disability. They distinguish between unaided and aided gadgets, with unaided options including sign languages and gestural cueing systems, while aided technology involves external devices. The authors further categorize aided technology into light and high technologies. Light technology includes tools like alphabet boards, symbol-based topic boards, communication books, and communication programs like picture exchange communication systems (PECs). These resources offer children with intellectual disability the means to overcome communication difficulties, facilitating their interactions and providing adaptable solutions. However, it is important to note that their study has a broader focus on communication disorders, while the present study specifically examines the impact of speech production problems in individuals with intellectual disability. In sum, Wilkinson and Hennig's (ibid) discoveries in their research, are relevant to the current study on speech production problems in individuals with intellectual disability. Their findings emphasize the potential of light technology devices and techniques to enhance communication abilities in this population. On the other hand, while the book offers valuable insights into communication disorders and technological interventions, it differs from the current study, which is cantered specifically on speech production problems and their effects, rather than the broader range of communication disorders.

Martin et al. (2017) worked on the impact of pragmatic language skills on individuals with intellectual disability, specifically focusing on Down syndrome, fragile X syndrome, and Williams's syndrome. The study primarily examines group-comparison studies involving young verbal individuals and addresses key pragmatic skills such as speech acts, topic initiation and maintenance, communication breakdown management, and narrative abilities. The authors highlight previous research findings concerning individuals with Down syndrome, emphasizing that studies have often focused on discrete pragmatic skills, such as signaling non-comprehension or contributing new information to a discussion. Carrow-woolfolk (1999) found that typically developing boys displayed earlier pragmatic skills compared to boys with Down syndrome.

The authors throw more light on the current study as it facilitates the understanding of the pragmatic language skills of individuals with ID, specifically examining the impact on Down syndrome, fragile X syndrome, and Williams's syndrome. Their focus on group-comparison studies and critical pragmatic skills provides insights into the specific areas of concern within the pragmatic language domain.

In their study on intellectual disability and language disorder, Marrus and Hall (2017) emphasize the presence of cognitive delays, including language and adaptive delays in individuals with intellectual disability (ID). They provide an overview of ID as a neurodevelopmental disorder characterized by cognitive deficits such as, deficits in adaptive functioning, and onset during the developmental period. The authors discuss various causes of ID, such as genetic abnormalities and prenatal, perinatal, and postnatal environmental factors. They intimate that, children with ID may exhibit delays in areas such as language development, motor skills, play, social interaction, comprehension, learning, and problem-solving.

Marrus and Hall (ibid) also mention the co-occurrence of other neurodevelopmental disorders like autism spectrum disorder (ASD) and epilepsy, which further contribute to communication impairments and frustrations in children with ID. While the study by Marrus and Hall provide valuable insights into intellectual disability and language disorders. They primarily present ID in a general sense without focusing on specific aspects of language disorders associated with the disability. This highlights the relevance of the current research, which aims at delving into the specific speech disorders that significantly impact the communication abilities of individuals with ID and associated NDDs.

Coppens-Hofman et al. (2013) conducted a study to examine the types of dysfluencies

present in adults with intellectual disabilities (ID) and speech difficulties, with a specific focus on stuttering and cluttering. The authors aimed to enhance treatment strategies targeting fluency and intelligibility improvements in this population. They observed that speech intelligibility is often severely impaired in adults with ID and identified two types of dysfluencies: stutter-like dysfluencies (SDF) and normal or non-stutter-like dysfluencies. The study analysed the dysfluencies exhibited by 28 adults with mild and moderate IDs, concluding that cluttering, rather than stuttering, was the predominant dysfluency in 29% of the participants. As a result, the authors recommended that dysfluency interventions should primarily address cluttering. However, this study solely focused on speech dysfluencies, specifically cluttering and stuttering, without delving into other disorders.

Tatham and Morton (2006) provide an overview of speech production and perception, focusing on phonetics as the foundation of their study. They begin by discussing classical phonetics, which regarded speech as a sequence of sounds and emphasized observations of surface phenomena. This led to the development of phonology, which aims to explain how sounds function in a given language. The authors explore various theories of speech production, including articulatory and prosodic theories, as well as speech perception theories. They examine the phonetics of speech sounds and their relationship to previous findings, delving into aspects such as co-articulation and co-production. They also touched on the acquisition of second language production and perception and briefly mentions speech disorders, although without providing an in-depth exploration of these disorders. This creates an opportunity for the current research as it allows one to understand the supposed phonological processes which in this case pose as deviations or language difficulties.

Blanken et al. (1993) provide a comprehensive examination of linguistic disorders and pathologies, aiming to develop a human processing model of language production through the study of language pathologies. They discuss the architecture of normal spoken language production, encompassing various stages such as conceptualization, formulation, articulation, and perception Blanken et al. (1993, pp.1-11). They further explore speech errors and aphasia, covering clinical symptoms and syndromes, including semantic, syntactic, morphological, and prosody disorders. Additionally, they delve into the development of linguistic competence in children, emphasizing phonological development and babbling. This is significant to the current study as it provides a solid foundation of knowledge to build on. Having a fore knowledge of what is normal permits one to give a full appreciation of what is abnormal. Again, the authors focused primarily on language disorders in normal children, leaving a significant

gap for the current empirical study.

Guenther (2016) examines the neural mechanisms involved in speech production, emphasizing the integration of different types of information by the brain. The author discusses various methods for investigating speech, including behavioural measures, lesion studies, intracranial electrical stimulation, and functional neuroimaging. He explores the neural structures and control processes involved in speech production, as well as neurological disorders such as dysarthria, apraxia of speech, and stuttering. However, he primarily focuses on the processes and mechanisms of speech production, providing limited coverage of speech disorders. As a result, the current study aims to expand on the understanding of the nature of speech disorders and their detrimental impact on ID cases with associated NDDs. By delving into the negative effects of speech disorders in ID cases, the current study goes beyond the detailed explanation of speech production activities provided by Guenther. It seeks to address the gap in understanding the implications of these disorders on the lives of the concerned.

Pena-Brooks and Hedge's (2007) worked on the assessment and treatment of articulation and phonological disorders in children. They offer practical knowledge and evidence-based strategies to address speech sound disorders in children. Their work combines developmental and linguistic perspectives and provides various assessment techniques, including standardized tests and perceptual judgments. It also discusses treatment strategies supported by empirical evidence and case studies. While they primarily focus on typically developing children, their concepts and assessment strategies can be adapted for studying speech production problems in individuals with intellectual disability. By integrating this knowledge with the specific needs of individuals with intellectual disability, researchers and clinicians can enhance their understanding and interventions for neurodevelopmental disorders. Brooks and Hedge's work has laid a solid foundation for the current study; it has enabled the identification of speech problems in children with intellectual disabilities and associated neurodevelopmental disorders.

Lof et al. (2001) provides a succinct review of the prevalence, characteristics, and potential causes of phonological disorders in children with intellectual disabilities. The authors highlight the higher severity and persistence of these disorders in this population, along with limited phonemic inventories and inconsistent phonological patterns. Factors such as cognitive impairments, auditory processing deficits, motor difficulties, and linguistic factors are

discussed as potential contributors. The review emphasizes the need for early identification and comprehensive assessments to inform effective intervention strategies for promoting communication and language development in these children. Even though Lof et al. (2001) touch on phonological disorders, all they do is to state the possible causes of this disorder in the children thus, creating a gap to be filled with real life data that proves the existence of this disorder and other speech disorders in this group of individuals not limited to children. Donaher and Mirenda (2010) focused on presenting a valuable resource for clinicians working with individuals who have both stuttering and intellectual disabilities. They offer a clear and concise guide that addresses the unique challenges and considerations associated with assessing and treating stuttering in this population. Donaher and Mirenda (2010) provide practical strategies, evidence-based interventions, and case examples to assist clinicians in delivering effective therapy tailored to the need of individuals with stuttering and intellectual disabilities. This comprehensive guide fills a crucial gap in the literature, providing invaluable support for clinicians seeking to improve the communication and quality of life for these individuals. This also paves the way for the current study that seeks to identify speech problems in individuals with ID and associated NDDs not only limited to stuttering in order to enable speech therapist come up with more effective tools in the assessing and treating of these disorders in these individuals.

1.2.1.3 Neurodevelopmental disorders

Herwegen and Riby (2015) present a study on neurodevelopmental disorders, emphasizing the importance of researching and understanding these disorders for accurate diagnosis and effective intervention measures. They highlight critical issues that should be considered in such research, including studying brain development, addressing issues of variability and comorbidity in diagnosis, and implementing theoretical-based interventions. In addition, the authors discuss specific neurodevelopmental disorders such as autism spectrum disorder (ASD), Fragile X Syndrome (FXS), and William Syndrome (WS). They provide brief descriptions of each disorder, highlighting their characteristic features and underlying genetic factors. They state that, autism spectrum disorder (ASD) which is a disorder "characterized by restricted social interactions and verbal and nonverbal communication, and by restricted, repetitive behaviour" (p. 39), Fragile X Syndrome (FXS) a "disorder caused by a trinucleotide repeat (CGG) mutation of the fragile X mental retardation1 (FMR1) gene on chromosome X q27.3." and William Syndrome (WS) a disorder "caused by a deletion of 26-28 genes on chromosome 7q11.23".

However, the focus of the study is on the broader aspects of neurodevelopmental disorders and the need for comprehensive research to improve diagnosis and intervention strategies. In contrast, the current study builds upon this foundation by specifically examining the impact of neurodevelopmental disorders on speech and communication abilities in individuals with intellectual disabilities.

American's Children and the Environment (2019) provides an article focusing on neurodevelopmental disorders by providing information on their types, prevalence, and causes. The authors define neurodevelopmental disorders as disabilities primarily affecting the neurological system and brain. They discuss various disorders such as ADHD, Autism, learning disabilities, and conduct disorders, highlighting their potential impact on children's speech, language, motor skills, behaviour, memory, and learning abilities. The authors emphasize the prevalence of ADHD and learning disabilities among children in the United States, noting an increasing trend in neurodevelopmental disorders like autism and ADHD. They suggest that these disorders often coexist in children, and their causes can be attributed to a combination of genetic, biological, psychosocial, and environmental risk factors. Environmental chemicals, such as methyl mercury, are mentioned as potential contributors to neurodevelopmental disorders, particularly when exposure occurs prenatally or post-natally. However, the article does not delve into the specific impact of these disorders on a child's communication abilities.

Fitzgerald (2019) explores neurodevelopmental disorders, discussing their types, prevalence, and consequences. He highlights the relationship between disorders like autism and psychiatric conditions, emphasizing the comorbidity between autism and ADHD. The author further addresses cerebral palsy and its association with epilepsy, as well as the neurobiological components involved in dyslexia and fluent reading. The importance of early intervention is emphasized. While Fitzgerald's (ibid) study provides valuable insights into neurodevelopmental disorders, like "The American Children Association" (ibid), it does not specifically cover the impact of these disorders on speech.

1.3 Empirical Review

This section tackles the empirical review according to the three specific research objectives.

1.3.1 Research Objective 1: Speech Production Problems on ID and Associated NDDs

This targets empirical review on the identification of speech production problems in

individuals with ID and associated NDDs.

Roberts et al. (2007), focused on boys with Down syndrome and compared their conversational skills to typically developing boys of the same age group. They found that boys with Down syndrome had difficulties elaborating on topics and adding new information to conversations. Moreover, children with Down syndrome demonstrated better narrative skills when provided with visual support, but their speech intelligibility or understandability was poorer compared to typically developing children of the same age. Though Robert et al. also worked on identifying language issues, they focused on conversational skill in Down syndrome while the present study is interested in speech production problems and on ID as a whole. The present study goes further to look at the impact of this speech disorder in ID and associated NDDs.

In terms of Fragile X syndrome, Klusek et al. (2014) and Losh et al. (2012) conducted studies focusing on boys with comorbid Fragile X syndrome and autism spectrum disorder (ASD). Both studies indicated a high level of pragmatic impairment in these boys, emphasizing difficulties in using language in social contexts. In the same vein, Laws and Bishop (2004) explored pragmatic skills in individuals with Williams's syndrome (WS) and identified relatively weaker pragmatic abilities compared to their peers. Their study advocated for further research to enhance pragmatic competences in these individuals. While this study contributes to the understanding of pragmatic difficulties in WS, it does not directly address speech utterances, which is the primary focus of the current study. By examining speech production problems in individuals with intellectual disability and associated neurodevelopmental disorders, the current study bridges a gap in the existing literature by providing valuable insights into this specific aspect of communication.

Georgieva and Cholakova (1996) conducted a study on speech and language disorders in children with intellectual disability, analysing 148 Bulgarian children with mild intellectual disabilities. The study identified various types of speech, language, and fluency disorders in these children, including writing, reading, arithmetic problems, cluttering, stuttering, voice disorders, and articulation disorders. Georgieva emphasized the prevalence of specific speech characteristics in children with Down syndrome, such as increased speech rate, disarticulations, perseverations, hoarse voices, and monotonous voices.

The study provided a comprehensive understanding of the clinical manifestations of speech and language disorders in children with intellectual disability, highlighting the

importance of tailored interventions for this population. While Georgieva's study focused on characterizing speech and language disorders in children with intellectual disability, the current study aims to investigate the impact of speech production problems on individuals with intellectual disability and associated neurodevelopmental disorders. It seeks to identify speech production problems, explore their effects, and provide insights into therapeutic interventions. By examining a wider range of speech production issues and their impact, the current study expands on Georgieva's research, providing a more comprehensive understanding of the speech challenges faced by individuals with intellectual disability and associated neurodevelopmental disorders.

1.3.2 Research Objective 2: Impact of Speech Production Problems on Individuals with ID and Associated NDDs

This part handles empirical review on the second specific research objective which is to determine the impact of speech production problems on individuals with ID and associated NDDs.

Coppens-Hofman et al. (2016) conducted an empirical study focusing on the reduced speech intelligibility observed in adults with mild or moderate intellectual disabilities (ID). They aimed to identify the main predictors of this reduced intelligibility and explore potential solutions. The study involved thirty-six adults with mixed etiology of ID who completed spontaneous speech and picture- naming tasks. Recordings were transcribed, and speech intelligibility was rated by naïve listeners. The authors found that while adults with ID had a complete inventory of phonemic and syllabic units, they exhibited multiple errors at these levels, resulting in high levels of unintelligibility. They attributed these difficulties to challenges in speech motor control and planning, suggesting that speech deficiencies persist throughout the lives of individuals with ID. However, the authors only observed these difficulties in adults with ID which is in contrast to the current study which examines both children and some adults. In addition, while Coppens-Hofman et al.'s (ibid) study highlighted the impact of speech motor control and planning difficulties on speech intelligibility in adults with ID, the current study aims to look further into various speech production problems that individuals with mixed etiology of ID may experience.

Koizumi et al. (2019) investigated the syntactic development in native Japanese-speaking children with intellectual disabilities, highlighting delays and difficulties in understanding and using grammatical structures. Their study focused on syntax and the impact of mental age and specific disabilities on language development. In contrast, the current study

aims to examine speech production problems in individuals with intellectual disability and associated neurodevelopmental disorders, going beyond syntax to explore a wider range of speech-related challenges. By addressing gaps in the literature, the current study seeks to provide a comprehensive understanding of speech impairments in this population and contribute to the development of diagnostic and therapeutic approaches for improving speech abilities.

1.3.3 Research Objective 3: Therapeutic Measures that can Ameliorate the Speech Prowess of ID and Associated NDDs

This part provides empirical review on the third research objective which aims at identifying therapeutic measures appropriate for the amelioration of the speech abilities of individuals with ID and associated NDDs.

Jacob et al. (2015) conducted a study examining developmental and communication disorders in children with intellectual disability (ID) and emphasized the importance of early intervention in addressing these challenges. Their research focused on the benefits of early intervention, including improved developmental, social, and educational outcomes for children with ID. The study highlighted the role of early intervention in reducing the risk of disabilities and promoting inclusion in educational settings. In addition, Jacob et al. (ibid) emphasized the significance of early intervention in improving communication abilities and fostering inclusive educational environments for children with ID. However, their study did not provide detailed insights into speech-related issues or therapeutic advancements even though it did address communication disorders in children with ID. This distinction highlights the gap that the current study aims to fill by focusing specifically on the impact of speech production problems on individuals with ID and associated NDDs.

Terband et al. (2017) conducted an empirical study focusing on the outcome of speech therapy in adults with intellectual disability (ID). They selected thirty-six adults with mild to moderate ID and speech unintelligibility, and provided them with articulatory training for two to three months. The study revealed significant improvement in speech intelligibility regardless of the severity of ID, hearing loss, or etiology. The authors concluded that speech therapy is highly effective for adults with intellectual disability and continuous attention to speech can enhance their speech abilities. This finding challenges the notion that speech deficiencies persist throughout life, as suggested by Coppens- Hofman et al. (2016). The current study aims to contribute further empirical analysis of speech abilities in individuals with ID, serving as a foundation for speech training interventions in this population.

1.4 Definition of Operational Terms and Concepts

This section defines essential terms crucial to the study. It is important to define the terms because their understanding largely facilitates the understanding of many aspects in the work. The terms to be defined are: speech, speech intelligibility, speech disorder, communication disorders, disability, articulation disorder, phonological disorder, intellectual disability/mental retardation, intelligence, adaptive behaviour assessment, inclusive education, voice disorders, muscle speech disorders, microcephaly, macrocephaly, cerebral palsy, down syndrome and pervasive developmental disorder not otherwise specified (PDD-NOS). These terms are defined in order to choose a working definition that suit the needs of the research study.

Speech

The term "speech" is defined differently by various authors. According to Dictionary.com (2023), speech refers to "the faculty or power of speaking; oral communication; ability to express one's thoughts and emotions by speech sounds and gesture." Alternatively, Bilingual Kidspot (2023) defines speech as "the production of sounds that make up words and sentences. Speech involves the coordination of our breathing, vocal cords, vocal tract, nasal tract, tongue, jaw, and lips." For the purpose of this linguistic research, the definition provided by Bilingual Kidspot is utilized. It aligns with the study's focus on identifying issues related to the miscoordination of oral structures involved in speech production, which contribute to difficulties experienced by individuals with intellectual disability and associated NDDs.

Speech Intelligibility

According to Coppens-Hofman et al. (2016), speech intelligibility is defined as "how clearly a person speaks so that his or her speech is comprehensible to a listener." They emphasize that the clarity of speech determines its intelligibility. Similarly, the American Psychological Association (2020) defines speech intelligibility as "the degree to which speech sounds (whether conversational or communication-system output) can be correctly identified and understood by listeners in a particular environment." On the part, Hassan et al. (2013) defines speech intelligibility as "the percentage of linguistic units (words) that are being correctly recognized by a listener and what a listener recognizes from the speech signal, which is also determined by the percentage of words, sentences, or phonemes correctly identified." In this study, the definition by Hassan et al. (2013) is deemed appropriate, as it aligns with the research's objective of highlighting linguistic deficits in speech production among individuals

with intellectual disability. This definition explicitly addresses the linguistic units that constitute speech and emphasizes the study's focus on examining the impact of speech problems on individuals with ID and associated NDDs.

Speech Disorder

Penn Medicine (2022) defines speech disorder as "…a condition in which a person has problems creating or forming the speech sounds needed to communicate with others". According to the American Speech Hearing Association (1993), a speech disorder refers to problems in the production of speech sounds that may be characterized by an interruption in fluency or rhythm of speech, difficulties with pronunciation of speech sounds, or problems with the stress or intonation of syllables or words. This definition aligns with the study's objective of identifying speech problems in individuals with intellectual disability associated with other NNDs, who encounter significant difficulties in producing speech sounds.

Communication Disorders

Communication disorders encompass a range of difficulties related to speech, language, and auditory processing. These challenges can vary from simple sound repetitions, such as stuttering, to occasional misarticulation of words, or even the complete inability to use speech and language to communicate, as in the case of aphasia (Psychology Today, 2022). Gleason (2001), posits that communication disorders encompass any impairments that affect an individual's ability to communicate, including simple sound substitution or a complete inability to understand. The American Speech and Hearing Association (ASHA) (1993) defines communication disorder as an impairment in the ability to receive, send, process, and comprehend concepts using verbal, nonverbal, and graphic symbol systems. While all three definitions acknowledge impaired language production and processing, the definition provided by ASHA is particularly suitable for this study. It offers a more comprehensive explanation of communication disorders, highlighting characteristics relevant to the research population.

Disability

Hallahan et al. (2009) note that a disability refers to an inability to perform certain tasks or a diminished capacity to perform them (impairment). According to the World Health Organization (2022), disability is an umbrella term for impairments, activity limitations and participation restrictions, referring to the negative aspects of the interaction between an individual's health condition and contextual factors. For the current research, Hallahan et al.'s (2009) definition is most appropriate for it gives a clearer description of the research

participants. Their definition does not only carry the term “diminished capacity” but talks about an inability to perform certain task which is an appropriate description of the population under study (intellectual disability).

Articulation Disorder

The National Institute on Deafness and Other Communication Disorders (NIDCD, 2022) defines articulation disorder as the inability to accurately produce speech sounds (phonemes) due to imprecise placement, timing, pressure, speed, or flow of movement of the lips, tongue, or throat. According to Flint (2017), articulation disorder is present when a child faces challenges in physically producing a specific sound or sounds, either due to structural defects or difficulties in achieving proper placement of articulators to create the target sound. Both definitions highlight that articulation disorder stems from the incapacity to produce speech sounds accurately, often attributed to physiological factors. For this study, Flint's (2017) definition is utilized as it effectively encapsulates the focus on speech problems such as "structural defects" which is related to the study.

Phonological Disorder

Phonological disorder, as defined by Spivey (2022), refers to a child's difficulty in comprehending the sound system and speech rules of a language that typically-developing children acquire effortlessly. Children with phonological disorders may mispronounce specific sounds in certain words while articulating them correctly in others. According to the American Speech-Language-Hearing Association (2008), phonological disorder involves patterns of sound errors within a child's speech and language repertoire, with an underlying difficulty relating to the rules governing the language's sound system. Both definitions emphasize the challenge of grasping language rules. Spivey's (2022) definition aligns closely with the objectives of this study as it delves into the core aspect of the researcher's inquiry, highlighting the inability of children with this disorder to naturally acquire speech skills exhibited by their peers of the same age.

Intellectual Disability/Mental Retardation

Intellectual disability, as defined by Harris (2006), refers to an impairment in both cognitive functioning and adaptive skills that manifests during the developmental period. It is a comprehensive disability encompassing developmental, intellectual, and cognitive aspects. The Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association, 2000) defines mental retardation as having significantly below-average general intellectual functioning (criterion A), accompanied by significant limitations in adaptive functioning in

areas such as communication, self- care, social skills, and more (criterion B). The onset of mental retardation must occur before the age of 18. For this study, the definition provided by the American Psychiatric Association is utilized, as it encompasses the researcher's focus on limitations in the communicative ability of individuals with ID and associated NDDs, as emphasized by the association.

Intelligence

The concept of intelligence has been defined by Wechsler (1940) as the overall capacity of an individual to purposefully act, think rationally, and effectively engage with their environment. Stoddard (1941) defines intelligence as the ability to undertake challenging, complex, and adaptive activities that hold social value, require originality, demand concentrated energy, and withstand emotional forces. In the context of this research, the first definition will be adopted due to its inclusion of key phrases such as acting purposefully, thinking rationally, and effectively dealing with the environment. These traits distinguish individuals with intellectual disabilities from their neurotypical peers, as they often lack the ability to think rationally, act purposefully towards specific goals, and effectively navigate their environment. Therefore, this definition aligns closely with the focus of the study.

Adaptive Behaviour Assessment

Reschly (2002) defines adaptive behaviour assessment as "…the measurement of an individual's performance of daily activities required for personal and social sufficiency. Adaptive behaviours are age-appropriate behaviours necessary for people to live independently and to function safely and appropriately in daily life". Sparrow et al. (2005) define adaptive behaviour assessment as "…how effectively individuals cope with the nature and social demands of their environment". Both definitions give a good picture of what adaptive behaviour assessment is. However, for this study, the researcher utilized Reschly's definition for it is more explicit in its description of the term. This term is very important in the study for it is used to assess the intellectual level of the research participants. Reschly's definition provide a detailed base on the skills the researcher assessed in the research participants thereby justifying their intellectually disabled state.

Inclusive Education

Inclusive education, as defined by UNICEF (2017), refers to the practice of educating all children, including those with disabilities, in the same classrooms and schools. It aims to provide equal learning opportunities for a group of individuals who have traditionally faced exclusion. Inclusive education involves placing students, regardless of their challenges, in age-

appropriate general education classes within their local community schools. These students receive high-quality instruction, interventions, and support to help them succeed in the core curriculum. According to Obi (2010), inclusive education entails reforming and restructuring the entire school system to ensure that all students have access to a comprehensive range of educational and social opportunities provided by the school. For this study, the definition provided by UNICEF is very much accepted for it is in line with the researcher's need for more inclusive environment for children with ID and associated NDDs as a recommendation to the society as a whole.

Voice Disorders (VDs)

This disorder is defined by a wide range of authors. Titze (2000) defines voice disorders as deviations from the normal voice production process, leading to changes in vocal quality, pitch, loudness, and endurance. To him, these deviations may result from various underlying causes, such as tissue abnormalities, neurological issues, or misuse of the vocal mechanism. Boone & McFarlane (2000) define voice disorders as any deviations from normal vocal function that impacts a person's ability to produce clear, efficient, and effective vocal communication. This encompasses a wide range of conditions affecting the larynx, vocal folds, and other vocal tract structures. Even though both definitions give a clearer picture to what voice disorders are, the definition provided by Titze (2000) is of more interest in the current study. The definition captures the characteristics of voice disorders the researcher observed in the research participants thereby giving a clearer insight into what voice disorders are all about

Neurodevelopmental Disorders (NDDs)

American Psychiatric Association (2013) through their Diagnostic and Statistical Manual of Mental Disorders 5th edition define NDDs as a group of conditions with onset in the developmental period. The disorders typically manifest early in development, often before the child enters grade school, and are characterized by developmental deficits that produce impairments of personal, social, academic, or occupational functioning. Thapar et al. (2017) defines NDDs as disorders that emerge in the developmental period and involve significant challenges in domains like language, motor function, socialization, self-regulation and academic skills. Even though the definition provided by the American Psychiatry Association gives a general ideal of what the researcher means by NDDs in the current study in that it gives the general characteristics of individuals with NDDs, the second definition provided by Thapar et al. (2017) is most appropriate for the study for it gives not only the characteristics of the participants but also helps in ascertaining the research objectives in that, it vocalizes the

challenges the research participants face such as language, socialization and academic skill impairments.

Muscle Speech Disorders (MSDs)

Also known as motor speech disorders are defined by Duffy (2013) as "speech disorders caused by neurologic impairment affecting the motor planning, programming, neuromuscular control, or execution of speech". Rossi et al. (2020) define motor speech disorders as disorders of speech resulting from "…neurologic impairment affecting the motor planning and programming, neuromuscular control, or execution of speech". Both studies as well as other studies define muscle/motor speech disorders similarly. Both definitions are of great use in the study for they help to explain why the research participants tend to face these disorders and also why other participants face these disorders more than others.

Microcephaly

Microcephaly, as described by Mayo Clinic (2022), is a rare neurological condition characterized by an infant having a significantly smaller head size compared to children of the same age and sex. It is often attributed to abnormalities in brain development during pregnancy or stunted brain growth after birth. Hanzlik and Gigante (2017) define microcephaly as a head circumference that falls more than two standard deviations below the mean for gender and age. The first definition provides a clearer understanding of microcephaly and its association with speech defects and intellectual disability in affected children, making it more suitable for the current study.

Macrocephaly

Macrocephaly, as defined by Cleveland Clinic (2022), is a condition in which a child has a significantly larger head circumference compared to others of the same age and sex. Specifically, the head circumference measurement around the widest part of the head exceeds the 97th percentile, indicating that the child's head size surpasses that of 97% of children in the same age and sex group. In Swaiman et al. (2017), macrocephaly is described as an occipital circumference (OFC) that is 2 standard deviations or more above the mean for age, gender, and ethnicity, measured over the greatest frontal circumference. The first definition provides a clearer understanding of macrocephaly and its potential impact on speech development, as abnormal enlargements of the brain associated with macrocephaly can affect language regions in the brain, leading to speech defects. This is a very important term in the current research for it falls under one of the associated NDDs the research is based on.

Cerebral Palsy

Cerebral palsy, as defined by Rosenbaum et al. (2007), refers to a group of permanent disorders that affect the development and posture, leading to limitations in activities. These disorders are attributed to non-progressive disturbances that occurred in the developing fetal or infant brain. Similarly, according to CerebralPalsyFoundation.com (2023), cerebral palsy is a neurological disorder that arises from a nonprogressive brain injury or malformation occurring during the developmental stage of the child's brain. In this study, the focus will be on the first definition, as it aligns with the research's objective of investigating the limitations associated with this neurological disorder when associated to ID.

Down Syndrome

Down syndrome, as defined by the Centers for Disease Control and Prevention (2021), is a condition characterized by the presence of an extra chromosome. Antonarakis et al. (2020) further describe Down syndrome as the presence of a supernumerary chromosome 21, resulting in a collection of clinical features commonly known as Down syndrome (DS). Both definitions highlight that Down syndrome is a genetic disorder caused by abnormal cell divisions, leading to the presence of additional genetic material from chromosome 21. This disorder is associated with developmental and intellectual delays in children, often resulting in various speech defects, particularly articulation and phonological disorders. In this study, the first, more concise definition is used, as it effectively conveys the concept and aligns with the research focus on associated NDDs in individuals with ID.

Pervasive Developmental Disorders-Not Otherwise Specified (PDD-NOS)

Matson and Minshawi (2006) define PDD-NOS as severe and pervasive impairment in the development of reciprocal social interaction or verbal and nonverbal communication skills or the presence of stereotyped behaviour, interest, and activities. Volkmar et al. (2005) define PDD-NOS as a neurodevelopmental disorder which is diagnosed when symptoms characteristic of the broader PDD category that cause impairment are present, but criteria are not met for a specific PDD. Volkmat et al. (2005) definition is more appropriate for the study for it gives a better description of the research population who have PDD-NOS as associated NDD to ID. With this definition, the researcher is able to better understand the characteristics of the research participants suffering from this NDD when associated to ID.

1.5 Conclusion

The aim of this chapter was to provide an in-depth exploration of the theoretical framework utilized in the study and to discuss relevant literature related to the research topic. Additionally, it aimed to establish clear definitions of key operational terms that will be used throughout the study. By examining the theoretical foundations and reviewing pertinent literature, the chapter sets the stage for the research by providing a comprehensive understanding of the concepts and context surrounding the study. This theoretical framework and literature review serve as a basis for formulating research questions, developing hypotheses, and guiding the analysis and interpretation of data in subsequent chapters.

Chapter Two: Methodology

This chapter presents the methodology employed in this study. It outlines the instruments and methods used. It begins by presenting the research design, followed by a description of the study area, research population, research procedure and data collection, reliability and validity, data presentation and analysis, ethical considerations and a chapter conclusion.

2.1 Research Design

To ensure adherence to scientific principles and methods, a well-constructed research design aligned with the study's objectives is crucial. The selected research design should provide a systematic framework for data collection and analysis (Bryman, 2012, p.46). In this study, the aim is to identify and describe speech production problems and their impact on individuals with intellectual disability (ID) and associated NDDs. Therefore, a qualitative research design is adopted.

The adoption of a qualitative research design is supported by several reasons. Firstly, it harmoniously aligns with the research objectives, as it allows for the collection of rich and insightful descriptive data. This design is likely to facilitate a deep exploration of the various qualities and inherent characteristics of speech abilities in individuals with ID and associated NDDs. Additionally, this approach would enable the researcher gain valuable insights into the experiences of individuals with ID and associated NDDs by observing them within natural settings. The research philosophy of phenomenology or interpretivism aligns well with the chosen qualitative research design for this study. This design provides a conceptual framework for analysing and interpreting the speech problems experienced by individuals with intellectual disability (ID), considering their unique characteristics. This approach is chosen over the quantitative design which focuses mostly on numerical data and fails to capture complexities and personal context critical to understand unique perspectives of participants and the mixed design that might lead to the diluting of rich and descriptive data due to the usage of two designs.

Furthermore, the qualitative design necessitated the alignment of subsequent methods and strategies. In order to focus on observing speech production problems in individuals with ID and associated neurodevelopmental disorders (NDDs), a case study research strategy is adopted. This strategy allows for a deeper understanding of the nature of speech impairments in NDDs, using ID as a lens. It is particularly relevant given that data was collected from two

different institutions, involving young children, adolescents, and adults with ID and associated NDDs. The researcher's presence in the field was essential to observe the phenomenon under study which aligns with the research design and philosophy.

2.2 Study Area

In order to gain a comprehensive understanding of the research, it is crucial to explore the study area that serves as the backdrop for the investigation. This section delves into the administrative structure of the city in which the study takes place, providing valuable insights into the intricate dynamics and spatial dimensions that shape the research context. This would ultimately enhance the comprehension of the findings and their implications. The research is conducted in the city of Yaoundé specifically in two handicap centres namely the National Rehabilitation Center for Persons with Disabilities (CNRH) and Centre de Prise en Charge des Handicaps Mentaux (CAF/CEBNF ESPOIR).

2.2.1 Brief Description of the Study Area

The study is conducted in Yaounde, the capital city of Cameroon, located in the Centre region. This region comprises ten administrative divisions, namely Haute-Sanaga, Lekie, Mbam-et-Inoubou, Mbam-et-Kim, Mefou-et-Afamba, Mefou-et-Akono, Mfoundi, Nyong-et-Kelle, Nyong-et-Mfoumou, and Nyong-et-So'o (Ngoh, 1996). However, the focus of this study is specifically on the Mfoundi division which encompasses Yaounde and its surrounding area. Within Yaounde, there are several administrative subdivisions and their respective headquarters, including Yaoundé 1 (Nlongkak), Yaoundé 2 (Tsinga), Yaoundé 3 (Efoulan), Yaoundé 4 (Kondengui), Yaoundé 5 (Nkolmesseng), Yaoundé 6 (Biyem-Assi), and Yaoundé 7 (Nkolbisson) (Julius, ibid). The two institutions where the study is conducted are located in Etougebe (CNRH) and Mimboman (CAF/CEBNF ESPOIR) within the city of Yaounde. Consequently, the subdivisions of interest for this research are Yaounde 6, like Etougebe, where CNRH is situated, falls under its jurisdiction, and Yaounde 4, which encompasses Mimboman, where CAF/CEBNF ESPOIR is located.

The researcher used two centres for the study in order to have a holistic understanding of the speech production problems across different ages. The following paragraphs describe both centres navigating through their inception to their objectives.

2.2.1.1 National Rehabilitation Centre for Persons with Disabilities (CNRH).

This centre was created in 1971 by a Canadian prelate, by name Cardinal Paul Emile Leger. It was later on inaugurated on 15 January 1972 by the former president, El Hadj Ahmadou Ahidjo as a private social centre called, the Yaoundé Rehabilitation Centre. After

some years of operation, in 1978, it was transferred to the State of Cameroon under the name of National Rehabilitation Centre for People with Disabilities as a Specialized Agency of the Ministry of Social Affairs. (CNRH, n.d.). This centre had as main mission to rehabilitate children suffering from polio, meningitis and congenital malformation. In 2009, through decree no. 2009/096 of March the centre was assigned, an extended task of managing all types of disabilities. Some of its main functions include;

- Rehabilitation of individuals with motor disabilities.
- Provision of special education for disabled children.
- Professional training and social integration.
- Orthopedic surgery.

To better execute these functions, the centre provides three core services:

- Medical and paramedical treatments (including General Medicine consultations, Neurology consultations, Traumatic consultations, etc.).
- Support for disabled individuals through psychological follow-ups and social workers.
- Special Education (comprising a special and inclusive primary section) and Professional Training (consisting of seven workshops).

It is important to note that the centre caters to a wide range of disabilities. Alongside its responsibilities in handling various types of disabilities, the centre also houses a special primary school called "La Colombe," which focuses on the educational and pedagogical support of children with special needs. This school holds particular significance for the current research as the research participants and empirical data are also derived from this institution.

"La Colombe" was established in 1973 by Cardinal Emile Paul Leger and was officially inaugurated as a private institution on September 29th, 1973, with the presence of the First Lady, Mrs. Germaine Ahidjo (CNRH, n.d, p.8). To fulfill its mission, the school is divided into three main sections: the special education section, the inclusive section, and the professional training section. Each section plays a distinct role in the rehabilitation and overall development of the learners. This aspect was one of the primary reasons for selecting this site for the research, as it encompasses children with intellectual disabilities within the age range of 9 to 19 years, covering one of the targeted age groups. Additionally, conducting the research at this site allows the researcher to observe the participants in their natural setting, providing a first-

hand perspective of the children's experiences and the challenges they encounter.

2.2.1.2 Centre de Prise en Charge des Handicaps Mentaux (CAF/ CEBNF ESPOIR).

CAF-ESPOIR is a specialized school established by Mme Bitang A. Mougnol Setou on August 19th, 2019. This school operates under the association Coeur Maternel and has been granted authorization by article 7 no 00000382 RDA/J06/SAAJP/BAPP of August 2019. It caters to individuals with special needs, specifically those with intellectual disabilities. The institution comprises two primary structures with distinct functions and they are;

A) CAF ESPOIR

The Alphabetization Centre Espoir consists of two main structures responsible for the education of adolescents and adults. Its mission is to provide literacy training for individuals with intellectual disabilities, encompassing reading, writing, basic arithmetic, as well as functional skills such as crafts with beads, agriculture, hairdressing, and various fabrication skills (e.g., lotions, carpentry, and more). Additionally, the centre offers training in computer science, motor stimulation, and psychological support.

B) CEBNF (Centre d'éducation de base non formelle)

This section focuses on children with any form of intellectual disability. The children receive instruction in basic literacy skills, adaptive learning, stimulation, and early interventions. Parents are also offered psychological consultations by a dedicated psychologist. This specialized school serves as a centre for functional literacy training and education for children and adults with intellectual disabilities. The primary objective is to equip individuals with specific needs with the necessary skills to achieve autonomy within the society. This centre was selected for the study due to the availability of the target study population. The researcher had the opportunity to interact fully with the study participants, facilitating the sampling process. The presence of qualified psychologists within the institution ensures the validity of the sample, as the children are well-classified based on their specific needs and disability.

2.3 Population of the Study

This section begins by providing an overview of the target population, accessible, sample population, sampling technique and sample size.

2.3.1 Target population

The target population are individuals suffering from intellectual disability (ID) and other associated neurodevelopmental disorders such as; pervasive development disorder-not otherwise specified, CP, DS, microcephaly and macrocephaly with speech production problems within the city of Yaounde. These individuals range from nine to twenty-five years of age and includes males and females. This age range was selected because it covers key developmental years through early adulthood when social communication demands change.

2.3.2 Accessible Population

In this study, the researcher had the opportunity to access individuals from two distinct specialized schools or centres: The National Centre for the Rehabilitation of Persons with Disabilities (CNRH), specifically the children from the "La Colombe" special education primary school, and the Centre de Prise en Charge des Handicaps Mentaux (CAF/CEBNF ESPOIR) located in the city of Yaoundé. It includes children who were at the school at the time of research and who were available for assessment during the study. These institutions provided valuable access to the target population for the research.

2.3.3 Sample Population

The researcher sampled fourteen participants who suffer from ID and associated NDDs from both CNRH and CAF/CEBNF ESPOIR institutions. Eight participants were sampled from CNRH and six participants from CAF/CEBNF ESPOIR. The inclusion criteria for the selected population were diagnosis of ID with associated neurodevelopmental disorders and exhibiting manifestations of speech production problems which is better elaborated in the sample size. Also, the researcher sampled teachers from both institutions with the aim of collecting more insightful data corresponding to the research demands. The inclusion criterion was for these teachers to have had a lot of experience teaching children with ID and other associated NDDs.

2.3.3.1 Sampling Technique and Sample Size.

This section of the study presents details regarding the sampling technique employed and the sample size chosen for the research.

2.3.3.1.1 Sampling Technique

A non-probability sampling strategy was employed in this study to select the study population in a non-randomized manner. The selection process was based on non-random criteria that tied with the objectives of the study. Through this criterion, participants were obtained based on their possessing the necessary characteristics present in the target population and relevant to the study such as being diagnosed with ID, exhibiting speech production

problems and be within the age range of 9 to 25 years. This technique proved beneficial for it allowed the researcher to focus on the variables of individuals with intellectual disability and associated NDDs, as the independent variable and speech production problems as the independent variable. It aligned with the research strategy of conducting a case study, which required an in-depth examination of a specific population. Hence, a quantity-oriented technique such as random sampling was not suitable. The teacher population was obtained based on two criteria: their being inclusive specialized teachers and being teachers of the selected participants or have at least taught the selected participants for some amount of time. This ensured that the researcher could obtain relevant data from the teachers.

Purposive sampling was utilized in this study, as the study population (individuals with intellectual disability and associated neurodevelopmental disorders) screened after meeting the study criteria and on their availability. Obtaining the study population posed minimal challenges, as the researcher simply needed to visit two handicap centres and recruit the participants. Purposive sampling technique provided the necessary elements needed for the research for it facilitated easy access to and recruitment of the sample population without significant obstacles.

2.3.3.1.2 Sample Size

In the National Centre for the Rehabilitation of Persons with Disabilities (CNRH), a sample of eight participants was selected from the accessible population based on the research strategy. The participants were chosen from specific classes, namely Initiation 1 & 2 and specialisation classes 5, 6a, and 6b. Participants from both the inclusive and specialised sections made up the sample for they met up with the researcher's sampling criteria. This sample group fulfilled the research objectives as all of the participants had intellectual disability and associated NDDs, which were relevant for the study. The age range of the participants, from nine to nineteen years, was suitable for the research study. It is important to note that the focus of the sampling in this centre was primarily on children and teenagers this was in order to capture the language data in diverse age groups to ensure representation. The researcher determined the suitability of the selected participants for the research objectives through observation, a language test and their medical records.

In terms of the method of observation, the criteria used to observe the study participants with ID was based on Reschly et al. (2002) adaptive behaviours assessment method to diagnose persons with ID. The assessment strategy used involved the observation of the participants' adaptive behaviours such as their conceptual, social, and practical skills. Using this

assessment, the researcher observed substantial limitations in conceptual skills like; literacy, understanding time, and money, and following complex instructions which are indicators of intellectual disability. Deficits in social skills like social judgement, gullibility, and ability to follow social norms also hinted at intellectual disability. Finally, shortcomings in practical abilities such as, self-care, occupational skills, and safety, highlighted the presence of ID. This assessment method, is affirmed by many researchers such as; Salvador-Carulla et al. (2013), and Navas et al. (2021) as being far more effective than an intelligent quotient (IQ) test in identifying persons/children with ID. In line with Reschly et al. (2002), all criteria were checked in each participant in CNRH and they met the criteria for the research.

In order to determine the presence of speech production problems in individuals with ID and associated NDDs, an oral language test was employed. The researcher administered a test on all eight participants wherein, they were made to pronounce sounds and words. This was useful in pointing out speech problems in the participants hence their eligibility for the research sample.

To ensure the reliability of the diagnosis of ID and NDDs in the study participants, the researcher consulted their medical records. This method was very effective for it enabled the researcher know exactly what associated disabilities each participant with ID had which was a very important criterion for sample selection. This is seen in the tables 1 and table 2 below.

It is important to highlight that the researcher relied on the participants' medical histories to confirm their intellectual disability and the specific types of associated neurodevelopmental disorders. Therefore, the table presented below, which includes information on the intellectual disability and associated NDDs, is based on the available records obtained from the participants' medical history gotten from the schools' administration.

Table 1: Research Participants' Identification (CNRH)

Traits / Participants	Age(s)	Sex	Disability	School	L1
P5	9	Female	ID with DS	CNRH	French
P6	15	Female	ID with CP	CNRH	English
P7	17	Male	ID with DS	CNRH	English
P8	12	Female	ID with macrocephaly	CNRH	French
P11	15	Female	ID with CP	CNRH	English
P12	10	Male	ID with microcephaly	CNRH	English
P13	19	Male	ID with CP	CNRH	French
P14	15	Female	ID with CP	CNRH	French

The above table presents the research participants in CNRH. Two participants had ID associated with DS (P5 and P7), four participants had ID associated with CP (P6, P11, P3 and P14), one participant with ID associated with macrocephaly (P8) and one participant with ID associated with microcephaly (P12).

Apart from the identification data, the researcher was able to get each participant's environmental data from their medical record which helped in pointing out the fact that the participants have difficulties that started right from a certain point of their lives leading to them being disabled intellectually. The following table presents the environmental data for the eight participants. Yes/no is used to indicate the presence or absence of difficulties. The difficulties run from prenatal (during pregnancy) to natal (at birth) to postnatal (after birth) and the family situation of the participants. The table indicates that three participants (P5, P7and P8) had no prenatal problems, four participants had no difficulties at birth (P 8, P11, P13 and P14), just two participants face difficulties after birth (P7 and P8). Majority of the participants live with both parents with the exception of Participants 7 and 13.

Table 2: Environmental Data for CNRH Cases

Difficulties / Participants	Prenatal	natal	Postnatal	Live with both parents
P5	No	yes	no	Yes
P6	Yes	yes	no	Yes
P7	No	yes	yes	No
P8	No	no	yes	Yes
P11	Yes	no	no	Yes
P12	Yes	yes	no	Yes
P13	Yes	no	no	No
P14	Yes	no	no	Yes

At the Centre de Prise en Charge des Handicaps Mentaux (CAF/CEBNF ESPOIR), a sample of six participants comprising teenagers and young adults were selected for this study. The participants ranged from fifteen to twenty-five years of age. This age group was considered appropriate as it covered the transition from childhood to adolescence and into adulthood, which was the intended age spectrum for the study. The rationale for choosing these individuals was their alignment with the three criteria of selection which were observation, language test and medical records. As already elaborated above, the participants' adaptive behaviours such as conceptual, social, and practical skills were assessed. All six participants checked this criterion for they all exhibited difficulties in all three adaptive skills thereby indicating their level of intellectual prowess. Also, the researcher administered a language test enabling the identification of speech production problems in the research participants. The participants showed visible struggles when pronouncing sounds and words hence their selection. And lastly, the researcher made use of their medical records to ascertain the fact that they do not only suffer from ID but have other associated NDDs. The table below provides specific details about the overall participants included in the sample. The table illustrates that, three participants had ID associated with Pervasive developmental disorder-not otherwise specified (PDD) (P1, P3 and P9), one participant had ID associated with microcephaly (P2), one participant had ID associated with DS (P4) and one participant had ID associated with CP (P10).

Table 3: Research Participants' Identification (CAF/ CEBNF ESPOIR)

Traits / Participants	Age	Sex	Disability	School	L1
P1	23	Male	ID with associated PDD-NOS	CAF/ CEBNF ESPOIR	French
P2	22	Male	ID with microcephaly	CAF/ CEBNF ESPOIR	French
P3	21	Male	ID with PDD-NOS	CAF/ CEBNF ESPOIR	French
P4	15	Female	ID with DS	CAF/ CEBNF ESPOIR	French
P9	25	Female	ID with PDD-NOS	CAF/ CEBNF ESPOIR	French
P10	20	Male	ID with CP	CAF/ CEBNF ESPOIR	French

The environmental data for these participants was also obtained from their medical records. This data affirms the researcher's initial diagnosis of ID and associated neurodevelopmental disorders. The table below presents the participants' difficulties by the

use of the terms “yes” indicating the presence of a difficulty and/or “no” indicating the absence of a difficulty. On the table, majority of the participants had prenatal difficulties except for P2. As for difficulties at birth, three participants face no difficulties (P1, P3 and P9) while three participants had difficulties (P2, P4 and P10). At the postnatal period, two participants had no issues (P2 and P10) whereas the remaining four participants faced one issue or another at this stage. Looking at the table, one can notice that the majority of the participants live in single parental homes and only P1 and P4 live with both parents.

Table 4: Environmental Data for CAF/ CEBNF ESPOIR Cases

Difficulties / Participants	Prenatal	natal	Postnatal	Live with both parents
P1	No	no	yes	Yes
P2	Yes	yes	no	No
P3	No	no	yes	No
P4	No	yes	yes	Yes
P9	No	no	yes	No
P10	No	yes	no	No

Summarily, the researcher sampled fourteen participants with three participants suffering from ID associated with DS (P4, P5 and P7), five participants with ID associated with CP (P6, P10, P11, P13 and P14), three participants with ID associated with PDD (P1, P3 and P9), two participants with ID associated with microcephaly (P2 and P12) and lastly, one participant had ID associated with macrocephaly. Following the environmental data for participants from each school, one can conclude that few participants faced all of the difficulties at once. Some had two of the difficulties, some had three, while others like P3 faced only one of the difficulties. The table shows that the most rampant difficulty was the single parenting. Most participants live with single parents.

2.4 Research Procedure and Data Collection

This section handles the different steps that the research underwent as well as the data collection method employed.

2.4.1 Research Procedure

This study was carried out in two institutions, The National Centre for the

Rehabilitation of Persons with Disabilities (CNRH) and Centre de Prise en Charge des Handicaps Mentaux (CAF/ CEBNF ESPOIR). In order to ensure ample time for collecting the necessary empirical data, the researcher employed a case study strategy which allowed for a fieldwork period of four months. This accorded enough time to get rich and profound speech data for the study. The researcher made use of semi-structured one-on-one interview, observation checklists, and language tests to obtain data. At the start of the fieldwork, the researcher visited the various classes for each participant and observed them, jotting down notes. Based on the observations, the researcher developed a wordlist and an interview guide which was pilot tested with some of the population before implementation. The researcher used feedback from the pilot test to modify some words and interview questions before proceeding to administer. For the study participants with ID and associated NDDs, a one-on-one language test was conducted with each participant in an empty classroom for privacy and confidentiality. Each session per participant ran for 20 to 30 minutes depending on each participants attention span. At the start of each session, the researcher introduced herself to the participant and explained the task at hand. The researcher also adopted a warm and open posture to ensure the participant was relaxed and felt at ease to avoid external factors influencing his or her performance. With permission from the schools, the researcher recorded each session with a digital recorder (smartphone). The recorder was placed before the participant at a close but unobtrusive distance to ensure a clear capture of their utterances. During each session, the researcher provided a word list for the participant to pronounce sounds and words.

With the teacher population, semi-structured interviews were conducted with them in their respective classrooms during lunch breaks ranging from 30 to 45 minutes. The interview was done with the help of an interview guide containing questions related to the impact of speech production problems on ID and the therapeutic strategies available. The researcher used field notes during such interviews to jot down relevant information. A digital audio recorder was also used during these sessions. The audios from both the language test and semi-structured interviews were transcribed, treated and coded accordingly. The instruments were administered during each session that ran from Mondays to Fridays.

These recordings served as a supplementary tool that went beyond mere observation, allowing the researcher to capture nuances and intricacies that may have been missed by the naked eye or ear alone. By utilizing audio recordings, the researcher aimed to enhance the accuracy and reliability of the data collected. These recordings provided a reliable source for

later analysis, transcription, and interpretation of the participants' speech abilities, challenges, and progress phonetically.

2.4.2 Data Collection

This section elaborates on the methods of data collection employed as well as the instruments used in each method.

2.4.2.1 Methods of Data Collection

The methods employed in the collection of empirical data for the research included semi- structured interviews and observation. These methods were administered in order to attain the objectives of obtaining in-depth descriptive data on speech production problems and their impacts. Utilizing both methods ensured the reliability of the data obtained as both methods complimented each other's shortcomings thereby facilitating the collection of a comprehensive data set. The following lines elaborate further on each method and their application during the study.

2.4.2.1.1 Participant Observation

The researcher made use of participant observation during fieldwork. This is something that requires a lot of time, thus was ideal for the study. The researcher in the course of data collection made use of passive and active participant observation. Upon the researcher's initial encounter with the research participants, the researcher adopted an active participant observation method in order to ingratiate and familiarize with the research participants so that natural data could be collected with little or no influence. This was achieved by participating in some of their morning dances, singing along with them and greeting them and also performing curricular activities such as sports and craftsmanship with them. After this, the researcher switched to a passive participant observation method in order to study them objectively. The use of the two types of participant observation permitted the researcher to capture their experiences and meaning of their actions in context leading to a rich data set. Which is what observation is all about. Observation allowed the researcher to directly observe the participants and their speech production problems in their natural setting.

2.4.2.1.2 Interview

In addition to observation, interviews were utilized as a means of gathering primary data for this study. The use of interviews allowed the researcher to obtain insightful information that could not be captured through observation alone. When direct observation proved insufficient for obtaining in- depth information, interviews were conducted to complement observation. The interviews were applied in two formats; a guided interview with a word list

for language assessment and a semi-structured interview. For guided interviews, the researcher administered a word list to participants with ID and associated NDDs while allowing them repeat words from the list. Semi-structured interview provided a platform to obtain information from the teachers about the experiences of individuals with ID and associated NDDs. Additionally, the impact of the speech impairment on the participants' social lives was assessed through discussions with their teachers. Through the use of interviews, the researcher gained a better understanding of the research participants and their experiences, which further aligned with the research objectives. The combination of observation and interviews facilitated a comprehensive data collection process, capturing observable behaviours.

2.4.2.2 Instruments of Data Collection

The researcher made use of instruments such as; observation checklists, semi-structured interview and language tests.

Observation Checklist

In this study, five observation checklists were utilized to determine the speech skills and competencies of the subjects and also validate their selection for the study. The checklists allowed for the systematic evaluation of the participants' speech when it came to collecting information on their speech data. The observation checklist for speech data contained information on the participants' speech manifestations such as; short pauses, long pauses, hesitation, violence, responsiveness, gestures, cooperation, friendliness and articulation. This information was checked on all fourteen participants using a grading system ranging from 0 (null perceptibility), 1 (almost perceptible), 2 (perceptible) to 3 (very perceptible). The second checklist was used to check information on the environmental data. The checklist was made up of information regarding the stages where the participants faced difficulties that led to their disabilities. Information gathered observing the onset of difficulties were; prenatal (during pregnancy), natal (at birth), postnatal (after birth) and the living conditions of the participants (living with both parents or not). This information was checked on all fourteen participants primarily gotten from their medical records. The third checklist handled the participants' identification data. This was preliminary data regarding the participants which was effectively gotten through observation. It consisted of information such as the participants' ages, sex, disability, school and first language (L1). The fourth checklist was used to check adaptive behaviour of each participant. This was very important in the selection process for it enabled the researcher assess participants ensuring that they indeed suffer from intellectual disability (ID). It contained information such as; literacy, understanding time, understanding money, social

judgement, gullibility, social norms, self-care, occupational skills and safety skills (Reschly et al. 2002). This information was checked on each participant using the yes/no method to indicate the presence or absence of knowledge of a skill. The last checklist was used to assess the speech prowess of the research participants by use of a language test. It contained information on the speech disorders namely; Articulatory disorders, phonological disorders, voice disorders, fluency disorders and muscle speech disorders. This information was checked on the participants according to their associated NDDs such as; pervasive developmental disorders-not otherwise specified, cerebral palsy, down syndrome, macrocephaly and microcephaly. The aforementioned grading system was used to check these disorders in relation to speech problems.

Semi-structured Interview

The researcher made use of a semi-structured interview in order to collect valuable information needed in the research study. The researcher interviewed the teachers of both CNRH and CAF/CEBNF ESPOIR. An interview guide that consisted of questions on the teachers' background information such as, their educational background and their experience with children with intellectual disability and associated NDDs (how long they have been working with children with this disability and their role in supporting the children) was employed. The guide also contained questions on how well they understand speech production problems and how these problems manifest or impact the daily communication of the children suffering from intellectual disability and associated NDDs. That is, the researcher garnered information on the social and emotional consequences these individuals face due to their speech problems. The researcher also asked questions regarding some specific triggers or situations that exacerbate speech production difficulties in individuals with ID and associated NDDs. The interview guide also contained questions on therapeutic measures the teachers employ with the need of ameliorating the speech prowess of the children and how effective these techniques are as far as their purpose is concerned.

Language Tests

The researcher made use of a language test as a very useful instrument of data collection and also of ensuring that the participants selected did have speech production problems. The language assessment was made up of a word list of over 200 words. The assessment was an oral test that required the participants to pronounce words on the said word list. This test specifically targeted sounds in words. The participants were made to pronounce complex sounds, consonants, vowels, suprasegmental structure such as, syllable structure. With this test, the researcher was able to bring out the/observe/identify the various speech production problems

the participants suffered from such as; articulatory disorders, phonological disorders, voice disorders, fluency disorders and muscle speech disorders. This was the very first objective of the research study.

2.5 Reliability and Validity

According to Joppe (2000 cited by Golafshani, 2003, p.5), reliability refers to "The extent to which results are consistent over time, and an accurate representation of the total population under study is referred to as reliability and if the results of a study can be reproduced under a similar methodology, then the research instrument is considered to be reliable." Following this definition, the researcher made use of qualitative methods of data collection such as observation and interview. Before commencing with field work proper, the researcher in order to test the reliability of the instruments, performed a test-retest method by pilot testing the research participants. This was achieved by the researcher taking some time upon initial encounter with the participants to observe, interact and subsequently pose a set of questions designed to test their speech capabilities. This was done by first of all giving them a language test wherein the participants were made to pronounce words on a word list. This was in order to ascertain that the participants had speech production problems. The researcher also used an observation checklist to get more insight into their speech prowess. This checklist helped in getting speech data such as fluency attitudes, pauses, hesitations among others. These exercises were trials and errors to be sure that the research hypotheses are justifiable. After the pilot test, the researcher moved to fully interviewing and observing them. The researcher realized that, the same manner of responses the samples gave in the pilot test were the same manner of responses they gave in the main interviews and observation. The results obtained demonstrated the reliability of the instruments used and also indicated the possibility of replicating said results in another study if the methods used in this study are systematically applied.

Validity which is one of the most crucial aspects in research, refers to "…the assurance that the study measures what it claims to study and the conclusions are supported by the data collected by the researcher" Rolfe (2006 cited by Shepard, 2016). This is in line with Kelly (1927) who posits that "a test is valid if it measures what it claims to measure". Bearing this in mind, the researcher developed and asked the participants questions aimed at assessing their speech. This is in line with the main objective of the research which is to identify speech production problems and their impact. Asking questions and getting the participants to

pronounce sounds of the alphabet, say what they ate that day all help the researcher to experience their speech capabilities thereby making their underlying speech problems apparent to the researcher. These questions fulfil face and content validity because they test what they set out to test and the questions are appropriate.

In addition, the researcher made use of Levelt's (1989) model of speech production which entails the stages involved in the conceptualization, formulation and articulation of speech and serves as an insight into determining what aspect of the participants speech is affected and why. Employing this model fulfils construct validity as the model closely relates to the underlying theoretical concept of speech.

2.6 Data Presentation and Analysis

Data for this study is presented according to the demands of the research questions. That is, a table format is used to present data on the first research question which has to do with identifying speech production problems in the research participants. A prose format is used to present data on both the second and third research questions which are based on enumerating the impact of speech production problems on the research participants and possible therapeutic measures that are used to ameliorate these problems. Charts are also used to illustrate the prevalence of the various speech production problems found in the research participants according to the NDDs associated with ID.

Consistent with the research design and the type of data collected for the current study which are both qualitative, the method of data analysis that is employed is a qualitative method of data analysis. The specific qualitative method of data analysis that is used is content analysis. This study makes use of content analysis to analyse data profoundly in order to uncover hidden meanings within the data by inferring recurrent codes and assigning them under broad thematic categories. This helps in drawing out trends and patterns from the data and making appropriate interpretations. The researcher makes use of this method of data analysis because it is flexible and has the ability of being applicable to the interpretation of different forms of media such as interview transcripts, field notes and transcripts from audio recordings gotten from language tests in the international phonetic alphabet (IPA) format all of which are used in this research. In addition, Bryman (2012, p.288) states that "content analysis is an approach to the analysis of documents and texts that seeks to quantify content in terms of predetermined categories and in a systematic and replicable manner". This systematic approach of content analysis is another reason why the approach is suitable for this research. This is because qualitative data due to its

richness is huge and bulky and if not properly handled can lead to unreliable deductions, hence in order to ensure the assertions and interpretations drawn from the data are reliable, a systematic approach will need to be employed in order to uncover the hidden patterns as well as ensure that the resulting conclusions are objective and not "an extension of the analyst and his or her biases" Bryman (2012, P. 289).

2.7 Ethical Considerations

The researcher in accordance with the regulations for research at The University of Yaounde 1, presented a research proposal for supervision. The supervisor went through and considered the impact of the research as well as the need to conduct it in accordance with the rules and ethics of the discipline. Before embarking on fieldwork, the researcher had to apply for and obtain a formal research permit from the head of department of African Languages and linguistics. With this document, the researcher along with handwritten applications was able to apply to the two centres for permission to conduct academic research within a stipulated duration.

The researcher not only secured the approval of the centres but also the consent of the teachers in charge of the children after having discussed with them the purpose of the study and data being collected. The researcher also taking into consideration the fact that parents of these children will be concerned or sensitive about their disability, consented to and ensured that the children who took part in the research remained anonymous. In interacting with the participants, the researcher was sensitive to their needs and made sure not to coerce them or ask questions that were biased or stigmatizing.

2.8 Conclusion

This chapter was out to provide the methods the research used to come out with the research findings. It touched the research design, study area, research population, sampling and sampling technic, research procedure, data collection, data collection methods, instruments, reliability and validity, data presentation and analysis and ethical considerations (verbal consent was gotten from both the parents and the schools' administration before the research).

Chapter Three: Data Presentation and Analysis

This chapter presents research data and conducts a detailed analysis of the data presented. The chapter focuses on handling the three research questions of the study. It first begins by identifying speech production problems in individuals with ID and associated NDDs, then goes on to look at the impact of speech production problems on the cases with ID and associated NDDs before presenting therapeutic strategies to overcoming the speech problems and limiting the impact.

3.1 Speech Production Problems in Individuals with ID and Associated NDDs

This section presents and analysis data related to speech production problems in individuals with ID and associated NDDs.

3.1.1 Data Presentation on Speech Production Problems in Individuals with ID and Associated NDDs

This part focuses on presenting speech and language data.

3.1.1.1 Speech Data

Table 5 presented below displays speech data for all fourteen participants, assessed using the interpersonal skills matrix. This matrix evaluates specific traits based on observable behaviours and interactions. The data is measured on a scale of 0 to 3, where "0" represents null perceptibility, "1" indicates almost perceptible, "2" signifies perceptible, and "3" represents very perceptible. Hence, one finds that P1 does not experience short or long pauses (0), he never hesitates when talking (0), not very violent (1), response to questions very well (3), uses gestures to a certain level (2), is very cooperative (3) as well as friendly (3) and is quite articulate (2). P2 experiences short pauses to a lesser degree within his speech (1), does not have long pauses (0), hesitates when speaking (2), has no degree of violence (0), very responsive (3), uses gestures to communicate most at times (3), is very cooperative (3), extremely friendly (3) and is articulate to a lesser degree (1). P3 faces short pauses to a lesser degree (1), he does not experience long pauses (0), he has a barely perceptible hesitation while speaking (1), no violence (0), quite responsive to questions (2), does not gesture while communicating, quite friendly (2) and is articulate in a lesser degree (1). P4 does not experience short and long pauses (0), is not hesitant while speaking (0), has no signs of violence (0), very responsive (3), does not gesture (0), very cooperative (3), extremely friendly (3) and she is quite articulate (2). P5 experiences short pauses at a lesser degree (1), does not experience long pauses (0), barely hesitates when talking (1), she is quite violent (2), quite responsive (2),

does not use gestures (0), quite cooperative (2), she is friendly (2) and not very articulate (1). P6 has short pauses in a very low degree (1), does not experience long pauses (0), she is a little bit hesitant when answering questions (1), has no violent tendencies (0), a little bit responsive (1), does not gesture when communicating (0), cooperative to a lesser degree (1), friendly (2) and just a little bit articulate (1). P7 experiences short pauses to a lesser extent (1), does not have long pauses (0), he is quite hesitant (2), not violent (0), very responsive (3), does not use gestures (0), very cooperative (3), very friendly (3), and not very articulate (1). P8 experiences long pauses (2) and no short pauses (0), she is quite hesitant (2), not violent (0), very responsive (3), does not gesture (0), very cooperative (3), extremely friendly (3), and quite articulate (2). P9 does not have short or long pauses (0), she does not hesitate when talking (0), not violent (0), very responsive (3), does not gesture (0), extremely cooperative (3), very friendly (3) and quite articulate (2). P10 does not experience short pauses (0) rather he has long pauses to a lesser extent (1), he is hesitant a bit when talking (1), no signs of violence (0), quite responsive (2), does not gesture (0), very cooperative (3), extremely friendly (3) and is articulate to a lesser degree (1). P11 does not have short pauses (0) but faces a little degree of long pauses (1) when talking, she is a little bit hesitant when talking (1), not violent (0), quite responsive (2), does not gesture when communicating (0), quite cooperative (2), friendly (2) and not very articulate (1). P12 does not experience short or long pauses (0), he does not hesitate when talking (0), is not violent (0), very responsive (3), does not gesture (0), very cooperative (3), very friendly (3) and quite articulate (2). P13 barely experiences short pauses (1), he does not have long pauses when talking (0), he does not hesitate in answering questions (0), not violent (0), quite responsive (2), no gestures (0), very cooperative (3), very friendly (3) and articulate to a lesser degree (1). P14 does not experience short pauses (0) but rather long pauses (2), he is very hesitant to answer questions (3), not violent (0), a little bit responsive (1), does not use gestures (0), not very cooperative (1), not very friendly (1) and not quite articulate (1).

Table 5: Speech data

Traits / Participants	Short pauses	Long pauses	Hesitations	Violence	Responsiveness	Gestures	Cooperation	Friendliness	Articulation
P1	0	0	0	1	3	2	3	3	2
P2	1	0	2	0	3	3	3	3	1
P3	1	0	1	0	2	0	2	2	1
P4	0	0	0	0	3	0	3	3	2
P5	1	0	1	2	2	0	2	2	1
P6	1	0	1	0	1	0	1	2	1
P7	1	0	2	0	3	0	3	3	1
P8	0	2	2	0	3	0	3	3	2
P9	0	0	0	0	3	0	3	3	2
P10	0	1	1	0	2	0	3	3	1
P11	0	1	1	0	2	0	2	2	1
P12	0	0	0	0	3	0	3	3	2
P13	1	0	0	0	2	0	3	3	1
P14	0	2	3	0	1	0	1	1	1

The table indicates that while some participants with ID and associated NDDs somehow do not have short pauses in between speech (eight participants), six participants show an almost perceptible (1) presence of short pauses in their speech. Four participants exhibit long pauses as they are perceptible (2) in their speech and a majority of the participants (ten participants) do not exhibit any form of long pauses. A good number of participants exhibit non-violent behaviour which is not perceptible (0) (twelve participants) and only two participants have almost perceptible violent tendencies (1). Importantly, all fourteen participants demonstrate high level of responsiveness (3), only two participants use gestures to facilitate communication (2) and the remaining twelve participants do not use gestures (0). All fourteen participants show a good level of cooperation (2) with only participants p 6 and p 14 having an almost perceptible level of cooperation (1). The participants have a good level of friendliness with only participants 14 having an almost perceptible level of friendliness (1). Although some

participants may lack articulatory skills going as far as being almost perceptible (1), their disabilities are not profound or severe, allowing them to express themselves despite distortions.

3.1.1.2 Language Data

This section examines the language data of the participants in order to identify speech production problems. The data reveals information related to articulation disorders, phonological disorders, voice disorders, fluency disorders, and muscle speech disorders manifested by the research participants. It should be noted that gaps in tables indicate that on the particular word test, the participants with gaps did not face similar disorders as other participants regarding the given words.

3.1.1.2.1 Articulation Disorders (ADs)

As far as this disorder is concerned, ID and associated NDDs suffer from substitution and addition as manifested in their speech seen in subsequent discussions.

Substitution

The data indicated several instances of substitution in the utterances of participants with ID and associated NDDs. They substitute some sounds for others such as fricative sounds substituted for other fricatives regardless of their voicing quality for example, the voiceless fricative /ʃ/ →[z] and [s] in /ʃapəlɛ/→[zapəlɛ]/ [sapəlɛ] “chapelais”, /z/→[ʒ] in /bizu/→[biʒu] “bisou”, /s/→[ʃ] in /pus/→[puʃ] “pus”. The substitution of nasal sounds for other sounds such as, the substitution of /ɲ/ for [n]/[l]/[j] in /mɔ̃taɲ/→[mɔ̃tan]/[mɔ↑tal↓]/[mɔtaj] “montagne”. Most importantly, one notices the substitution of the uvular fricative /R/ for the liquid [l] and glide [j] for example, /R/→[l] or [j] in /zeRo/→[zelo]/ [zejo] “zero”, /Repɛt/→[jepɛt]/ [lə↑pɛ↓]. This case of numerous substituted sounds is seen in table 6a below of participants with ID and associated NDDs with French as their L1.

Table 6a: Substitution in French speaking participants

Ideal Speech	P1	P2	P3	P4	P5	P8	P9	P10	P13	P14	Deviation	Gloss
/ʃapəlɛ/	[zapəlɛ]	-	[sa↑pə↓lɛ↑]	[sapəlɛ]	[zapəlɛ]	[sa.a.pəlɛ]	-	[ja.a.pəlɛ]	[za.a.pəlɛ]	[ja.a.pəlɛ]	/ʃ/→[z,s,j]	chapelais
/bizu/	[biʒu]	[biʒu]	[biʒu]	[biʒu]	[biʒu]	[biʒ.ʒ.u]	-	[bi.i.ʒu]	[bi.i.ʒu]	[bi.i.ʒu]	/z/→[ʒ]	bisou
/Repɛt/	[jepɛt]	-	[lə↑pɛ↓]	-	[zepɛt]	[j.j.epɛt]	-	[jepɛ.ɛ]	[je.e.pɛ]	[je.e.pɛt]	/R/→[j,l,z]	répète
/mɔ̃taɲ/	[mɔ̃tan]	-	[mɔ↑tal↓]	[mɔtan]	-	[mɔta.a.j]	-	[mɔta.a.j]	[mɔta.a.n]	[mɔ.ɔtaj]	/ɲ/→[n,l,j]	montagne
/pus/	-	[puʃ]	[puʃ]	[puʃ]	[puʃ]	[pu.uʃ]	[p̃uʃ]	[pu.u.ʃ]	[pu.u.ʃ]	[pu.u.ʃ]	/s/→[ʃ]	pousse
/ʃosyR/	[sosy]	-	[so↑sy↓]	[sosy]	[sosy]	[sos.s.y]	[ʃoʃy]	[sosy.y]	[so.o.sy]	[s.s.osy]	/ʃ/→[s] /s/→[ʃ]	Chaussure
/banan/	-	[ba..jan]	[balan]	-	[bajan]	[baj.j.an]	-	[ba.a.jan]	[ba.a.jan]	[ba.a.jan]	/n/→[l,j]	banane
/duz/	[duʃ]	[duʃ]	[duʃ]	[duʃ]	[duʃ]	[du.u.ʃ]	-	[du.u.ʃ]	[du.u.ʃ]	[du.u.ʃ]	/z/→[ʃ]	douze
/zeRo/	-	[ze..lo]	[zelo]	[zelo]	[zelo]	[zej.j.o]	-	[zelo.o]	[ze.e.lo]	[z.z.elo]	/R/→[l,j]	zero
/osi/	-	-	[oʃi]	[oʃi]	[oʃi]	[o.o.ʃi]	[oʃh̃i]	[o.o.ʃi]	[o.o.ʃi]	[o.o.ʃi]	/s/→[ʃ]	aussi

The gaps on the table indicate that certain participants did not exhibit any instances of sound substitution in the tested words. However, they still have other identified speech disorders related to the other words of the corpus.

Table 6b below presents instances of consonant substitution in participants with ID and associated NDDs having English as their L1. In the table, the liquid sound /r/ is substituted for the liquid [l] and the glide [w] for instance, /r/→[l] in /raɪt/→[lat] "write", /rʌbə/→[wəba] "rubber". Some fricatives are substituted for other fricative sounds such as, /f/→[v] in /fiʃ/→[viʃ] "fish", /s/→[ʃ] in /jɛs/→[jɛʃ] "yes" and the vioceless affricate /tʃ/ for the voiceless fricative [ʃ] in /kætʃ/→[kaʃ] "catch". More is seen on the table.

Table 6b: Substitution in English-speaking participants (Consonants)

Ideal Speech	P6	P7	P11	P12	Deviation	Gloss
/raɪt/	[l.l.at]	[lat]	[la.a.t]	[lat]	/r/→[l]	Write
/fiʃ/	[vi.i.ʃ]	[viʃ]	[vi.i.ʃ]	[viʃ]	/f/→[v]	Fish
/jɛs/	[j.j.ɛʃ]	[jɛʃ]	[jɛ. ɛ.ʃ]	[jɛʃ]	/s/→[ʃ]	Yes
/dʒuːs/	[du.u.s]	[dus]	[du.u.s]	[duːs]	/dʒ/→[d]	Juice
/sɪŋ/	[s.s.ɪn]	[sɪn]	[sɪ. ɪ.n]	[sɪn]	/ŋ/→[n]	Sing
/tʃaɪld/	[d.d.aɪ]	[daɪ]	[d.d.aɪ]	[daɪ]	/tʃ/→[d]	Child
/rʌbə/	[wɔ. ɔ.ba]	[wəba]	[wəba.a]	[wəba]	/r/→[w]	rubber
/kætʃ/	[ka.a.ʃ]	[kaʃ]	[ka.a.ʃ]	[kaʃ]	/tʃ/→[ʃ]	Catch
/wɪsl/	[wɪ. ɪ.zə]	[wɪzə]	[wɪ. ɪ.zə]	[wɪzə]	/s/→[z]	whistle
/zibrə/	[li.i.ba]	[liba]	[liba.a]	[liba]	/z/→[l]	Zebra

Table 6c below illustrates instances of vowel sound substitution by English speaking participants. Following the table, one notices that the participants tend to substitute diphthongs for monophthongs for instance, /aɪ/→[a] in /raɪt/→[lat] "write". There is also the presence of compensatory lengthening wherein some consonant and vowel sounds are lengthened as seen in the word /raɪt/→[l.l.at] and [la.a.t] "write".

Table 6c: Substitution in English-speaking participants (Vowels)

Ideal Speech	P6	P7	P11	P12	Deviation	Gloss
/raɪt/	[l.l.at]	[lat]	[la.a.t]	[lat]	/aɪ/→[a]	Write
/feɪs/	[fe.e]	-	[fe.e]	-	/eɪ/→[e]	Face
/vɔɪs/	[v.v.ɔ]	-	[v.v.ɔ]	-	/ɔɪ/→[ɔ]	Voice
/baɪsɪkl/	[ba.a.kə]	[bakə]	[ba.a.kə]	[bakə]	/aɪ/→[a]	Bicycle

Addition

The researcher noticed the presence of some instances of addition indicating that the participants do not suffer a lot from this disorder both among French and English-speaking participants. However, addition can be seen at the level of labialization, palatalization and nasalization of sounds. For example, /pyblik/→[pwybli] "publique", /vɑlœR/ →[vwɑlœ] "valeur", /bɔ̃ʒu/→ [bɔʒh̃u] "bonjour". More is seen in table 7a below.

Table 7a: Addition in French speaking participants

Ideal speech	P1	P3	P8	P9	P10	P13	P14	Deviation	Gloss
/pyblik/	[pwybli.]	[pwybli]	[pwybli.i]	-	-	[pwybli.i]	[pwybli.i]	Ø →[w]	Publique
/vɑlœR/	[vwɑlœ]	[vwɑlœ]	[v.v.wɑlœ]	-	-	[v.v.wɑlœ]	[v.v.wɑlœ]	Ø →[w]	Valeur
/bɔ̃ʒu/	-	-	-	[b̃ɔ̃ʒh̃u]	-	-	[bɔ. ɔ.ʒh̃u]	Ø →[h̃]	bonjour
/lapɛ̃/	-	-	-	[l̃a h̃pɛ]	-	-	[la.a.h̃pɛ]	Ø →[h̃]	Lapin

In table 7b, participants with English language as their L1 present some characteristics of adding certain sounds like the glide [w] and the liquid [r] in words such as, /ʃugə/→[ʃurga] "sugar", /bɪskɪt/→[bɪkwɪt] "biscuit". The table shows that English speaking participants tend to add the sound /r/ to words making them slightly slurry.

Table 7b: Addition in English speaking participants

Ideal speech	P6	P7	P11	P12	Deviation	Gloss
/bɪskɪt/	[bɪ. ɪ.kwɪ]	[bɪkwɪ]	[bɪ. ɪ.kwɪ]	[bɪkwɪ]	Ø →[w]	Biscuit
/ʃugə/	[ʃu.u.rga]	[ʃurga]	[ʃu.u.rga]	-	Ø →[r]	Sugar

3.1.1.2.2 Phonological Disorders /Phonological Process Disorders (PDs)

This part presents data on phonological disorders found in the research participants such as, deletion (final consonant and initial consonant deletions, syllable deletion and cluster reduction), gliding, voicing, devoicing, and denasalization.

a) Deletion

Deletion is divided into the four aforementioned types as discussed subsequently.

Final Consonant Deletion (FCD)

Going through the data revealed occurrences of study subjects with ID deleting voiced and voiceless consonants at word final positions. This is evident specifically in plosives such as /k/ and /d/ in words like /ɑvɛk/→[ɑvɛ] "avec", /tɔnad/→[tɔna] "tornade". Nasals such as /m/, /n/ and /ɲ/ for instance /fam/→[fa] "femme", /Rɛn/→ [Rɛ]/ [jɛ] "reine", /mɔ̃taɲ/→[mɔta] "montagne". Fricatives such as /R/, /ʒ/ and /s/ for example, /ɑ̃kɔR/→[ɑkɔ]/[kɔ] "encore", /masaʒ/→[masa]/ [maʃe] "massage", /fis/→[fi] "fils". Glides such as, /j/ for example /abɛj/→[abɛ] "abeille". Liquids such as, /l/ for instance /tRɑ̃kil/→[tRɑki]/ [ɑki] "tranquille". As seen on table 8 below.

Table 8a: FCD in French speaking participants

Ideal Speech	P1	P2	P3	P4	P5	P8	P9	P10	P13	P14	Deviation	gloss
/abɛj/	[abɛ]	[a…abɛ]	[abɛ]	-	[abɛ]	-	-	[a.a.bɛ]	[a.a.bɛ]	[a.a.bɛ]	/j/→Ø/ɛ_#	abeille
/ɑvɛk/	[ɑvɛ]	[ɑvɛ]	[ɑvɛ]	-	[ɑvɛ]	[ɑ. ɑvɛ]	-	[ɑv.v.ɛ]	[ɑvɛ.ɛ]	[ɑ.a.vɛ]	/k/→Ø/ɛ_#	avec
/Repɛt/	[jepɛ]	[Rəp...ɛ]	[lə↑pɛ↓]	-	[epɛ]	[j.j.epɛ]	-	[je.e.pɛ]	[je.e.pɛ]	[je.e.pɛ]	/t/→Ø/ɛ_#	repète
/dɜup/	-	[dɜu]	[dɜu]	-	[zu]	[dɜu.u]	-	[j.j.u]	[dɜu.u]	[dɜu.u]	/p/→Ø/u_#	jupe
/ɑ̃kɔʁ/	[ɑ̃kɔ]	[kɔ]	[ɑkɔ]	[ɑkɔ]	[ɑkɔ]	[ɑ.ɑ.kɔ]	[ɑ̃k̃ h̃ɔ]	[kɔ. ɔ]	[ɑ. ɑ.kɔ]	[ɑ. ɑ.kɔ]	/R/→Ø/ɔ_#	encore
/lak/	[la]	[la]	[la]	-	[la]	[la.a]	-	[la.a]	[la.a]	[la.a]	/k/→Ø/a_#	lac
/tɔnad/	[tɔna]	[tɔ…na]	[tɔna]	-	[na]	[tɔ. ɔ.na]	-	[tɔna.a]	[tɔna.a]	[tɔna.a]	/d/→Ø/a_#	tornade
/fam/	-	[fa]	-	-	[fa]	[fa.a]	-	[fa.a]	[fa.a]	[fa.a]	/m/→Ø/a_#	femme
/Rɛn/	-	[Rɛ]	-	-	[Rɛ]	[j.j.ɛ]	-	[Rɛ.ɛ]	[Rɛ.ɛ]	[Rɛ.ɛ]	/n/→Ø/ɛ_#	reine
/tRɑ̃kil/	-	-	[tRɑ↑ki↓]	-	[tRɑki]	[tRɑki.i]	-	[ɑki.i]	[tRɑ.ɑki]	[tRɑ.ɑki]	/l/→Ø/i_#	tranquille
/masaʒ/	-	[ə..sa]	-	-	[masa]	-	-	[ma.a.ʃe]	[ma.a.sa]	-	/ʒ/→Ø/a_#	massage
/mɔ̃taɲ/	-	[ta]	-	-	[mɔta]	-	-	-	-	-	/ɲ/→Ø/a_#	montagne

/fis/	-	[fi]	[fi]	-	[fi]	[fi]	-	[fi.i]	[fi.f]	[fi.i]	/s/→Ø/i _#	fils

Table 8b shows that English speaking participants tend to delete some consonant sounds at word final positions such as the plosives /p/ and /d/ for example, /su:p/→[du]/ [su] "soup", and /brɛd/→[brɛ] "bread". The liquid /l/ for example, /pɛnsəl/→[pɛzə]/ [pɛnzə]. And lastly the fricatives /s/ and /ʃ/ for example, /vɔɪs/→[vɔ]/ [vɔ] "voice", /brʌʃ/→[brɔ] "brush".

Table 8b: FCD in English-speaking participants

Ideal speech	P6	P7	P11	P12	Deviation	gloss
/su:p/	[du.u]	[su]	[su.u]	[su]	/p/→ Ø /u_#	soup
/pɛnsəl/	[pɛ. ɛ.zə]	[pɛnzə]	[pɛ. ɛ.nzə]	[pɛnzə]	/l/→ Ø /ə_#	pencil
/brɛd/	[brɛ. ɛ]	[brɛ]	[brɛ. ɛ]	[brɛ]	/d/→ Ø /ɛ_#	bread
/vɔɪs/	[vɔ. ɔ]	[vɔɪ]	[vɔ. ɔ]	[vɔɪ]	/s/→ Ø /ɔɪ_#	voice
/feɪs/	[fe.e]	[feɪ]	[fe.e]	[feɪ]	/s/→ Ø /eɪ_#	face
/bɔ:l/	[bɔ. ɔ]	[bɔ:]	[bɔ. ɔ]	-	/l/→ Ø /ɔ:_#	ball
/brʌʃ/	[brɔ. ɔ]	[brɔ]	[brɔ. ɔ]	[brɔ]	/ʃ/→ Ø /ʌ_#	brush

Initial Consonant deletion (ICD)

The following table 9a shows that the French speaking participants tend to delete initial consonants such as; fricative sounds like /s/, /R/ and /ʒ/ for example /sfɛR/→[fɛ] "spère", /Rjɛ̃/ →[jɛ] "rien" and /ʒwe/→[we] "jouer". Nasal sounds like /n/ for instance, /nyaʒ/→[ya]/ [yaʒ] "nuage". Plosives like /t/ for example /tRo/→[Ro]/ [ho] "trop". And liquids such as, /l/ for example, /legym/→[gym]/ [egym] "lègume".

Table 9a: ICD in French speaking participants

Ideal speech	P1	P2	P3	P4	P5	P8	P10	P13	P14	deviation	gloss
/sfɛR/	[fɛ]	[fɛ]	[fɛ]	[fɛ]	[fɛ]	[fɛ. ɛ]	[fɛ]	[fɛ]	[fɛ. ɛ]	/s/→Ø/#_f	spère
/nyaʒ/	-	[ya]	[yaʒ]	-	[ya]	[yaʒ]	[ya.a]	[yaʒ]	[ya.a.]	/n/→Ø/#_y	nuage
/stRɛs/	-	[tɛs]	[tRɛs]	[tRɛʃ]	[tɛs]	[tRɛ. ɛj]	[tɛ. ɛ.s]	[tRɛ. ɛ.j]	[tRɛ. ɛ.j]	/s/→Ø/#_t	stress
/stilo/	-	[lo]	[ti↑lo	[tilo]	[tilo]	[ti.i.lo]	[lo]	[ti.i.lo]	[j̃i .i.jo]	/s/→Ø/#_t	stylo
/Rjɛ̃/	-	[jɛ]	[jɛ]	-	[jɛ]	[jɛ. ɛ]	[jɛ. ɛ]	[jɛ. ɛ]	[j̃ɛ̃ . ɛ]	/R/→Ø/#_j	rien
/tRo/	[Ro]	[Ro]	-	-	[ho]	[ho]	[ho.o]	[ho]	[h̃o.o]	/t/→Ø/#_R	trop
/legym/	-	[gym]	[egym]	-	[gym]	[e.e.gym]	-	[e.e.gym]	[e.e.gym]	/l/→Ø/#_e	lègume
/ʒwe/	-	[we]	[we]	-	[we]	[je.e]	[we.e]	[we.e]	[we.e]	/ʒ/→Ø/#_w	jouer

Table 9b presents illustrates initial consonant deletion in English speaking participants. Following the table, the participants mostly delete the fricative sound /s/ at word initial positions. For example, /spu:n/→[pən]/ [pun] “spoon”, /spæt/→[pat] “spat”, /skəʊp/→[kop] “scope”.

Table 9b: ICD in English speaking participants

Ideal speech	P6	P7	P11	P12	Deviation	gloss
/spu:n/	[p.p.ə]	[pun]	[pu.u.]	[pun]	/s/→ Ø /#_p	spoon
/spæt/	[pa.a.]	[pa]	[pa.a.]	[pat]	/s/→ Ø /#_p	spat
/skəʊp/	[ko.o.]	[kop]	[ko.o.]	[kop]	/s/→ Ø /#_k	scope
/smɛl/	[mɛ. ɛ]	[mɛl]	[mɛ. ɛ]	-	/s/→ Ø /#_m	smell
/swi:p/	[wi.ip]	[wi:p]	[wi.i]	-	/s/→ Ø /#_w	sweep

On the table above, the fricative /s/ is deleted at initial positions followed by plosives /p/ and /k/, the nasal /m/ and glide /w/.

Syllable deletion (SD)

The data from participants with ID shows that some French speaking participants tend to delete syllables in words with two syllables for example, /lepe/→[pe] "lepe", /ɔtaʒ/→[ta]/ [tas] "otage", /salad/→[sa]/ [lad] "salade". The second syllables are mostly deleted. As seen on the table below.

Table 10a: Two syllable words for French speaking participants

Ideal Speech	P2	P5	P10	Deviation	gloss
/lepe/	[pe]	[pe]	[pe.e]	/le/→Ø	lepe
/ɔtaʒ/	[ta]	[tas]	[ta.as]	/ɔ/→ Ø	otage
/salad/	[sa]	[lad]	[la.ad]	/lad/→ Ø /sa/→ Ø	salade
/kɔlɛR/	[lɛ]	[lɛ]	[lɛ. ɛ]	/kɔ/→ Ø	colère
/kado/	[do]	[do]	[do.o]	/ka/→ Ø	cadeau
/kite/	[te]	[te]	[te.e]	/ki/→ Ø	quitter

Table 10b presents data on three syllable word deletions in French speaking participants. For example, /defisi/→[desi] "deficit", /paRasɔl/→[pasɔ]/ [sɔ] "parasol", /magazɛ̃/ →[gazɛ]/ [mazɛ]/ [majɛ] "magasin, /lavabo/→[bo]/ [labo]/ [jabo] "lavabo". Deletion occurs at any syllable position. A good number of the participants do not face this problem as seen on the

tables below.

Table 10b: Three syllable words for French speaking participants

Ideal Speech	P2	P3	P5	P8	P10	P13	Deviation	gloss
/defisi/	[de…si]	[desi]	[desi]	[de.esi]	[de.esi]	[fi.isi]	/fi/→ Ø /de/→ Ø	deficit
/nuRityR/	[tyR]	[nu↑ty↓]	[nuty]	[nu.u.ty]	[i.ity]	[nu.u.ty]	/Ri/→ Ø	nourriture
/paRasɔl/	[sɔ]	[pa↑sɔ↓]	[pasɔ]	[pa.a.sɔ]	[pa.a.sɔ]	[pa.asɔ]	/Ra/→ Ø /pa/→ Ø	parasol
/magazɛ̃/	[ga..zɛ]	[ma↑zɛ↓]	[mazɛ]	[ma.a.jɛ]	[ma.a.zɛ]	[ma.a.zɛ]	/ma/→ Ø /ga/→ Ø	magasin
/lavabo/	[bo]	[la↑bo↓]	[labo]	[j.j.abo]	[la.a.bo]	[va.abo]	/va/→ Ø /la/→ Ø	lavabo
/famasi/	[si]	[fa↑si↓]	[fasi]	[fa.a.si]	[fa.a.si]	[fa.a.si]	/fa/→ Ø /ma/→ Ø	pharmacie
/kɔ̃pRɑ̃dR/	[ə…pɑ]	[pɑ↑də↓]	[pɑdə]	[pɑ.ɑ.də]	[pɑ.ɑ.də]	[pɑ.ɑ.də]	/kɔ̃/→ Ø	comprendre

Table 10c presents data on syllable deletion in English speaking participants. The table shows that English speaking participants are not very prune to deleting two syllable words but rather get them distorted same goes to some French speaking participants. It also shows that first and last syllables are mostly deleted in three syllable words for example, /baɪsɪkl/→[bakə] “bicycle”, /ɛləfənt/→[ɛfa] “elephant”. As seen on the table below.

Table 10c7: SD in English speaking participants

Ideal speech	P6	P7	P11	P12	Deviation	gloss
/baɪsɪkl/	[ba.a.kə]	[bakə]	[ba.a.kə]	[bakə]	/sɪ/→ Ø	bicycle
/ɛləfənt/	[ɛ. ɛ.fa]	[ɛfa]	[ɛ. ɛ.fa]	[ɛfa]	/ɛ/ +/lə/→Ø	elephant
/tɛlɪfəʊn/	[tɛ. ɛ.fo]	[tɛfo]	[tɛ. ɛ.fo]	[tɛfo]	/lɪ/→ Ø	telephone

Syllable structure

Syllable deletion leads to the identifying of the syllable structure of both the French and English-speaking participants' speech. Following the tables 10a to 10c, it is concluded that the participants have as syllable structure CV, for example /kado/→[do] "Cadeau", /kite/→[te] "quitter". CVC structure for example, /ɛləfənt/→[ɛfa] "elephant", /ɔtaʒ/→[tas] "otage". And the CVCV structure for example, /kɔ̃pʁɑ̃dR/→[pɑdə] "comprendre", /tɛlɪfəʊn/→[tɛfo] "telephone". As shown on the table below.

Table 8: Participants' syllable structure

Ideal structure	Participants' structure	Ideal Speech output
CVCV	CV	/lepe/
VCVC	CV/CVC	/ɔtaʒ/
CVCVC	CV/CVC	/salad/
CVCVC	CV	/kɔlɛR/
CVCV	CV	/kado/
CVCV	CV	/kite/
CVCVCV	CVCV	/defisi/
CVCVCV	CVCV	/magazɛ̃/
CVCVCV	CV/CVCV	/lavabo/
CVCVCV	CV/CVCV	/famasi/
CVCCVCC	CVCV	/kɔ̃pRɑ̃dR/
CVCVCC	CVCV	/baɪsɪkl/
VCVCVCC	CVC	/ɛləfənt/
CVCVCVC	CVCV	/tɛlɪfəʊn/

The table above illustrates the syllable structure capacity of the participants. In words with two syllables that have as structure CVCVCV the participants tend to delete two or one syllable and produce CVCV/CV. An important realization is the fact that syllables that begin with V have the V deleted at initial syllable positions for example VCVC becomes CV/CVC.

Cluster Reduction (CR)

From the data, participants with ID demonstrated evidences of reducing consonant clusters. The tables below present data as proof that the participants simplify consonant clusters in their speech. Table 12a below shows that French speaking participants simplify consonant

clusters such as, /sw, pR, lj, kt, kl, tR, pj, bl, pw, st, kR, Rj/ by mostly deleting first consonant sounds. For example, /swi/→[si]/ [ʃi] “suis”, /pRɔpR/→[popə] “Proper”, /atəlje/→[atəje]/[əje]/[teje] “atelier”, /ɛpakt/→[ɛpak]/[ɛpa] “impact”, /klɑs/→[lɑs]/[kɑs] “classe”, /tRavaj/→[tavaj] “travail”, /pje/→[pe] “pied”, /sablə/→[sabə] “sable”, /pwazɔ̃/→[pazɔ] “poison”, /stRɛs/→[tɛs]/[tɛ]/[tɛʃ] “stress”, /kRɛjɔ̃/→[kɛjɔ̃]/[kɛ] “crayon”, /Rjɛ̃/ →[jɛ] “rien”.

Table 12a: CR in French speaking participants

Ideal Speech	P1	P2	P3	P4	P5	P8	P10	P13	P14	deviation	gloss
/swi/	[si]	[si]	[si]	[ʃi]	[si]	-	[si.i]	[si.i]	[si.i]	/w/→Ø/s_ i	suis
/pRɔpR/	[popə]	[pə]	[popə]	-	[pɔ]	-	[pɔ]	[popə]	[p̃o.opə]	/R/→Ø/p __ɔ	Proper
/pRije/	[pije]	[pje]	[pje]	-	[pje]	-	[pi.ije]	[pi.ije]	[p̃i.ij̃e]	/R/→Ø/p __i	prier
/atəlje/	[atəje]	[əje]	[atəle]	-	[teje]	[a.atəje]	[təj.je]	[a.atəje]	[a.atəj ̃e]	/l/→Ø/ə_ _e /j/→ Ø /l_e	atelier
/ɛpakt/	[ɛpak]	[ɛpa]	[ɛpak]	[ɛpa]	[pa]	[ɛpa.a]	[ɛpa.a]	[ɛpa.a]	[ɛp̃a.a]	/t/→Ø/k_ __# /kt/→Ø/a _#	impact
/klɑs/	[lɑs]	[kɑs]	[lɑs]	-	[lɑs]	-	[lɑ.ɑs]	[lɑs]	[lɑs]	/k/→Ø/#_ _l /l/→Ø/k_ _a	classe

/tRavaj/	[tavaj]	[a…a…vaj]	[ta↑vaj↓]	-	[avaj]	[ta.avaj]	[tavaj.j]	[ta.a.vaj]	[ta.a.vaj̃]	/R/→Ø/t_a /tR/→Ø/#_a	travail
/pje/	[pe]	[pe]	[pe]	-	[pe]	-	[pe.e]	-	-	/j/→Ø/p__e	pied
/sablə/	[sabə]	[sa…bə]	[sa↑bə↓]	-	[sabə]	-	[sa.abə]	[sa.abə]	[sa.abə]	/l/→Ø/b__ə	sable
/pwazɔ̃/	[pazɔ]	-	[pa↑zɔ↓]	-	[pazɔ]	-	[pazɔ]	[pazɔ]	[pazɔ]	/w/→Ø/p__a	poison
/stRɛs/	[tɛs]	[tɛ]	[tɛ]	[tɛʃ]	[tɛs]	[tRɛ.ɛʃ]	[tɛ.ɛs]	[tɛ.ɛ.s]	[t.t.ɛs]	/s/→Ø/#_t /R/→Ø/t-_ɛ	stress
/miljɔ̃/	-	[lɔ]	[milɔ]	[milɔ]	-	[mi.ijɔ]	[mi.ijɔ]	[mi.ijɔ]	[mi.ijɔ̃]	/j/→Ø/l___ɔ /l/→Ø/i___j	million
/stilo/	-	[lo]	[ti↑lo]	[tilo]	[tilo]	[ti.ilo]	[lo]	[ti.ilo]	[jĩ .i. jo]	/s/→Ø/#_t	stylo
/kRɛjɔ̃/	[kɛjɔ̃]	[kɛ]	[kɛjɔ]	[kɛjɔ]	[kɛlɔ]	[kɛj.j.ɔ]	[kɛj.jɔ]	[kɛ.ɛjɔ]	[kɛ.ɛj̃ɔ]	/R/→Ø/#___ɛ	crayon
/tRo/	[Ro]	[Ro]	[ho]	[Ro]	[ho]	[ho]	[ho.o]	[ho]	[ho]	/t/→Ø/#_R /R/→Ø/t_o	trop
/Rjɛ̃/	-	[jɛ]	[jɛ]	[jɛ]	[jɛ]	[jɛ. ɛ]	[jɛ. ɛ]	[jɛ. ɛ]	[j̃ɛ̃ . ɛ]	/R/→Ø/#__j	rien

Table 12b shows the instances of consonant reduction in English-speaking participants. Clusters like, /sp/, /sm/, /dr/, and /sk/ are not present in the speech of the participants. For example, /spɪn/→[pi] "spin", /smɛl/→[mɛ] "smell", /drɛs/→[dɛ] "dress", /skəʊp/→[ko] "scope".

Table 12b: CR in English speaking participants

Ideal speech	P6	P7	P11	P12	Deviation	gloss
/drɛs/	[dɛ. ɛ]	[dɛ]	[dɛ. ɛ]	[dɛ]	/r/→ Ø /d__ɛ	dress
/spɪn/	[pi.i]	[pi]	[pi.i]	[pi]	/s/→ Ø /#__p	spin
/skəʊp/	[ko.o]	[ko]	[ko.o]	[ko]	/s/→ Ø /#_k	scope
/smɛl/	[mɛ. ɛ]	[mɛl]	[mɛ. ɛ]	-	/s/→ Ø /#_m	smell

a) Gliding (G)

The researcher noticed several instances of gliding in the speech of ID cases. Tables 13a and 13b presented below show instances of gliding in the French speaking and English-speaking participants. Table 13a show that the majority of French speaking participants substitute liquid sounds like /l/ and /R/ for glides such as /w/ and /j/ at both initial and median positions. For example, /l/→[w] in /plɥi/→[pwi] "Pluie", /l/→[j] in /plɛ̃/ →[pjɛ]/[pja] "plein", /lave/→[jave] "laver", /lɛd/→[jɛd] "laide", /R/→[w]/[j] in /nuRiR/→[nuwi]/[nuji] "nourrir", /R/→[j] in /Repɛt/→[jepɛt] "répète", /aRiko/→[jiko]/ [ajiko] "haricot", /Ri/→[ji] "riz", /ɔRɑ̃ʒ/→[jas]/[ɔja]/[ɔjaʃ] "orange". More is seen on the table below.

Table 13a: G in French speaking participants

Ideal speech	P1	P2	P3	P4	P5	P8	P10	P13	P14	deviation	gloss
/plɥi/	[piwi]	-	[pwi]	-	[pwi]	-	[pwi]	[p.pwi]	[pwi.i]	/l/→[w]/ ɥ__i	Pluie
/Repɛt/	[jepɛt]	-	-	-	-	[j.jepɛt]	[je.epɛt]	[je.epɛt]	[je.epɛt]	/R/→[j]/ #__e	répète
/nuRiʁ/	[nuwi]	[nu…nu…wi]	[nuwi]	-	[nuwi]	[nu.uji]	[nu.uji]	[nu.uji]	[nu.uji]	/R/→[w] /u_i /R/→[j]/ u_i	nourrir
/balɔ̃/	-	[jɔ]	-	-	[bajɔ]	[ba.ajɔ]	[ba.ajɔ]	[ba.ajɔ]	[ba.ajɔ̃]	/l/→[j]/a __ɔ̃	ballon
/plɛ̃/	-	-	-	-	-	[pjɛ. ɛ]	[pja.a]	[pjɛ. ɛ]	[pjɛ̃ . ɛ	/l/→[j]/p __ɛ̃	plein
/lave/	-	-	-	-	-	[ja.ave]	[ja.ave]	[ja.ave]	[jã .ave]	/l/→[j]/# __a	laver
/lɛd/	-	-	-	-	[jɛd]	[jɛ. ɛd]	[jɛ. ɛd]	[jɛ. ɛd]	[jɛ̃ . ɛd]	/l/→[j]/# __ɛ	laide
/ʃɔkɔla/	-	-	-	-	[kojа]	[ʃo.ok oja]	[jo.ok oja]	[jo.ok oja]	[jõ .ok oja]	/l/→[j]/ɔ __a	chocolat
/aRiko/	-	-	-	-	[jiko]	[aj.jik o]	[aj.jik o]	[aj.jik o]	[ajiko. o]	/R/→[j]/ a__i	haricot
/Ri/	-	-	-	-	[ji]	[ji.i]	[ji.i]	[ji.i]	[jĩ .i]	/R/→[j]/ #__i	riz
/tele/	-	-	-	-	[teje]	[te.eje]	[te.eje]	[te.eje]	[te.ejẽ]	/l/→[j]/e __e	tele

/ɔRɑ̃ ʒ/	-	-	-	-	[jas]	[ɔj.ja]	[ɔja.a]	[ɔja.aʃ]	[ɔjã .a]	/R/→[j]/ ɔ__ɑ̃	orang e

Table 13b below presents gliding in English speaking participants. These participants tend to substitute the liquid /r/ for the glides [w] and [j]. For example, /r/→[w] in /rʌbə/→[wɔba] "rubber",/r/→[j] in /zero/→[jɛjo] "zero", /vɛri/→[vɛji] "very". As seen on the table below.

Table 13b: G in English-speaking participants

Ideal speech	P6	P7	P11	P12	Deviation	gloss
/rʌbə/	[wɔ. ɔba]	[wɔba]	[wɔ. ɔba]	[wɔba]	/r/→[w]	rubber
/zero/	[jɛ. ɛjo]	[jɛjo]	[jɛ. ɛjo]	[jɛjo]	/r/→[j]	zero
/vɛri/	[vɛ. ɛji]	[vɛji]	[vɛ. ɛji]	[vɛji]	/r/→[j]	very

The table above shows that English participants do not exhibit this disorder at a great level. This can be justified by the above data presented.

b) Voicing (V)

The data revealed the presence of voice disorders in the speech of participants. This is illustrated in tables 14a and 14b below. They show that not all participants experience this disorder. Table 14a shows the presence of this disorder in French speaking participants. The table shows that these participants tend to substitute voiceless fricatives such as / ʃ/ and /s/ for voiced fricatives such as, [z], [j] and [h]. For example, /ʃ/→[z] in /ʃapəlɛ/→[zapəlɛ] "chapelais", /s/→[j] in /ɔs/→[ɔj] "os",/s/→[h] in /sup/→[hup] "soupe". They also substitute voiceless plosives such as, /t/, /p/, and /k/ for voiced plosives such as, [b], [d] and [g]. For example, /t/→[d] in /atəʃe/→[a…de…de] "attacher",/p/→[b] in /ʒyp/→[ʒyb] "jupe", /k/→[g] in /sykR/→[tigə] "sucre". Some participants substitute fricative sounds like /ʃ/ for glides [d] and glides [j] for example, /ʃ/→[d] in /atəʃe/→[a…de…de] "attacher" /ʃ/→[j] in /ʃɑ̃te/→[jã te] [j] in /ʃɑ̃te/→[jã te] in "chanter". Some substitute voiceless plosive /t/ for liquid and glide [l] and [j] for example, /t/→[l] in /stRɛs/→[slɛs] "stress", /t/→[j] in /paRtiR/→[paji] "partir". It is worth noting that these traits are specific to each participant for they do not show similar manifestations. This is shown on the table below.

Table 14a: V in French participants

Ideal speech	Participants	Speech output	Deviation	gloss
/ʃapəlɛ/	P1	[zapəlɛ]	/ʃ/→[z]/#__a	chapelais
/atəʃe/	P2	[a…de…de]	/t/→[d]/a__ə /ʃ/→[d]/ə__e	attacher
/ʒyp/ - /stRɛs/	P3 - 	[ʒyb] [slɛs]	/p/→[b]/y__# /t/→[l]/s__R	jupe stress
/tɑ̃buʁ/	P4	[dɑbu]	/t/→[d]/#__ɑ̃	tambour
/sykʁ/ - /ɔs/	P10 - 	[ti.igə] [ɔj.j]	/k/→[g̟]/y__ʁ /s/→[j̟]/ɔ__#	sucre os
/sup/ - /pɑ̃talɔ̃/	P13 - 	[hup] [bɑbalɔ]	/s/→[h]/#__u /p/→[b]/#__ɑ̃ /t/→[b]/ɑ̃__a	soupe pantalon
/ʃɑ̃te/ /paRtiR/	P14 	[j̃ɑ̃ .ate] [pa.ajĩ .i]	/ʃ/→[j̟]/#__ɑ̃ /t/→[j̟]/R__i	chanter partir

Table 14b presents data on the manifestation of voicing in English speaking participants. The table shows that these participants substitute voiceless fricatives /s/, /ʃ/ and /tʃ/ for voiced plosive /d/ for example, /s/→[d] in /sɪt/→[diz] “sit”, /ʃ/→[d] in /ʃu:/ →[du:] “shoe”, /tʃ/→[d] in /tʃaɪld/→[daɪ] “child”. Voiceless fricatives such as, /s/ and /f/ are substituted for voiced fricatives [v], [h] and [z] for example, /f/→[v] in /fiʃ/→[viʃ] “fish”, /s/→[h] in /sɔ:lt/→[hɔ] “salt”, /s/→[z] in /wɪsl/→[wɪzən] “whistle”. Voiceless plosives /p/, /k/ and /t/ for

voiced plosives [b], [k] and [d] for example, /k/→[g] in /kuk/→[guk] “cook”, /t/→[d] in /laɪt/→[lad] “light”, /p/→[b] in /apəl/→[abə] “apple”. Voiceless fricative /f/ becomes glide [w] for example, /f/→[w] in /faɪə/→[waja] “fire”.

Table 14b: V in English speaking participants

Ideal speech	Participants	Speech output	Deviation	Gloss
/sɪt/	P6	[di.iz]	/s/→[d]/#__ɪ /t/→[z]/ɪ__#	sit
/fiʃ/	-	[vi.iʃ]	/f/→[v]/#__i	fish
/kuk/	-	[gu.uk]	/k/→[g̟]/#__u	cook
/faɪə/	-	[wa.aja]	/f/→[w]/#__aɪ	fire
/laɪt/	P7	[lad]	/t/→[d]/aɪ__#	light
/sɔ:lt/	P11	[hɔ]	/s/→[h]/#___ɔ:	salt
/tʃaɪld/	-	[d.daɪ]	/tʃ/→[d]/#__aɪ	child
/ʃu:/	-	[du.u]	/ʃ/→[d]/#__u:	shoe
/ɒfɪs/	-	[ɔ. ɔhɪs]	/f/→[h]/ɒ__ɪ	office
/wɪsl/	P12	[wɪzən]	/s/→[z]/ɪ__l	whistle
/apəl/	-	[abə]	/p/→[b]/a__ə	apple
/hæpi/	-	[habi]	/p/→[b]/#__æ	happy

b) Devoicing

Another deviation noticed in the data is devoicing. Table 15 below presents data on

devoicing in both French and English-speaking participants. Due to the fact that the participants face devoicing at different levels, the investigator chose to present data with words unique to each participant who experiences the disorder. Only five participants face this disorder on the table and those that have sound devoicing, tend to substitute voiced sounds such as, plosives /d/ and /g/ to voiceless fricatives and plosives such as [s] and [t] for example, /d/→[s] in /maladi/→[ma↑la↓si↑] "maladie", /g/→[t]/ in /egal/→[e↑tal↓] "egale". Voiced fricatives such as /v/, /ʒ/ and /z/ to vioceless fricatives such as [f] and [ʃ] for example, /v/→[f] in /vi/→[fi] "vie", /ʒ/→[ʃ] in /ʒune/→[ʃule] "journée", /z/→[ʃ] in /egliz/→[egliʃ] "eglise". More is seen on the table below.

Table 15: Devoicing in French and English-speaking participants

Ideal speech	Participants	Speech output	Deviation	gloss
/diR/	P3	[si]	/d/→[s]/#___i	dire
/maladi/	-	[ma↑la↓si↑]	/d/→[s]/a__i	maladie
/egal/	-	[e↑tal↓]	/g/→[t]/e__a	égale
/mɔ̃djal/	-	[mɔ↑sja↓]	/d/→ [s]/ɔ̃__j	mondial
/vi/	-	[fi]	/v/→[f]/#__i	vie
/ʒune/	-	[ʃule]	/ʒ/→[ʃ]/#__u	journée
/egliz/	P4	[egliʃ]	/z/→[ʃ]/i__#	église
/duz/	-	[duʃ]	/z/→[ʃ]/u___#	douze
/ʃɛz/	-	[ʃɛʃ]	/z/→[ʃ]/ɛ__#	chaise
/ʒozɛf/	P8	[jo.oʃɛf]	/z/→[ʃ]/o__ɛ	Joseph
/lɛvR/	P10	[lɛ. ɛf]	/v/→[f]/ɛ__R	lèvre
				visage
	-		/z/→[s]/i__a	
/vizaʒ/		[hi.isaf]	/ʒ/→[f]/a__#	aller
	-		/l/→[t]/a__e	
/ale/		[a.ate]		
/vizaʒ/	P13	[vi.iʃa]	/z/→[ʃ]/#___i	visage
/pwazɔ̃/	-	[pa.aʃɔ]	/z/→[ʃ]/a___ɔ̃	poison

c) Denasalization

From the data, instances of denasalization are detected in the speech of ID cases. The is evident in table 16 below. It shows that this disorder is very common in eight participants of the study. This disorder is very common among the French speaking participants. This is manifested by the denasalization of nasalised vowel sounds such as, front mid-low unrounded vowel /ɛ/ for example, /ɛ̃/→[ɛ] in /lwɛ̃/ →[lwɛ] "loin", /pɛ̃/ →[pɛ] "pain". Back low unrounded vowel /ɑ/ for example, /ɑ̃/→[ɑ] in /sɛRpɑ̃/→[sɛpɑ] "serpent", /tɑ̃buR/→[tɑ]/[tɑbu] "tambour". And back midlow rounded vowel /ɔ/ for example, /ɔ̃/→[ɔ] in /mezɔ̃/→[zɔ]/[mezɔ] "maison". As seen on the table below.

Table 16: DN in French speaking participants

Ideal speech	P2	P3	P4	P5	P8	P10	P13	P14	deviation	gloss
/lwɛ̃/	[lwɛ]	[lwɛ]	[lwɛ]	[lwɛ]	[wɛ. ɛ]	[wɛ. ɛ]	[wɛ. ɛ]	[lwɛ. ɛ]	/ɛ̃/ →[ɛ]/w_ _#	loin
/pɛ̃/	[ə…pɛ… pɛ]	[pɛ]	[pɛ]	[pɛ]	[pɛ]	[pɛ. ɛ]	[pɛ]	[pɛ. ɛ]	/ɛ̃/ →[ɛ]/p_ _#	pain
/sɛRpɑ̃/	[sɛpɑ]	[sɛpɑ]	[sɛpɑ]	[sɛpɑ]	[sɛpɑ. ɑ]	[sɛ.ɛp ɑ]	[sɛ.ɛp ɑ]	[sɛ.ɛp ɑ]	/ɑ̃/→[ɑ]/p_ __#	serpent
/mezɔ̃/	[zɔ]	[me↑zɔ ↓]	[mez ɔ]	[mez ɔ]	[me.ez ɔ]	[me.ez ɔ]	[me.ez ɔ]	[me.ez ɔ]	/ɔ̃/→[ɔ]/z_ __#	maison
/tɑ̃buR/	[tɑ]	[tɑbu]	[tɑbu]	[tɑbu]	[tɑbu]	[tɑbu. u]	[tɑbu. u]	[tɑbu. u]	/ɑ̃/→[ɑ]/t_ __b	tambour
/tɑ̃t/	[tɑ]	[tɑ]	[tɑt]	[tɑ]	[tɑ. ɑ]	[tɑ]	[tɑ]	[tɑ. ɑ]	/ɑ̃/→[ɑ]/t_ _t	tante

3.1.1.2.3 Voice Disorders (VD)

This section elaborates on the various voice disorders found in individuals with ID and associated NDDs precisely hypernasality and dysprosody.

Hypernasality

This disorder is observed in two participants P9 and P14. The participants tend to over nasalise. This is seen in the tables 17a and 17b below wherein, both participants nasalise oral consonant sounds. Table 17a presents data for P9 speech. The participant tends to nasalise oral consonant sounds such as /b/→[b̃] /b/→[b̃] in /bɔ̃ʒu/→[b̃̃ɔ̃ʒ̃hu] “bonjour”, /ʃ/→[ʃ] in /osi/→[oʃ̃h̃i] “aussi”, /k/→[k̃] in /ɑ̃kɔR/→[ɑ̃k̃h̃ɔ] “encore”, /p/→[p̃] in /pwasɔ̃/→[p̃wh̃aʃɔ̃̃] “poisson”, /d/→[d̃] in /desɑ̃dR/→[d̃h̃eʃh̃̃ ɑ̃d̃R] “descender”.

Table 17a: Hypernasality in P9

Ideal Speech	P9 speech output	Deviation	Gloss
/bɔ̃ʒu/	[b̃ɔ̃ʒ̃h̃u]	/b/→[b̃]/#____ɔ̃ /ʒ/→[ʒ̃]/ ɔ̃___u	bonjour
/osi/	[oʃ̃hi]	/ʃ/→[ʃ]/o___i	aussi
/ãkɔR/	[ãk̃h̃ɔ]	/k/→[k̃]ã__ɔ	encore
/vɔle/	[ṽh̃ɔle]	/v/→ [ṽ]/#____ɔ /l/→[l]/# ɔ___l	voler
/pwasɔ̃/	[p̃wh̃aʃɔ̃]	/p/→[p̃]/#___w /ʃ/→[ʃ]/a___ɔ	poisson
/fãdR/	[f̃h̃ ãd̃R]	/f/→[f]/#___ã /d/→ [d̃]/ã___ʁ	fendre
/pul/	[p̃h̃ul]	/p/→[p̃]/#___u	poule
/desãdR/	[d̃h̃eʃ̃h̃ãd̃R]	/d/→[d̃]/#___e	descendre

The above data shows that P9 nasalizes both nasalized vowels and oral sounds/consonant sounds.

Table 17b presents data for P14 on denasalization. The participant tends to denasalize oral consonant sounds such as /w/→[w̃] in /wi/→[w̃i] “oui”, /j/→[j] in /ljɔ̃/→[jɔ̃] “lion”, /d/→[d̃] in /dɔRmi/→[d̃ɔmi] “dormir”.

Table 17b: Hypernasality in P14

Ideal speech	P14 speech output	Deviation	Gloss
/wi/	[w̃i]	/w/→[w̃]/#__i	oui
/ljɔ̃/	[j̃ɔ̃ . ɔ]	/j/→[j]/l____ɔ̃	lion
/lɛd/	[j̃ɛ̃ . ɛd]	/l/→[j]/#___ɛ	laide
/mãʒe/	[ma.aje]	/ʒ/→[j]/ã___e	manger
/dɔRmi/	[d̃ɔmi.i]	/d/→[d̃]/#____ɔ	dormir
/Ri/	[j̃i.i]	/R/→[j]/#___i	riz
/sote/	[j̃õ .ote]	/s/→[j]/#__o /t/→[t]/o__e	sauter

Though the table above shows that P14 nasalizes oral sounds, he does not nasalize nasalized vowel sounds.

Dysprosody

This disorder is observed in only one participant (P3) as far as rhythmic dysprosody is concerned. A legend (↑) for high or rising pitch is used to indicate high melody and (↓) for low or falling pitch indicating a fall in melody. This helps in indicating the participant's sing-song rhythm. For example, /bɔ̃ʒu/→[bɔ↑ʒu↓] "bonjour", /banan/→[ba↑nan↓] "banana", /ʃapəlɛ/→[sa↑pə↓lɛ↑] "chapelais", /Rəpɛt/→[lə↑pɛ↓] "repète", /sɛRpã/→[sɛ↑pɑ↓] "serpent". More is seen on the table below.

Table 18: Dysprosody in P3

Ideal speech	P3 speech output	Deviation	Gloss
/bɔ̃ʒu/	[bɔ↑ʒu↓]	High-low	bonjour
/banan/	[ba↑nan↓]	High-low	banane
/Rjɛ̃/	[R↑jɛn↓]	High-low	rien
/mezɔ̃/	[me↑zɔ↓]	High-low	maison
/tRavaj/	[ta↑vaj↓]	High-low	travail
/dɔʁmi/	[dɔ↑mi↓]	High-low	dormir
/ʃapəlɛ/	[sa↑pə↓lɛ↑]	High-low-high	chapelais
/kafe/	[ta↑fe↓]	High-low	cafe
/Rəpɛt/	[lə↑pɛ↓]	High-low	repète
/sɛRpɑ̃/	[sɛ↑pɑ↓]	High-low	serpent

3.1.1.2.4 Fluency Disorders (FDs)

Stuttering is the fluency disorder observed in the study and it can be seen in just one research participant (P2).

Stuttering

The researcher observed occurrences of stuttering in the data entries. This is mostly evident in P2. The table below `shows that the participant repeats words and syllables at least twice with the /ə/ sound very prominent in his speech. This can be seen in instances such as, /nɔ̃/→[nɔ̃...nɔ̃...nɔ̃] "non",/wi/→[wi…wi] "oui", /pɛ̃/ →[ə…pɛ…pɛ] "pain", /pɔlisje/→[ə…ə…ə…pə] "police",/Repɛt/→[Rəp...ɛ] "repète", /deficit/→[de…si] "deficit". More is shown on the table below.

Table 19: Stuttering in P2

Ideal speech	P2 speech output	Deviation	Gloss
/nɔ̃/	[nɔ̃...nɔ̃...nɔ̃]	Repetition	non
/wi/	[wi…wi]	Repetition	oui
/pɛ̃/	[ə…pɛ…pɛ]	Repetition	pain
/pje/	[ə…ə…pje]	prolongation	pied
/pɔlisje/	[ə…ə…ə…pə]	Prolongation	policier
/Repɛt/	[Rəp...ɛ]	Block	répète
/tablo/	[ta… do…do…o]	prolongation	tableau

/deficit/	[de…si]	Block	déficit
/kabinɛ/	[nɛ...nɛ]	Repetition	cabinet

3.1.1.2.5 Muscle Speech Disorders (MSDs)

Dysarthria and apraxia of speech are two disorders observed in the study.

Dysarthria

The researcher investigates slurring in this part in six participants (P8, P10, P13, P14, P6, P11). The table below indicates many participants with ID and associated NDDs suffer from dysarthria in the form of slurring. As far as slurring is concerned, a word like /ʒɑ̃/ is realised as [j.j.a] by P8, [j.a] by P10, [j.a.a] by P13 and [j.a] by P14. The deviation here is that the sound /ʒ/ is substituted with [j] and in some cases, [j] undergoes a form of dragging. The dragging is also frequent in words wih the /a/ sound which also tends to be dragged as seen in /mãʒe/→[ma.a.j.e] and many more as seen in the data from ID French speaker cases in table 20a below and table 20b from English-speaking cases of ID.

Table 20a: Slurring in French speaking participants

Ideal Speech	P8	P10	P13	P14	deviation	gloss
/ʒɑ̃/	[j.j.a]	[j.a]	[j.a.a]	[j.a]	The substitution of /ʒ/ and dragging of the /j/ and /a/ sounds	Jean
/mãʒe/	[ma.a.j.e]	[ma.je]	[ma.je]	[ma.je]	The substitution of /ʒ/ and dragging of /a/	manger
/iɲam/	[ji.ja..m]	[ji.ja..m]	[ji.ja..m]	[ji.ja..m]	The substitution of /ɲ/ for [j] with breaks	igname
/mɔ̃taɲ/	[mɔ.ta.j]	[mu.ta.j]	[mɔ.ta.j]	[mɔ.ta.j̃]	The substitution of /ɲ/ for [j] with sound breaks	montagne
/ɔɲɔ̃/	[ɔ.j.ɔ]	[wa.jo.]	[ɔ.j.ɔ]	[ɔ.j.ɔ]	The substitution of /ɲ/ for [j] with sound breaks	oignon
/ʒwe/	[j.e]	[w.e]	[j.e]	[j.e]	The substitution of /ʒ/ for [j] and the deletion of /ʒ/	jouer
/lave/	[ja.ve]	[ja.ve]	[ja.ve]	[ja.ve]	The substitution of /l/ for [j] with syllable breaks	laver
/lɑ̃dmɛ̃/	[jɑ.mɛ]	[jɑ.mɛ]	[jɑ.mɛ]	[jɑ.mɛ]	The substitution of /l/ for [j] with blocks	lendemain

Table 20b: Slurring in English speaking participants

Ideal speech	P6	P11	Deviation	Gloss
/jɛs/	[j.ɛ.ʃ]	[jɛ.ʃ]	The substitution of /s/ for [ʃ] alongside breaks	yes
/fɪŋgə/	[f.ɪ.j.a]	[fɪ.ja]	The substitution of /ŋg/ with [j] alongside breaks	finger

Apraxia of Speech (AOS)

Distorted speech is observed in the study. The table below shows the level of distorted speech per participants for they present different degrees of disorders as a result of the difference in associated NDD. Most importantly, not all 14 participants have this disorder. Distortion is seen in some instances with whole words for example P6 realises the word /spuːn/ "spoon" as [h.hwən], the word /mɛdsɪn/ "medicine" as [mʃi.i], /ʃiːp/ "sheep" as [dzi.ip], /pɪktʃə/ "picture" as [wɪtə]. P7 realises the word /pãtalõ/ "pantalon" as [panɪto], /sɪstə/ "sister" as [sɛʃa], /kɛrozɪn/ "kerosine" as[kɛməzɪ], /təmorəʊ/ "tomorrow" as [tuməlo]. P10 realises the word /lɑ̃p/ "lampe" as [kɑpo.o], /lavabo/ "lavabo" as [laza.avo.o], /legym/ "legume" as [we.ewhy], /zeRo/ "zero" as [lewo.o], /vizaʒ/ "visage" as [hi.isaf], /kuzɛ/ "cousin" as [ku.uzive.e], /ɔɲõ/ "oignon" as [wajo], /miɲõ/ "mignon" as [ta.amjo], /mo/ "mot" as [hywo.o], /pRəmje/ "premier" as [me.ebe], /kRɛjõ/ "crayon" as [gi.idɔ]. P11 distorts the word /mjuːzɪk/ "music" as [mɪmɪ]. P13 distorts the following words /bɔ̃ʒu/ "bonjour" as [b.bɔhyR], /ʃosyR/ "Chaussure" as [ʃe.eʃwi], /sɑ̃dR/ "sander" as [hu.uRɔ], /leɔnaR/ "Leonard" as [le.ela.a]. P14 realises the word /tRavaje/ "travailler" as [jẽ jẽ jẽ] and the word /paRle/ "parler" as [pa.ah̃e.e]. This is seen in the table below.

Table 21: Speech data on apraxia of speech

Ideal Speech	Participants	Speech output	Deviation	Gloss
/spu:n/	P6	[h.hwən]	Complete word distortion	Spoon
/mɛdsɪn/	-	[mʃi.i]		Medicine
/ʃi:p/	-	[dzi.ip]		Sheep
/pɪktʃə/	-	[wɪtə]		picture
/sɪstə/	P7	[sɛʃa]	Distortion of the last two syllables	Pantalon
/kɛrozɪn/	-	[kɛməzɪ]	Distortion of the last syllable	Sister
/təmorəʊ/	-	[tuməlo]	Distortion of the last two syllables	Kerosine
	-			tomorrow
/lɑ̃p/	P10	[kɑpo.o]	Complete word distortions	Lampe
/lavabo/	-	[la.aza.avo]		Lavabo
/legym/	-	[we.ewhy]		Legume
/zeRo/	-	[lewo.o]		Zero
/vizaʒ/	-	[hi.isaf]		Visage
/kuzɛ̃/	-	[ku.uzive.e]		Cousin
/ɔɲɔ̃/	-	[wa.ajo]		Oignon
/miɲɔ̃/	-	[ta.amjo]		Mignon
/mo/	-	[hywo.o]		Mot
/pRəmje/		[me.ebe]		Premier
/kRɛjɔ̃/		[gi.idɔ]		crayon
/mju:zɪk/	P11	[mɪ. ɪ.mɪ. ɪ]	Distortion	music
/bɔ̃ʒu/	P13	[b.bɔhyR]	Complete distortion of word	Bonjour
/ʃosyR/		[ʃe.eʃwi]		Chaussure
/sɑ̃dR/		[hu.uRɔ]		Oignon
/leɔnaR/		[le.ela.a]		Leonard
/tRavaje/	P14	[jẽ jẽ je]		Travailler
/paRle/		[pa.a͡he.e]		parler

3.2. Data Analysis on Speech Production Problems in ID and associated NDDs

This section analysis both speech and language data presented in the tables above.

3.2.1. Analysis of Speech Data

The data presented in table 5 shows the behavioural patterns that characterize the speech/communication of all fourteen participants. From the table, one notices that each research participant presents varieties of different speech characteristics. Data is analysed following the different speech characteristics observed in the research participants.

Pauses

The researcher observed this speech characteristic in two folds namely, short and long pauses. Four participants (P1, P4, P9 and P12) out of all fourteen participants did not demonstrate any form of pausing while communicating. However, the rest of the participants either demonstrated short or long pauses in their speech. This is because they face issues with lexical retrieval or conceptual planning. Participants with this defect though in a mostly lesser degree, sometimes face word finding difficulties which pushes them to either pause for short or long periods of time in the middle of discussions. As pointed out by Levelt (1989), participants such as P8 and P14 who pause for long during discourse have problems with macroplanning wherein they fail to conceptually plan discourse. This in turn limits their ability to coherently organize ideas. The advent of this defect inevitably affects the participants' speech spontaneity leading to speech problems.

Hesitation

This communication drawback is seen in nine of the participants at various degrees. It is observed that those with this defect tend to take longer time to talk during a verbal exchange. This occurs during word finding moments. This happens when there are difficulties at the lexical selection stage as pointed out by Levelt (1989). This defect is higher in P2, P7, P8 and P14 because they face more issues in activating lexical concepts in the temporal lobe. As a result, the participants tend to think for long before continuing a discourse which most often than not, affects the smooth flow of communication.

Violence

This behavioural defect is observed only in two of the research participants (P1 and P5). This is mostly manifested when the participants find it difficult to transmit a message. Some hysterical outbursts are sometimes present accompanied by violent verbal behaviour. Levelt (1989) helps to explain this by pointing out the presence of problems at the macroplanning stage leading to such behaviours. This is because problems at the frontal lobe which is important in assessing situations and determining appropriate reactions impairs their judgement and causes

them to consciously plan threatening or aggressive discourse. This shows that though this behavioural malfunction is not common in the research participants it is still present in some participants.

Responsiveness

The researcher observed that a majority of the participants are very responsive to questions asked. They are willing to answer questions asked with great enthusiasm. However, P6 and P14 show a lesser degree of responsiveness. This is because they are more withdrawn in verbal exchanges. Their limited responsiveness to questions reflects to some degree impaired conceptualization. That is, they find it difficult to conceive ideas or generate messages appropriate for the question posed. Hence, they are not as responsive as the other participants. This leads to obstruction in communication.

Gestures

This phenomenon is most common in P1 and P2. The participants tend to use hand gestures to supplement verbal speech output. This is when the participants find it difficult to produce utterances. The participants most especially P2 use hand gestures as a form of compensating for word access and articulation issues. The use of gestures in communication rather than verbal speech, relying on Levelt (1989) model, is explained as a word retrieval failure at the lexical stage. This is due to a malfunction in the temporal lobe regions that support word access. Gestures help the participants activate motor areas to depict words that cannot be retrieved.

Cooperation

The participants are very cooperative apart from P6 and P14 who are not as cooperative as the others. This shows that their comprehension system is working to a certain degree allowing the participants to understand what is being asked of them and formulate appropriate replies. However, participants with difficulties cooperating suffer from impaired macroplanning most especially P6. This makes it difficult for her to interpret questions and formulate coherent, on-topic responses. Hence, limiting her cooperation. Lack of cooperative tendencies limit the smooth flow of communication.

Friendliness

The researcher observed that all but one participant (P14) shows great signs of friendliness. P14 finds it difficult to open up to new people. This explains why he is quite introverted and not very friendly. This is associated to impaired perspective taking and abnormalities in the temporal and frontal lobes which make it difficult for p14 to emphasize and relate to others in a friendly manner. Due to this defect, fluency is affected in communication as the participant

chooses to stay quiet rather than conversing. This lack of friendliness affects his ability to socialize.

Articulation

Table 5 presented above indicates that the participants are articulate to a certain degree. That is, they are somewhat able to transmit ideas, though their speech is filled with disorders. This is because the participants sampled for the study were individuals with mild to moderate ID and associated NDDs and not severe cases where a total absence of speech is sometimes present. Levelt (1989) helps in explaining the absence of articulatory abilities in the participants which is associated to the fact that, the participants to a higher degree have issues with precise phonological encoding which leads to poorly formed speech motor plans for the articulators. The participants face oral control difficulties most especially those with ID associated with CP that affect the coordination of the lips, tongue and jaw necessary for effective speech production leading to speech dysfluency.

The above analysis shows that participants with pervasive developmental disorder not otherwise specified experience no pauses (0) neither do they face hesitations (0) same with violent tendencies (0). They are highly responsive in communication (3) have an almost perceptible (1) tendency to gesture while talking. They are highly cooperative and friendly (3) and their articulatory ability is perceptible (2). Participants with ID associated with CP have almost perceptible pauses (1), they have perceptible hesitation (2), zero violent tendencies (0), perceptible responsiveness (2), they do not gesture when talking (0), they are perceptibly cooperative (2), highly friendly (3) and almost perceptive articulatory ability (1). Participants with ID associated with DS have almost perceptible pauses, hesitations and violence (1), they are very responsive (3), make use of no gestures (0), very cooperative and friendly (3) and almost perceptive articulatory capacity (1). Participants with ID associated with Microcephaly have almost perceptible pauses and hesitations (1), they have no violent tendencies (0), very responsive (3), perceptible gestures (2), very cooperative and friendly (3) and an almost perceptible articulatory ability (1). Participants with ID associated with macrocephaly have almost perceptible pauses (1), perceptible hesitations (2), no violent tendencies (0), very responsive (3), no gestures (0), very cooperative and friendly (3) and perceptible articulatory ability (2). In sum, analysing the speech data of the research participants provides a clearer understanding of their verbal behaviours paving a way into the quest for understanding how their language functions.

3.2.2. Analysis of Language Data

From the data presented in section 3.1.1.2, individuals with ID and associated NDDs such as; Down syndrome, Cerebral Palsy, pervasive developmental disorders-not otherwise specified, Macrocephaly and Microcephaly present varying forms of speech production problems in various degrees. This section stands to analyse data presented in section 3.1.1.2. Data analysis here would be done following the deviations noticed and as presented in the section.

3.2.2.1 Articulation Disorders (ADs)

Articulation Disorders (ADs) are prevalent among all fourteen participants, with a higher occurrence observed in individuals with intellectual disability (ID) associated with cerebral palsy (CP). This is because they have higher rates of impairment in the structure of their articulatory apparatus. These individuals tend to experience more oral difficulties compared to participants with other NDDs. Successful articulation relies on the proper functioning of essential speech organs, known as articulators. The lips play a crucial role in producing labial sounds such as /p/, /b/, and /m/. Dental sounds like /θ/ and /ð/ are facilitated by the teeth. The tongue is responsible for a wide range of sounds, including alveolar sounds (/t/ and /d/), palatal sounds (/ʃ/), and velar sounds (/k/ and /g/). The alveolar ridge is important for alveolar sounds (/t/ and /d/), the hard palate aids in producing palatal sounds (/j/ and /ʃ/), the soft palate (velum) contributes to velar sounds (/k/ and /g/), and the uvula is involved in producing the voiced uvular fricative /R/. When these organs of speech malfunction, articulation disorders set in and this is manifested in the research participants. Hence, Levelt (1989) intimates that articulation problems arise from issues at different stages of the speech production process. According to Levelt's model, during the conceptualization stage, articulation disorders occur due to difficulties in selecting the appropriate phoneme to express a specific idea. This leads to word-finding difficulties and phoneme substitution errors. At the formulation stage, articulation disorders arise from challenges in transforming the selected word or phoneme into a motor plan for articulation. This results in issues with speech planning, sequencing, and coordination, leading to speech sound errors or dysfluencies. At the articulation stage, problems manifest in executing the motor plan, such as difficulties in muscle control, strength, or coordination. These difficulties contribute to speech sound errors, distortions, or omissions. This is backed by Flint's (2017) observation that articulation disorders manifest when a child faces challenges in physically producing specific sounds due to structural abnormalities or failure to achieve proper placement of articulators when creating targeted sounds. The study identifies the most common manifestations of articulation disorders which are substitution, and addition as elaborated

subsequently.

Substitution

Substitution is evident in all 14 participants, as demonstrated in tables 6a, 6b and 6c. These individuals exhibit sound substitutions where certain sounds are replaced with others. The research participants tend to substitute at any word level be it initial, median or final positions. Examples of these substitutions include the voiceless post-alveolar fricative /ʃ/ being substituted with other sibilant fricative sounds like [z] and [s] in a word like /ʃapəlɛ/→[zapəlɛ]/[sapəlɛ] "chapelais", fricative to fricative substitutions are also common in words such as, /bizu/→[biʒu] "bisou", /pus/→[puʃ] "pus", /jɛs/→[jɛʃ] "yes", /R/ for [z] in /Repɛt/→[zepɛt] "répète", /f/ is substituted for [v] in /fiʃ/→[viʃ] "fish". Affricates are substituted for other sounds for example, /tʃ/ is substituted for [ʃ] in the word /kætʃ/→[kaʃ] "catch", /dʒ/ for a plosive [d] in the word /dʒu:s/→[du:s] "juice". nasal sounds are substituted for other nasal sounds for example /ɲ/ for [n] in a word like /mɔ̃taɲ/→[mɔ̃tan] "montagne, /ŋ/ for [n] in sɪŋ/→[sɪn] "sing". The /ɲ/ is also substituted for the liquid [l] and glide [w] /mɔ̃taɲ/→[mɔ↑tal↓]/[mɔtaj] "montagne". liquids for other liquids or glides for example, /r/→[l] in /raɪt/→[lat] "write" and /r/→[w] in /rʌbə/→[wɔba] "ɻubber" in tables 6a and 6b. The English-speaking participants not only substitue consonant sounds, they tend to substitute diphthongs for monophthongs in words such as; /aɪ/→[a] in /raɪt/→[lat] "write", /ɔɪ/→[ɔ] in /vɔɪs/→[v.v.ɔ]/[v ɔ] "voice".

Due to articulation difficulties, the research participants with ID and associated NDDs have challenges with coordinating the motor movements required for accurate speech production including difficulties with fine motor skills and precise muscle control. This results in sound substitutions where they tend to replace certain sounds for other sounds. Following the data presented in tables 6a, 6b and 6c, it can be noted that the participants substitute sounds at any word positions for other less complex or easily articulated sounds. This act is fueled by the need to simplify sounds in words for easy articulation. The participants employ simplification strategies as a way of easing speech production. For example, since they face difficulties coordinating the tongue movements required for producing sounds like /r/, they substitute it with sounds that require less tongue movement, such as [w] or [l] in words like, /rʌbə/→[wɔba] "rubber", /raɪt/→[lat] "write". The palatal nasal /ɲ/ substituted for an alveolars [n]/[l] for it needs more mouth movements same goes for the velar nasal /ŋ/ being substituted for [n]. The participants substitute an affricate like /dʒ/ for a plosive [d] this is because, the previous sound is difficult to pronounce as compared to the voiced alveolar [d]. And the voiceless affricate /tʃ/

is replaced with the fricative /ʃ/ reason being that as a fricative sound, /ʃ/ is easier to pronounce compared to an affricate for its sibilant quality. The fricative /z/ is substitute with the liquid [l] for example, /z/→[l] in /zibrə/→[liba] "zebra" because most participants prefer an easy to pronounce sound. The English-speaking participants face problems producing diphthongs as proven by table 6c. This is as a result of the fact that, the participants face difficulties gliding from one sound quality to another simultaneously leading to the deleting of one sound quality and retaining one. Levelt's (1989) model helps elucidate the participants' difficulties. In selecting the intended words which they wish to express, they encounter challenges in accessing or retrieving the targeted sounds from their mental lexicon, resulting in the selection of similar and easy to pronounce substitute sounds. In addition, participants struggle to accurately encode the specific phonological segments of their intended sounds, leading to substitutions of various sounds. Most importantly, their inability to execute planned articulatory movements accurately for particular sounds leads them to substitute complex sounds with more comfortable or easier-to-produce sounds. Data for the study correlates with evidence presented by Georgiva (1996) whose finding admits the presence of substitution in Bulgarian children with ID.

The Data presented in tables 6a, 6b and 6c present a valuable characteristic of the participants' substitution pattern. That is, sound substitution manifests differently every time. This is seen in the fact that, in some instances, a sound like /z/ is produced the right way in for example /zeRo/→[zelo] "zero" while sometimes it is substituted for another in an example like, /bizu/→[biɜu] "bisou". This can be explained in that, the position where the sound appears matters for a right pronunciation. At the initial position, /z/ is not substituted but at a median position in between vowels, it is substituted for /ɜ/. Another pattern is seen in sound simplification. In situations where a complex sound is to be produced, they substitute it for a less complex sound which might seem similar to the original sound in some way. For example, /dɜ/ →[d] and /tʃ/→[d]/[ʃ]. This is because their cognitive insufficiency and faulty articulatory apparatus prevent them from articulating the voiced and voiceless affricates thereby leading to their substituting them for easier to produce sounds that seem quite similar to them.

Substitution is mostly common with consonant sounds. Even though the researcher noticed the alterations with diphthongs in table 6c, other instances like /ʌ/→[ɔ] and /ə/→/a/ in /rʌbə/→[wɔba] "rubber" were ignored for the researcher took into account the cultural context of the participants. That is, the way they have grown up hearing certain vowel sounds being pronounced inevitably influence their pronunciation of those sounds hence, their substitution. This is because even typical developing children make similar substitutions which is largely due

to the cultural or societal context. This limitation in vowel substitution in the study population stands in stark contrast to findings from previous studies such as Cleland et al. (2010) whose research showed imprecise vowel production in children with Down syndrome. The researcher in the current study noticed that vowel category of sounds was mostly unaffected as opposed to consonants. This is due to the phonetic properties or characteristics involved in their articulation, given that vowels require less constriction and movement of articulators which makes them relatively easier to articulate compared to consonants.

Following the above explanations, the manifestation of substitution is summarized as follows.

- Consonant fricatives are substituted for other fricatives as elaborated above
- Complex nasals are substituted for a simpler nasal or liquid or glide
- Affricates are substituted for plosive and fricative
- Fricatives are substituted for liquids and glides
- Liquids are substituted for other liquids or glides.

Addition

The research participants exhibit instances of addition, as demonstrated in tables 7a and 7b where they add additional sounds to words during speech. Table 7a shows that the French speaking participants tend to add the glide [w] preceded by plosive sounds such as /p/ for example, /pyblik/→[pwyblik] "publique", and fricatives such as [v] for example /vɑlœR/→[vwɑlœ] "valeur". P9 and P14 are prune to inserting a nasalized [h̃] sound in their speech for example, /bɔ̃ʒu/→[bɔʒh̃u] "bonjour". In table 7b, the English-speaking participants tend to add [w] and [r] sounds to words such as /bɪskɪt/ →[bɪkwɪ] "biscuit" and /ʃugə/→[ʃurga] "sugar". However, it is important to note that this manifestation of articulatory disorder is less common among most participants, with a higher prevalence observed in individuals with ID associated with PDD-NOS, CP, and DS. The data presented in the tables 7a and 7b indicate that the glide [w] is the most frequently added sound, often occurring before consonant sounds such as the plosive /p/ and the fricative /v/, followed by front and back vowel sounds like /y/ and /ɑ/. Participants with hypernasality tend to add the nasalized /h/ sound [h̃] in words, and this addition can be observed at any position within a word.

Sound addition is due to the fact that, the participants (P1, P3, P6, P7, P8, P9, P11, P12, P13, and P14) face motor control challenges. These participants struggle to control their

articulatory movements, leading to unintended extra sounds being produced. These added sounds that basically lead to labialization significantly affect the clarity and intelligibility of the participants' speech, resulting in slurred, hypernasal, and unclear articulation. Applying Levelt's (1989) model to these observations, it becomes apparent that the participants face difficulties in selecting and organizing the phonological information associated with their intended words. As a result, they add sounds that are not part of the target word during the planning phase. Their inability to accurately organize and encode the phonological structure of the intended words leads to the addition of extra phonological segments. This extra segment reduces speech intelligibility making it difficult for others to easily get what they are saying. Reduced speech intelligibility due to sound addition is not far fetch from Coppens-Hofman et al. (2016) finding that adults with ID suffer from reduced speech intelligibility.

Though the research participants insert sounds like [w] in front of the plosive /p/ and the fricative /v/, the researcher noticed that this is not common in every single word that the /p/ and /v/ appear. This is explained in that, surrounding sounds play a vital role in the accurate pronunciation of a word without the insertion of a foreign phonological segment. The advent of sound addition is summarized as follows.

- The glide [w] is inserted in between consonants /p, v, k, g, v/ and vowels like /ɪ, y, ɑ/

All participants with ID associated with CP (P6, P10, P11, P13, and P14) experience both substitution and addition articulatory manifestations, highlighting the significant impact of CP on articulation difficulties especially in ID cases. On the other hand, participants with other associated NDDs display variations in the occurrence of specific articulation disorders. Hence, Spivey (2022) holds that children with phonological disorders may mispronounce specific sounds in certain words while articulating them correctly in others. This explains why individuals with ID and associated NDDs suffer from different articulatory deviations as seen in table 22 below.

Table 22: Prevalence of articulation disorders in participants according to Associated NDDs

speech disorders / Associated disorders	Substitution	Addition
Pervasive Developmental Disorder Not Otherwise Specified	2	1
Cerebral Palsy	3	3
Down Syndrome	2	1
Microcephaly	2	1
Macrocephaly	3	2

The table provides a comprehensive overview of the distribution of substitution and addition deviations among participants with various associated disorders. The measurements are based on a scale ranging from 0 to 3, where 0 signifies null perceptibility, 1 represents almost perceptible, 2 indicates perceptible, and 3 signifies very perceptible. These measurements are derived from the data presented in tables 6a, 6b, 6c, 7a, and 7b in section 3.2 of the study.

To calculate the frequency of substitution or addition, the investigator tallies the number of occurrences of these disorders in each participant based on the word list used during testing. The results reveal that participants with ID associated with CP consistently exhibit a higher frequency of both substitution and addition deviations compared to individuals with other associated NDDs. This finding strongly supports the understanding that the presence of CP significantly contributes to the manifestation of articulation disorders in individuals with ID. This can be better depicted on the bar chart below.

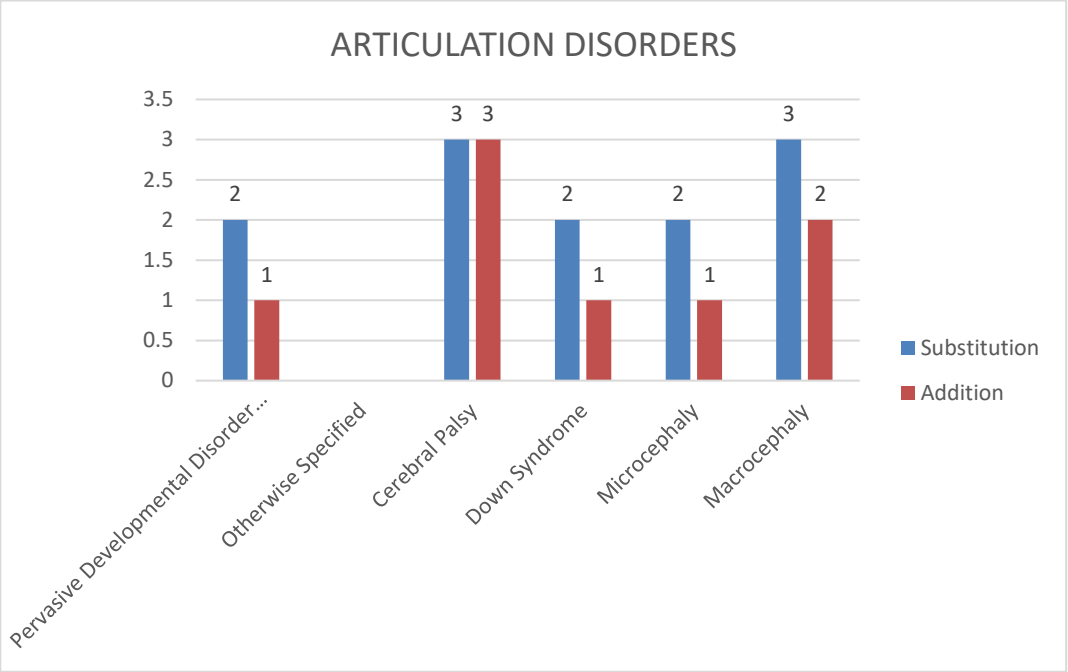


Figure 2: Articulation Disorders

The above chart represents the degree of substitution and addition in the research participants according to their associated NDDs. The chart demonstrates that participants with ID with associated CP are the highest rated individuals with articulation disorders. This is followed by participants with ID associated with macrocephaly, PDD-NOS, DS and microcephaly.

3.2.2.2 Phonological Disorders

Phonological disorders are prevalent among the research participants regardless of their associated NDDs. Based on Levelt's (1989) model of speech production, phonological disorders arise from difficulties in the phonological encoding stage, which involves selecting and sequencing of phonemes to form words and sentences. In the case of the research participants in the present research, this process is impaired, resulting in challenges in selecting and sequencing phonemes accurately and obstructing the phonological process. The model further explains that phonological encoding entails activating a set of abstract phonological representations, which are then translated into specific motor commands for articulation. In individuals with phonological disorders, like the participants in this study, these abstract phonological representations are poorly developed or inaccurate, leading to errors in speech production. This explains why discussing the prevalence and characteristics of phonological disorders in people with intellectual disability Lof et al. (2001), highlight the specific characteristics of phonological disorders which include difficulties in producing speech sounds accurately and

consistently, as well as limited phonological awareness and processing skills. The phonological process disorders presented above as witnessed in this study include: deletion (final consonant deletion, initial consonant deletion, syllable deletion and cluster reduction), gliding, voicing, devoicing and denasalization.

Deletion

Tables 8a to 12b above provide information on the occurrence of deletion disorders among the research participants. According to Levelt's (1989) model of speech production, deletion disorders occur at the formulator and articulation levels of speech production, where speakers generate phonological representations of sounds or words to be produced. In the case of the research participants here, sounds are deleted due to difficulties in accurately representing specific sounds. Challenges in precise planning and coordination of complex sounds such as /k/, /R/, /l/, /s/, /n/, /w/, /ɲ/, /ʃ/, and /d/ lead to their omission during the encoding process or at the level of articulation.

Participants with ID associated with CP, in particular, exhibit higher levels of faulty motor plans for articulation. They struggle with accurately planning the specific articulatory movements required for producing certain sounds. Complex tongue and vocal tract movements necessary for producing sounds like /R/, /l/, /s/, and /n/ pose challenges for these participants, potentially resulting in the deletion of these sounds in certain word positions. Examples in words like /ɑ̃kɔR/→[ɑkɔ] "encore" and /Rɛn/→[Rɛ] "reine" justify this claim. While all five associated NDDs involve motor execution errors, where planned articulatory movements are not fully realized, participants with ID associated with CP are specifically unable to produce the mentioned sounds in certain initial, medial, and final word positions. Tables 8a to 12b above also illustrate that all participants delete sounds in specific environments, particularly deleting one consonant in a consonant cluster like /sp/, /sk/, /sf/, /lj/, /pl/, /sw/, and /pR/. Additionally, many consonant sounds such as /k/, /ɲ/, /n/, and /d/ are deleted at word- final positions for example /lak/→[la] "lac", /mɔ̃taɲ/→[mɔta] "montagne", in table 8a and 8b. The inability to pronounce a /j/ sound when it appears between /l/ and a vowel or the /l/ sound when it is followed by /j/, or the deletion of /l/ when it precedes a consonant plosive like /b/, and the deletion of /R/ when it appears between a vowel and a consonant plosive /p/ are notable instances of deletion as seen in /miljɔ̃/→[milɔ]/ [mijɔ], /sablə/→[sabə] "sable", /pRije/→ [pije] "prier" table 12a. These instances indicate that the participants suffer from sound deletion. The simplification of speech contributes to the occurrence of this disorder. Based on the data collected, deletion is primarily observed in consonant sounds, with vowel sounds rarely being

deleted by the participants in words. This is likely due to the fact that vowels are sounds which intervene even in the process of vocalisation in baby language.

Although Kent and Vorperian (2012) do not specifically analyse sound deletion, their work contributes to the understanding that individuals with ID and associated NDDs face challenges in producing accurate and complete speech sounds. They emphasize that individuals with IDs experience difficulties in precise articulation and coordination of speech sounds. Their work upholds the notion that sound errors or omissions may be present in the speech of individuals with IDs due to difficulties in motor planning and execution. This aligns with the findings of the current study as all the ID cases with NDDs manifest such disorders.

Moreover, tables 8a and 8b provide data on the occurrence of final consonant deletion among the research participants. These tables demonstrate that the act of deleting final consonants is prevalent in individuals with ID and associated NDDs. Consonant sounds such as the plosives /p, k, d, t/, the nasals /m, n, ɲ/, the fricatives /s, ʃ, ʒ, R/, the glide /j/, and the liquid /l/are deleted when they appear at word-final positions and are preceded by vowel sounds. This can be seen in words such as /tRɑ̃kil/→[tRɑki] "tranquille", /Rɛn/→[Rɛ] "reine", /su:p/→[su] "soup", /brɛd/→[brɛ] "bread", /vɔɪs/→[vɔ] "voice", /brʌʃ/→[brɔ] "brush", /tɔnad/→[tɔna] "tonade", /fam/→[fa] "femme", /Repɛt/→[jepɛ] "repète", /abɛj/→[abɛ] "abeille", /mɔ̃taɲ/→[mɔta] "montagne" and /masaʒ/→[masa]/[maʃe] "massage". Thus, the Levelt's (1989) model thinks that the reasons for final consonant deletions is because the ID and associated NDD cases encounter difficulties in accurately retrieving or accessing the phonological representation of target words from their mental lexicon, resulting in the selection of word forms that lack final consonants. Regardless of the distinctive features or sound categorization, the majority of the participants' speech is governed by the deletion of final consonants. They demonstrate challenges in encoding the specific phonological segment representing final consonants. This therefore leads to the omission of these sounds during the planning of the phonological structure of words.

The deletion of final consonants too seems to be influenced by the environment of occurrence, where the absence of planned articulatory gestures for the final consonants plays a role. The participants face difficulties in accurately executing the motor plans associated with the final consonant sounds. This observation is particularly notable in participants with ID associated with CP and Macrocephaly.

Based on tables 8a and 8b, a general phonological rule is deduced, stating that consonant sounds

are deleted when preceded by vowel sounds:

General rule: C→ Ø /V__#

This rule indicates that the research participants delete final consonants when they are preceded by vowel sounds, as seen in tables 8a and 8b.

Apart from deleting final consonants, ID and associated NDD cases also suffer from the deletion of various consonants at word-initial positions. Tables 9a and 9b demonstrate that the participants often delete consonants, particularly when attempting to produce certain consonant clusters. Consonants such as the fricatives /s, R, ʒ/ and the plosive /t/ are deleted when followed by other consonant sounds like the fricative /f/, the plosives /t, p, k/ , the nasal /m/ and glides /j/ and /w/. Additionally, the alveolar nasal /n/ and the liquid /l/ are deleted at word-initial positions when followed by vowel sounds such as /y/ and /e/. This is seen in words like /sfɛR/→ [fɛ] "spère", /nyaʒ/→ [ya] "nuage", /stRɛs/→[tɛs] "stress", /stilo/→[tilo] "stylo", /Rjɛ̃/ →[jɛ] "rien", /tRo/→[Ro]/[ho] "trop", /legym/→[egym] "lègume", /ʒwe/→[we] "jouer", /smɛl/→[mɛ] "smell", /spu:n/→[pun] "spoon". With the Levelt's (1989) model, this disorder can be explained as follows: the participants end up deleting initial consonants because they struggle to activate or retrieve the appropriate conceptual representation for the words they intend to produce. Memory plays a significant role in the retrieval of information, and in the case of the research participants, faulty information retrieval leads to the deletion of initial consonants. They face difficulties in mapping the conceptual representation onto the appropriate phonological forms, whether it is about retrieving the correct phonological representations for the target words or planning the motor movements required for articulation. Failed motor planning, resulting from incomplete or inaccurate articulatory gestures, contributes to the deletion of initial consonants.

The data presented in tables 9a and 9b indicate that four sound categories, namely fricatives, plosives, nasals, and liquids, are deleted at word-initial positions. Based on the provided data, two phonological rules can be inferred:

1. Consonant sounds are deleted at word-initial positions when followed by consonants: Rule: C→ Ø /#_C
2. Consonant sounds are deleted at word-initial positions when followed by vowels: Rule: C→ Ø /#_V

These rules demonstrate that the deletion of consonant sounds at word-initial positions is primarily influenced by the sound that comes after the specific consonants. Finding in this study

also points to syllable deletion. Tables 10a, 10b and 10c, provide data on the deletion of one or two syllables from words by the research participants for example, /lepe/→[pe] "lepe", /salad/→[sa]/ [lad] "salade", /magazɛ̃/ →[mazɛ]/[majɛ] "magasin". It is important to note that not all participants in the study exhibit this disorder, and the degree of syllable deletion varies among those who do. Table 10a shows that some participants tend to delete first syllables in two-syllable words, while table 10b demonstrates syllable deletion at word-initial, word-medial, and word-final positions. The Levelt (1989) model serves as a foundation for explaining syllable deletion in the research participants. They experience syllable deletion due to difficulties in retrieving appropriate conceptual representations for the words they intend to produce. The participants produce incomplete or inaccurate conceptualizations, resulting in the omission of entire syllables in their speech output. They struggle to retrieve the correct syllable structures for the target words, and syllable deletion can also be attributed to motor planning or execution difficulties experienced by the participants.

Based on the data provided, three general rules can be derived regarding syllable deletion in the research participants:

- First syllables are deleted at word-initial positions in two- and three-syllable words.
- First and last syllables are deleted in three-syllable words.
- Median syllables are deleted in three-syllable words.

It is important to note that while syllable deletion is not as prevalent as other phonological process disorders among the research participants, it is still present and demonstrates the unique way in which they simplify syllable structures, particularly in two- and three-syllable words. The analysis of syllable structure, as shown on table 11 above, indicates that the participants have a tendency to simplify syllables, with structures like CV (consonant-vowel) being more prominent in their speech. For example, /kɔlɛR/→[lɛ] "colere". This is due to the fact that they are unable to reproduce words with a little over two to three syllables without deleting some syllables such as the first or last syllables for communication ease. This is demonstrated in a word like, /kado/→[do] "cadeau" which has the first syllable deleted and in a three-syllable word such as/defisi/→[desi] "deficit" which has the second syllable deleted. Hence, the participants can be said to be unable to produce multisyllabic words. This is in lign with what Cleland et al. (2010) said about syllabic patterns in the speech of children with DS regarding their excess use of CV structures.

Cluster Reduction (CR)

This is seen in tables 12a and 12b which present data on the cluster reduction disorder observed in the research participants. They exhibit a significant degree of cluster reduction wherein, consonant clusters such as /sw, pR, lj, kt, kl, tR, pj, bl, pw, st, kR, Rj, dr, sp/ are reduced by deleting either the first or second sound in the cluster for example in words such as /swi/→[si] "suis", /pRɔpR/→[popə] "propre", /atəlje/→[atəje] "atelier", /ɛpakt/→[ɛpa]/[ɛpa] "impact", /klɑs/ →[lɑs]/[kɑs] "classe",/tʁavaj/→[tavaj] "travail", /pje/→[pe] "pied", /sablə/→[sabə] "sable", /pwazɔ̃/→[pazɔ] "poison" /drɛs/→[dɛ] "dress" /spɪn/→[pi] "spin", /kRɛjɔ̃/→[kɛjɔ] "crayon", /tRo/→[ʁo]/[ho] "trop", /Rjɛ̃/ →[jɛ] "rien", /stilo/→[tilo] "stylo". This relates to Levelt (1989) model in that, the participants face difficulties at the formulation stage, specifically in phonological processes. They struggle to retrieve lexical and syntactic information from their memory and convert it into appropriate phonological representations. Encoding phonological information, such as phonemes, syllables, and phonological rules, is challenging for them at this stage. Consequently, the production of consonant clusters becomes problematic, leading to syllable simplification.

The research participants encounter significant challenges when transitioning from one consonant sound to another within the same syllable segment, including transitions from a plosive to a fricative or from a fricative to a plosive, from a plosive or fricative to a glide, from a liquid to a glide, from a velar to an alveolar, and from a plosive to a liquid. These syllable formations pose difficulties for the participants, who tend to simplify them by deleting one sound from the cluster. This observation aligns with the participants' inability to produce syllable structures of the form CC (Consonant- consonant) and their tendency to delete one sound for simplification purposes.

Gliding (G)

Tables 13a and 13b clearly demonstrate the presence of the gliding disorder in the research participants. A majority of the participants tend to substitute liquid sounds like /r/ and /l/ with glides such as /w/ and /j/ at both initial and median positions, which contributes to their slurred and slowed speech. This is seen in words such as /plɥi/→[pwi] "Pluie", /Repɛt/→[jepɛ] "répète", /balɔ̃/→[bajɔ] "ballon", /aRiko/→[ajiko] "haricot", /rʌbə/→[wɔba] "rubber", /zero/→[jɛjo] "zero". Levelt (1989) model enables the researcher explain this disorder in that, the participants glide due to difficulties in the planning, sequencing, and execution of liquid sounds. Glides require specific articulatory configurations, and the participants face challenges when transitioning from liquids to glides. The following transitions occur:

- /l/ → [w] and /l/ → [j]
- /r/ → [j] and /r/ → [w]
- /R/ → [j] and /R/ → [w]

Two general rules can be formulated based on the data:

1. Liquids become glides at word-medial positions between two vowels.

Rule: L → G / V__V

2. Liquids become glides at word-initial positions preceded by a vowel.

Rule: L → G / #__V

These rules highlight the role of vowels in the gliding of sounds in the participants' speech. The above analysis is not far from Kumin et al. ' (1994) study where he pointed out the presence of this disorder in children with DS.

Voicing (V)

Tables 14a and 14b provide information on the voicing disorder observed in the research participants. Out of fourteen participants, eleven exhibit this disorder. Using the Levelt (1989) model, it can be determined that participants with this disorder struggle to retrieve phonological information and convert it into appropriate phonological representations that include voicing features. As a result, they tend to substitute voiceless sounds for voiced sounds. Looking at tables 14a and 14b, the majority of substitutions involve fricatives and plosives, where voiceless sounds are replaced with voiced sounds. This substitution often occurs when participants find it challenging to articulate certain plosives or fricatives at word-initial or word-final positions such as /ʃ/→[z] in /ʃapəlɛ/→[zapəlɛ] "chapelais" as per P1, /t/→[d] /atəʃe/→[a…de…de] "attacher" as per P2, /p/→[b] in [ʒyb] "jupe" as noticed in P3.

The influence of surrounding vowel sounds also plays a role, as their presence makes it difficult for participants to produce a voiceless plosive or fricative followed by a voiced vowel sound. This assimilation-like process results in the plosive or fricative adopting the qualities of the surrounding vowel sound, transforming it into a voiced sound. The table below shows the sounds that undergo voicing:

Table 23: Voicing in research participants

Voiceless sounds	Voiced sounds
/ʃ/	[z]/ [d]
/t/	[d]/ [j]/[l]/[z]
/p/	[b]
/k/	[g]
/s/	[j]/[d]/[h]/[z]
/f/	[v]/[w]/[h]
/tʃ/	[d]

The table demonstrates that voicing occurs regardless of the place or manner of articulation. While some voiceless sounds are directly substituted with their voiced counterparts, others undergo assimilation-like changes based on the surrounding sounds.

From tables 14a and 14b, the following rules can be derived:

1. Voiceless consonants become voiced between vowels.

Rule: Ç → C / V___V

2. Voiceless consonants become voiced at word-initial positions followed by a vowel.

Rule: Ç → C / #___V

3. Voiceless consonants become voiced between consonants.

Rule: Ç → C / C__C

4. Voiceless consonants become voiced at word-final positions preceded by a vowel.

Rule: Ç → C / V__#

5. Voiceless consonants become voiced between a vowel and a consonant.

Rule: Ç → C / V__C

These rules indicate that voiceless consonants can become voiced at any position within a word when adjacent to a vowel sound.

Devoicing (DV)

Only five participants in the study exhibit the devoicing disorder. Table 15 displays instances where participants transition from voiced consonants to voiceless sounds. That is, plosives /d, g/ fricatives /v, ʒ, z/ and liquid /l/ to voiceless sounds such as, fricatives /s, f, ʃ/ and plosives /t/. For example, P3 substitutes plosive with a fricative in /d/→ [s] /maladi/→[ma↑la↓si↑] "maladie", plosive with another plosive /g/→ [t] /egal/→[e↑tal↓] "egale", and fricative for fricative /ʒ/→[ʃ] /ʒune/→[ʃule] "journee". P4 devoices voiced fricatives for voiceless fricative sounds for example, /z/→[ʃ] in /egliz/→[egliʃ] "eglise". The same goes for P8 who substitutes voiced fricatives for voiceless fricative for example, /z/→[ʃ] in /ʒozɛf/→[jo.oʃɛf] "Joseph". P10 devoices fricatives for other fricatives as seen in, /z/→[s] in /vizaʒ→[hi.isaf] "visage", a voiced glide for a voiceless plosive in /l/→[t] /ale/→[a.ate] "aller". And lastly, P14 substitutes fricatives for other fricatives. For example, /z/→[ʃ] in /pwazɔ̃/→[pa.aʃɔ] "poison". Leaning on Levelt (1989) model it is certain that during the formulation stage, participants struggle to retrieve the appropriate phonological information required for normal speech sound features, resulting in the devoicing of certain voiced consonant sounds mostly fricatives. This disorder is common in only five research participants. The advent of devoicing in the research participants though not very common is echoed by Hamilton (1993) whose work indicates the devoicing of final word obstruents by children with DS. The table below demonstrates the forms of devoicing observed in the research participants:

Table 24: Devoicing in participants

Voiced sounds	Voiceless sounds
/d/	[S]
/g/	[t]
/v/	[f]
/ʒ/	[ʃ]/[f]
/z/	[ʃ]/[s]
/l/	[t]

Vowels appear to play a significant role in assimilating the voiced sounds and transforming them into voiceless sounds. It can be observed that voiced sounds become devoiced between vowels, followed by vowels, or preceded by vowels. This can be summarized by the following rules:

1. Voiced consonants become devoiced between vowels.

   Rule: C → C̥ / V__V

2. Voiced consonants become devoiced at word-initial positions preceded by a vowel.

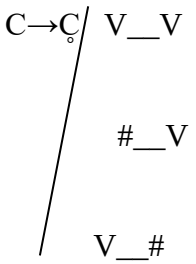
   Rule: C → C̥ / #__V

3. Voiced consonants become devoiced at word-final positions followed by a vowel.

   Rule: C → C̥ / V__#

These rules indicate that voiced consonants can undergo devoicing in the presence of neighboring vowels at various word positions.

General Rule



Denasalization (DN)

Among the participants in the study, denasalization is observed in those who struggle with nasalizing vowel sounds in the French language. It is important to note that not all participants exhibit this disorder, as it may be influenced by language differences. Participants who experience denasalization find it challenging to produce nasalized vowel sounds, except for P1 and P9, who either demonstrate mastery in nasalizing vowel sounds (P1) or exhibit hypernasality (P9).

Table 16 presents data indicating that none of the vowel sounds requiring nasalization are actually nasalized by the participants, indicating the phonological process of denasalization. This disorder suggests that participants face difficulties at the phonological encoding stage of the Levelt (1989) model, where they struggle to retrieve the nasalization feature for vowel sounds in the French language. Consequently, nasalized vowel sounds are produced as oral sounds instead. For example, /ɛ̃/→[ɛ] in /lwɛ̃/ →[lwɛ]/[lwɛ], /ɑ̃/→[ɑ] in /sɛRpɑ̃/→[sɛpɑ] “serpent”and /ɔ̃/→[ɔ] /mezɔ̃/→[mezɔ] “maison”. Table 16 indicates that denasalization occurs at word-final positions preceded by consonant sounds and in between consonants. Thus, it can be concluded that consonants play a crucial role in the denasalization process. The following

general rule accounts for this observation:

General Rule: $\tilde{V} \rightarrow V / C\_\#$

C_C

The above rule shows that nasalized vowel sounds ($\tilde{V}$) become denasalized (V) when they occur at word-final positions preceded by consonants (C_#) or in between consonants (C_C). The understanding of Levelt (1989) model leads to the conclusion that, denasalization is due to the participants 'inability to encode nasalized vowel sounds. That is to say that, the participants store these sounds in their lexicon without full nasality leading to their absence at the production stage. The failure of the participants to equally coordinate oral air flow when producing nasalized vowels is also an indispensable factor of denasalization. This is expected since the participants face faulty velopharyngeal function which make it difficult for air to flow through the nasal cavity for the target nasalized vowel sound. Cleland et al. (2010) also share this view as their finding suggests that children with DS are prune to denasalize nasal consonants. Even though this illustration is not witnessed in the current study, the idea of denasalization by individuals with ID and associated NDDs is shared.

The analysis of phonological process disorders can be concluded by noting that all participants in the study exhibit one or more of the disorders, albeit to varying degrees depending on the associated neurodevelopmental disorder. Participants with intellectual disability (ID) associated with cerebral palsy (CP) seem to experience more significant disturbances in speech compared to other participants. The table below provides a better illustration of this observation:

Table 25: Prevalence of phonological disorders in participants according to associated NDDs

Speech disorders / Associated disorders	FCD	ICD	SD	CR	G	V	DV	DN
Pervasive Developmental Disorder-Not Otherwise Specified	2	2	2	2	1	1	0	1
Cerebral Palsy	3	3	2	3	3	3	2	3
Down Syndrome	2	3	2	3	2	1	2	3
Microcephaly	3	3	3	3	2	1	0	3
Macrocephaly	2	3	3	2	3	0	1	3

From table 25, it can be observed that participants with cerebral palsy consistently exhibit a higher prevalence of speech disorders across all categories compared to participants with other associated disorders. This suggests that individuals with ID associated with cerebral palsy face more challenges in speech production. The chart below better elaborates on the table.

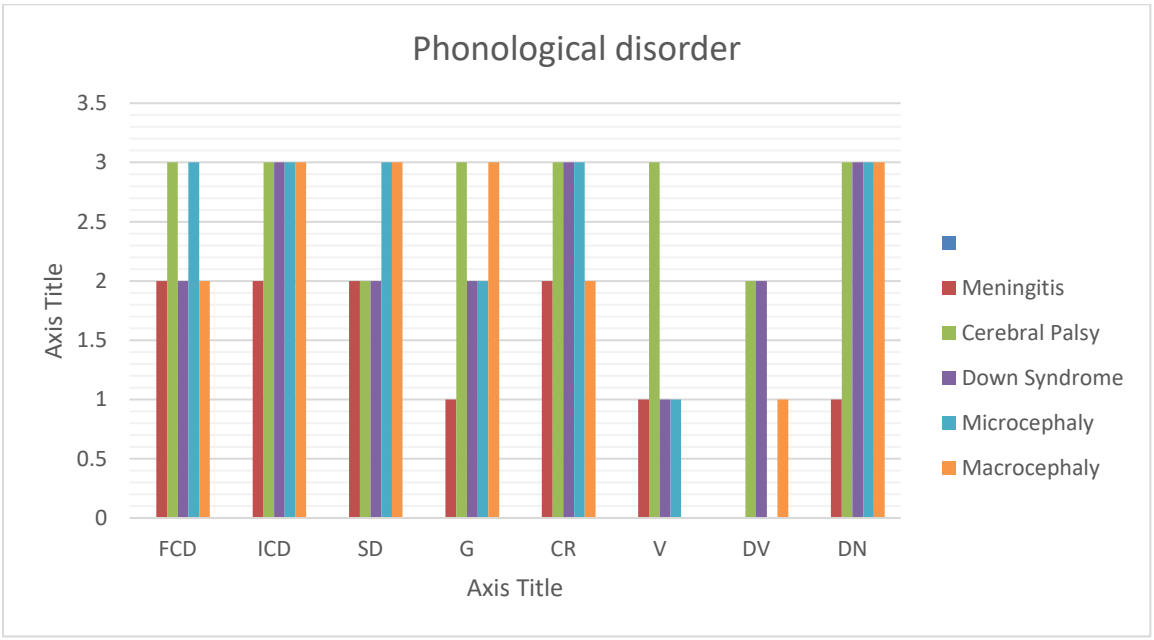


Figure 3: Phonological Disorders

Based on the data presented in tables 8a to table 12b, it can be observed that participants with intellectual disability (ID) associated with Cerebral Palsy (CP) tend to face more difficulties in phonological processing compared to the other participants with different

associated neurodevelopmental disorders (NDDs). This can be inferred from the higher prevalence of speech disorders, such as syllable deletion, gliding, cluster reduction, voicing, and devoicing, among participants with CP as compared to participants with other NDDs.

The chart above illustrates this difference in the prevalence of speech disorders across the different associated disorders. Participants with ID associated with CP show higher scores in most of the speech disorder categories compared to participants with other NDDs such as, PDD-NOS, Down Syndrome, Microcephaly, and Macrocephaly. This suggests that the combination of CP with ID contributes to more difficulties in phonological processing and speech production.

3.2.2.3 Voice Disorders (VDs)

The data presented in tables 17a, 17b, and 18 demonstrate the presence of voice disorders in the research participants with ID, such as, hypernasality and rhythmic dysprosody. Participants exhibiting hypernasality (P9 and P14) tend to nasalize oral consonant sounds in the French language. This is evident in P14 whereby he nasalizes the glide /j/, but denasalizes vowel sounds for example,/j/→[j] in /ljɔ̃/→[jɔ̃] "lion" and also nasalizes /t/→[t] in /sote/→[ʃ̃o tẽ] "sauter" . On the other hand, P9's speech is characterized by complete nasalization of speech sounds, including both consonant and nasalized vowel sounds. This is seen in words such as "aussi", "encore" and "poisson" where the sounds /ʃ/, /k/ and /p/ becomes [ʃ̃] , [k̃], and [p̃] respectively resulting alterations such as /osi/→[oʃ̃̃hi] , /ɑ̃kɔR/→[ɑ̃k̃h̃ɔ] and /pwasɔ̃/→[p̃wh̃aʃɔ̃ ̃] . Nova and Mello (2011) argue that these disorders are often associated with abnormal vocal quality, such as hoarseness, breathiness, and strain. This is in line with the situation observed here where the cases concerned experience or manifest voiced and rhythmic quality disorders like the aforementioned ones (dysprosody and hypernasality). Going by Levelt (1989), voice disorders primarily affect the articulation stage of speech production, which involves the physical movements required to articulate the sounds of a language. Difficulties in mastering the vocal movements necessary for articulation results in reduced speech intelligibility, as observed in the current study in the tables 17a, 17b and 18. It is worth mentioning that P9 does not nasalize vowel sounds that are not inherently nasalized. These examples above show that P9 has a higher rate of hypernasality relative to P14. It should be noted that P14 denasalizes nasalized vowels whereas P9 maintains their nasal qualities and does not nasalize vowel sounds that are not inherently nasalized.

Hypernasality can also be attributed to difficulties in the control of the velopharyngeal

port. This is visible in Participants 9 and 14 who struggle with proper control of the opening and closing of this port which regulates the airflow between the oral and nasal cavities during speech production. This is due to their inability to properly control the tongue because of impairments to the central nervous system. The tongue is responsible for controlling the flow of air during speech in the mouth by creating seals against parts of the mouth like the palate, teeth and velum thereby preventing hypernasality. However, in these participants poor tongue mobility prevents it from properly contacting oral structures during speech due to poor muscle control. Thereby resulting in hypernasality. This indicates a significant breakdown in the articulatory planning and execution processes involved in sound production.

On the other hand, dysprosody is exhibited in only one participant (P3). It affects the participant's rhythm by giving a sing-song tone making some syllables high in pitch and others low in pitch. This phenomenon is visible in words such as /bɔ̃ʒu/→[bɔ↑ʒu↓] "bonjour", /mezɔ̃/→[me↑zɔ↓] "maison"and /ʃapəlɛ/→[sa↑pə↓lɛ↑] "chapelais". The researcher makes use of a legend of the symbols (↑) for high (rising) pitch and (↓) for low (falling) pitch. The participant tends to change the rhythm of more than one syllable words into sing-song tunes pushing them to always appear as if they are singing while communicating. Taking Levelt (1989) as the theoretical backing for the research, dysprosody can be situated at both the formulation and articulation stages of the model. The participant faces a complete breakdown in the formulation and execution of speech. The formulation stage involves the conversion of conceptual representations into linguistic structures and motor plans that include the planning of prosodic features such as rhythmic features that include intonation patterns. The participant encounters breakdown due to disruptions in the coordination and timing necessary for the production of fluent and natural prosody.

Based on the overall research findings, it can be concluded that only three out of the 14 participants in the study exhibit voice disorders, indicating a relatively low prevalence of these disorders among the participants. The table provided captures the distribution of voice disorders across the participants based on their associated neurodevelopmental disorders (NDDs).

Table 26: Prevalence of voice disorders in participants according to associated NDDs

Speech disorders / Associated disorders	Hypernasality	Dysprosody
Pervasive Developmental Disorder-Not Otherwise Specified	2	2
Cerebral Palsy	2	0
Down Syndrome	0	0
Microcephaly	0	0
Macrocephaly	0	0

According to the table, participants with ID associated with pervasive developmental disorder tend to have a higher prevalence of voice disorders compared to the other associated NDDs. This suggests that PDD-NOS has a greater impact on the development of voice disorders among individuals with intellectual disabilities. However, these findings are clearer when viewed from a chart like the one below.

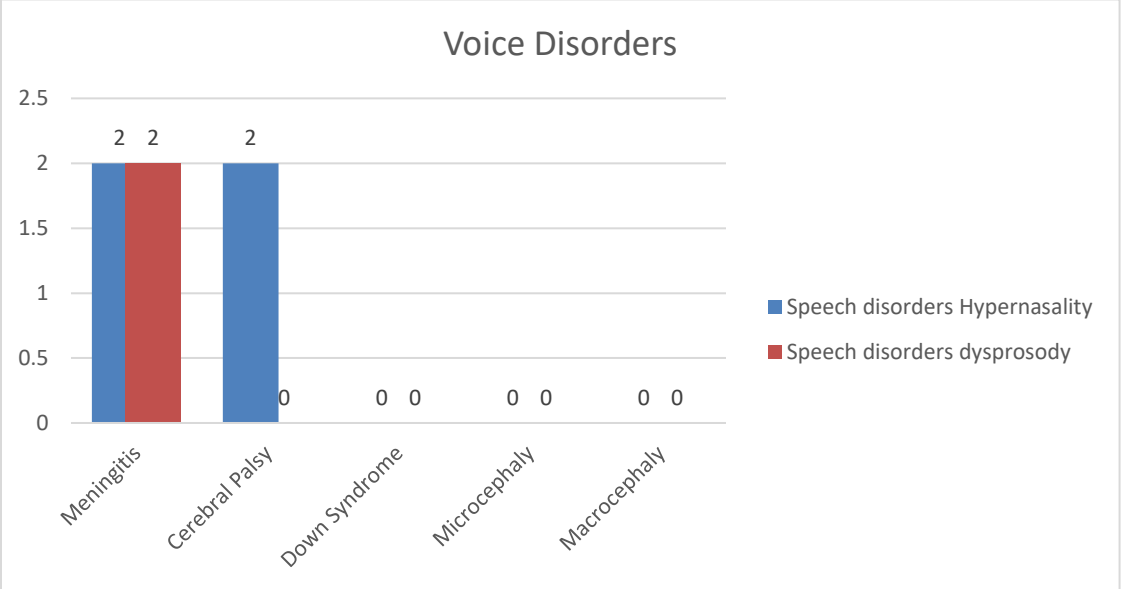


Figure 4: Voice Disorders

Based on the chart provided, it can be observed that not all participants in the study experience voice disorders. The majority of participants, including those with associated

neurodevelopmental disorders (NDDs) such as Down Syndrome, Microcephaly, and Macrocephaly, do not show signs of voice disorders. However, participants with ID associated with PDD-NOS and cerebral palsy (CP) demonstrate some degree of difficulty in this area. This suggests that these particular NDDs may be associated with a higher likelihood of voice-related difficulties. It's important to note that the chart specifically focuses on the presence of hypernasality and dysprosody as voice disorders, and there may be other voice disorders not accounted for in this analysis.

3.2.2.4 Fluency Disorders (FDs)

Only one participant (P2) is observed with this disorder specifically stuttering as seen on table 19 above. The researcher observed that, the speech of participant 2 is characterized by repetition of syllables or words at least twice or thrice, prolongation of the /ə/ sound, and a lot of breaks and blockages. This is seen in instances such as /pjɐ/→ [ə…ə…pjɐ] "pied", /wi/→[wi…wi] "oui", /pɛ̃/ →[ə…pɛ…pɛ] "pain", /Repɛt/→[Rəp...ɛ] "répète" and /kabinɛ/→[nɛ...nɛ] "cabinet". Parsing through Levelt's (1989) model of speech production indicates that fluency disorders such as stuttering arise primarily from difficulties in the formulation stage of speech production. This is the stage in which the speaker generates a phonetic plan for the words and sounds they intend to produce. P2 faces disruptions at this stage leading to repetitions, prolongations, or sound or word blockages. The model also states that other factors such as, emotional state, cognitive load and motor planning, influence the likelihood of fluency disruptions. In a similar vein, Coppens-Hofman et al. (2013) note the effects that this disorder has on communication, socialization and emotional well-being. They ascertain the presence of this disorder in individuals with ID as observed by the researcher of the current study. The participant exhibiting this trait has ID associated with Microcephaly as an added NDD. However, this disorder is not faced by other participants in the study with different associated NDDs as can be seen on the summary table below where only one case could be identified with ID associated with microcephaly.

Table 27: Prevalence of fluency disorders in participants according to associated NDDs

Speech disorder / Associated disorders	Stuttering
Pervasive Developmental Disorder-Not Otherwise Specified	0
Cerebral Palsy	0
Down Syndrome	0
Microcephaly	2
Macrocephaly	0

It is worth noting that while stuttering may not be prevalent in participants with other associated NDDs in this study, they may still experience other speech and language difficulties specific to their respective conditions. The chart below throws more light on the table.

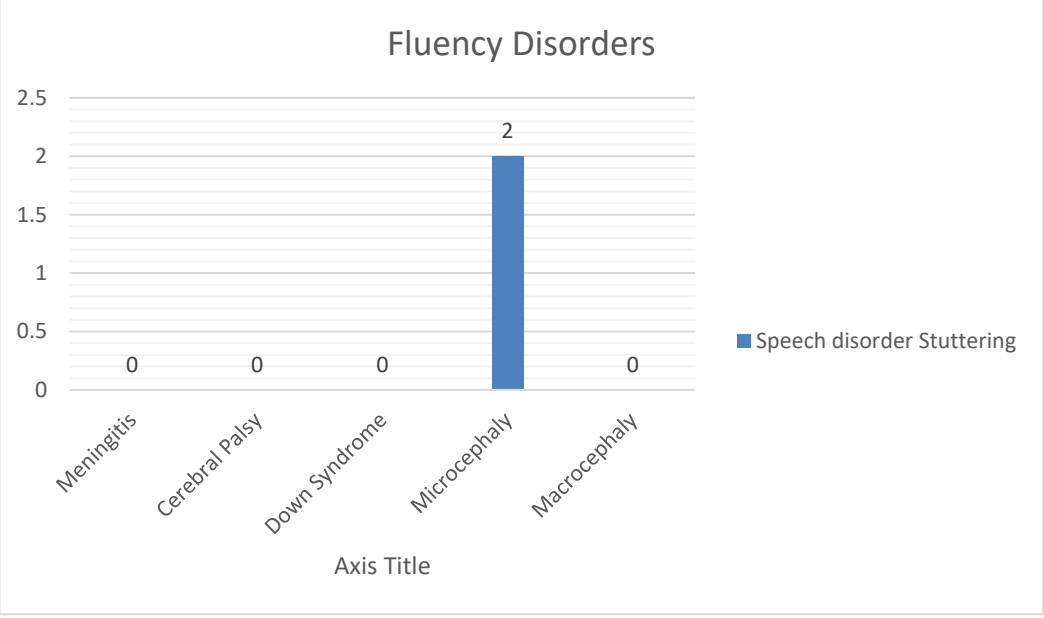


Figure 5: Fluency Disorders

Based on the information provided, it can be concluded that only one participant (P2) out of the fourteen participants in the study experiences stuttering. This participant has an associated neurodevelopmental disorder of Microcephaly. The grade of 2 for Microcephaly in

the chart indicates that out of the two participants with Microcephaly, one participant (P2) experiences stuttering at a high degree. Other participants with different neurodevelopmental disorders do not exhibit stuttering in this study.

3.2.2.5 Muscle Speech Disorders (MSDs)

These disorders are presented in tables 20a, 20b and 21. The researcher observes dysarthria and apraxia of speech as main MSDs. The researcher detected dysarthria (slurring) in the utterances of six participants (P6, P8, P10, P11, P13, P14). Most of these participants have CP as associated NDD. Instances of this disorder is evident in utterances such as, /ʒɑ̃/→ [j.a.a] "Jean", /mɑ̃ʒe/→[ma.a.j.e] "manger", /iɲam/→[ji.ja..m] "igname" and /ɔɲɔ̃/→[wa.jo.]/[ɔ.j.ɔ] "oignon". Levelt (1989) model situates this condition at the articulatory stage whereby, the participants face difficulties in executing the precise movements required for accurate and distinct articulation. Participants with ID associated with CP suffer more from muscle weaknesses or coordination problems affecting the tongue, lips, jaw, or other speech-related muscles. This muscle impairment leads to inadequate movement during their speech production resulting in slurred speech. Slurring is characterized by the participants substituting certain sounds for glides, dragging of sounds especially vowels and blockages. Apraxia of speech (AOS) is observed in six participants (P6, P7, P10, P11, P13, P14). In this list of participants, only P7 has as associated NDD, Down Syndrome the rest are ID associated with CP. This proves that AOS is more common in individuals with ID associated with CP. This is equally echoed by Nordberg et al. (2013) who confirm the presence of AOS in children with CP. Utilizing Levelt (1989) model it is apparent that this disorder is situated at articulatory stage wherein the participants have difficulties generating and accessing the appropriate motor plans for speech sounds. This leads to difficulties in planning sequential and coordinated movements necessary for fluent speech production. While articulating, the participants encounter disruptions in the execution and coordination of the speech organs for speech production leading to a great deal of distortions as a result of faulty timing and sequencing of movements. This can be seen in examples such as; /spuːn/→[hwən] "spoon", /kɛrozɪn/→[kɛməzɪ] "kerosine", /lɑ̃p/→[kɑpo] "lampe" and /tRavaje/→[jɛ̃ jɛ̃ jɛ̃] "travailler". More can be seen in table 21. The presence of both muscle speech disorders affect speech intelligibility in the participants thereby obstructing appropriate speech production. The above MSDs are not equally distributed to the research participants due to differences in associated NDDs as seen on the table below.

Table 28: Prevalence of muscle speech disorders in participants according to associated NDDs

Speech disorders / Associated disorders	Dysarthria	Apraxia of Speech
Pervasive Developmental Disorder-Not Otherwise Specified	0	0
Cerebral Palsy	3	3
Down Syndrome	1	1
Microcephaly	0	0
Macrocephaly	0	0

The table above shows that participants with ID associated with CP are the most affected with muscle speech disorders seconded by participants with associated DS. This is clearer on the chart below.

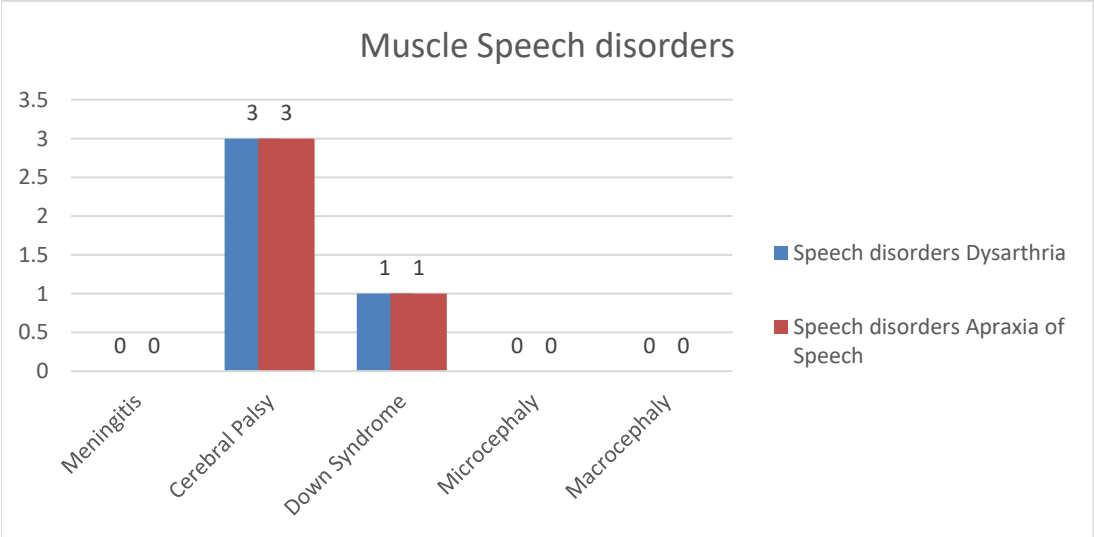


Figure 6: Muscle Speech Disorders

Out of the fourteen participants, three participants with CP exhibit dysarthria, which is characterized by slurred speech due to muscle weaknesses or coordination problems affecting the speech-related muscles. Additionally, three participants with CP also experience apraxia

of speech, which is characterized by difficulties in planning and executing the precise movements required for fluent speech production. Participants with ID associated with Down Syndrome (DS) are also affected by both dysarthria and apraxia of speech, but to a lesser extent, with one participant exhibiting each disorder. On the other hand, participants with ID associated with PDD-NOS, Microcephaly, and Macrocephaly do not show symptoms of dysarthria or apraxia of speech in this study. Overall, the findings indicate that CP is strongly associated with muscle speech disorders, followed by DS, while pervasive developmental disorder, Microcephaly, and Macrocephaly do not show significant prevalence of these disorders in the study.

In summary, this section has addressed the first research question by identifying and analysing the speech production problems commonly observed in individuals with ID and associated NDDs. The analysis emphasizes the impact of these problems on various aspects of their social lives. This understanding serves as a basis for developing effective interventions and strategies to improve their communication abilities and overall well-being.

3.3 The Impact of Speech Production Problems on Individuals with ID and Associated NDDs

This section presents and analysis data on the negative impacts of speech production problems in individuals with ID and associated NDDs. Some of the negative impacts observed were; Social interaction, academic difficulties, and communication difficulties

3.3.1 Data Presentation on the Impact of Speech Production Problems on Individuals with ID and Associated NDDs

Data obtained with regards to the negative impact of the many deviations noticed in the speech of persons with ID and associated NDDs shows that the patterns of speech produced by this group of persons greatly affect their social lives. The negative impacts are seen at three levels in the present study. These include; the level of social interactions, communication and academics.

3.3.1.1 Impact on Social Interaction

As regards social interactions, the teachers interviewed revealed that the children with ID and associated NDDs hardly interact with strangers or simply with people that they are unfamiliar with. A teacher said that “je peux vous dit qu’ils font fasse au grave problèmes quand il s’agit de communiquer avec les personnes de l’extérieur; il s’agit de l’incapacité d’être comprise”. In this way the teachers reported that people also avoid engaging them in social

activities. Another teacher revealed that “Comme enseignant, plusieurs personnes me fait par du fait qu’ils évitent de communiquer avec eux à cause de la barrière oral; ils ne comprennent pas ce qu’ils dissent”. These children hardly make friends with others as a teacher said “Ils ne sont pas capables de fait des nouveaux amis accuse de leur incapacité de bien s’exprimer. Quand on sort pour certain activités les enfants restent seulement entre eux de peur qu’on se moquent d’eux quand ils parlent”. This shows that their inability to express themselves like other people of their chronological age would makes it difficult for them to socialize like everyone else.

3.3.1.2 Impact on Communication

Children with intellectual disability and associated NDDs are also seen to suffer greatly from communication difficulties. They are very less fluent in communication irrespective of the language. They tend to be introverts and lack self-esteem. As a result, their communication partners (interlocutors) easily give up as a result of communication break. This is evident as a teacher stated that “Les enfants ont du mal à s’exprimer couramment”. Individuals with ID and associated NDDs are very slow in speech. A teacher regretted that “because of their slowness in speech, many people do not have the patience to sit and listen to them explain their idea…it will take forever and you know how people are serious about time”. Apart from being slow in speech, children with ID are less audible. Even though their language is full of phonological deviations one hardly hears them. They virtually whisper speech. Hence a teacher retorted that “Their voices are barely audible and people do not get them when they are talking”. More to this, pronunciation is a real problem to these individuals thus hindering communication. Again, the teachers explained that some of this group of children tend to be violent when frustrated by not been understood by their interlocutors. A teacher explained that “some even tend to tear their clothes when you seem not to understand what they are telling you, some even scream some start jumping all over. It is not a good sight to see”. Because of communication difficulties, the children with ID and associated NDDs need to always be accompanied especially to public places out of school. Someone has to constantly serve as an interpreter to let people understand their speech. This is very detrimental to their interaction with others.

3.3.1.3 Impact on Academics

Academically, the teachers say that the children are not progressing well or at the same pace with their peer because the language acquired by the peers of the same age is rather learnt in school and so the time they take to learn other things they use theirs to learn the language first. Even so, a teacher said that “C’est un défi pour eux d’assimiler les sons qui ensuite ne les permet pas d’assimiler la grammaire de la langue français. Alors apprendre à lire et a écrire restent difficile”. These children tend to forget a lot this is the reason why another teacher

regretted that “Ils ont du mal à garder les leçons dans leurs mémoires surtout le system des sons d’une langue donnant une mauvaise performance académique”. The teachers even went ahead to reveal that their inability to assimilate sounds make it difficult for them to read or write affecting their academics as a teacher said “Leurs performances sont vraiment derrière quand il s’agit de lire et d’écrit”. Hence, literacy is very difficult for most of them to achieve.

The above data proves that speech problems affect the lives of individuals with ID and associated NDDs greatly.

3.3.2 Data Analysis on impacts of speech production problems on individuals with ID and associated NDDs

As revealed above, persons with intellectual disability and associated NDDs sparingly interact socially especially with people that they are unfamiliar with (most especially P14 as seen on table 5). This is mainly because of their inability to produce language comprehensively and the difficulties faced by people to comprehend their speech. The sample for this study has revealed that people with ID and associated NDDs do not successfully undergo a normal process of language acquisition. As such what is considered normal at the acquisition age (0 – 60 months) lingers on into adulthood in the language of this group of persons. They continue to produce language with similar linguistic patterns like those produce at the acquisition age. Given that communication is a chain and all the elements and steps involved must be met before communication can take place, it is normal to say that communication hardly flows with people with ID and associated NDDs. This therefore hinder socialization passes through language. This explains why the teachers say that these children face serious difficulties when communicating with unfamiliar people “Ils font face au grave problème quand il s’agit de communiquer avec les personnes de l’extérieur”.

The sounds produced by these group of people hardly reflect the actual sound in the said words, they tend to substitute sounds in words, add sounds in words, distort words and many more thereby hindering communication from taking place. This justifies Blanken et al’s (1993 p.1) notion of microplanning which requires that the speaker gives propositional knowledge to the selected information. This implies that the speaker must give the message enough contextual relevance before formulation takes place with the output being a message. Being aware that the message they produce is likely nor going to be well perceived by the interlocutor, the ID individual prefers to stay quiet and isolate himself. Hence a teacher revealed that “Comme enseignant, plusieurs personnes ne me fait pas du fait qu’ils évitent de communique avec eux à cause de la barrière orale. Ils ne comprennent pas ce qu’ils dissent” this does not mean that

persons with ID and associated NDDs all do not go through the formulation process Blanken et al (1993 p.4) where the formulator maps messages into linguistic forms. That is, by giving them grammatical and phonological forms, the message is actually encoded and put in the phonetic buffer as is the case with everybody but the problems intervene at the articulation phase where the articulation of the phonetic plan has to take place, it is here that the sound distortion or deviations occur depending on the musculature of the respiratory, the laryngeal and the suprasegmental system. Hence, the role of the neurodevelopmental disorders to determine the nature of the sound to be produced. Once all of this tend problematic and the individual's speech is hardly perceived frustration sets in thereby leading to isolation and less involvement in social activities especially those of their natural environments.

These finding obtained through the interviews with the teachers corroborate findings from observation in that during the researcher's stay in the research sites, the learners with intellectual disability and any form of associated disorders were always either at the corner, loitering around the teacher or playing with a few familiar mates. They hardly accepted to come close to the researcher. They only got close the researcher when they were already familiar with each other. Even when a person came visiting in school, they never went closer to them.

Apart from social and communication problems, the data presented above points to the fact that individuals with ID and associated NDDs face a lot of problems academic-wise. This is demonstrated in that the interviewed teachers unanimously pointed out that the academic performance of the children is significantly low. This is attributed to the fact that the children have serious speech problems thereby hindering their assimilation of language skills such as; reading, writing and speaking as stated by a teacher "C'est un défi pour eux d'assimiler les sons qui ensuite ne les permet pas d'assimiler la grammaire du français. Ceci alors rend difficile le fait de leur enseigner comment lire et écrire parce qu'ils ont du mal à garder dans leurs mémoires le system de sons de la langue donnant une performance académique pauvre". This assertion is echoed by Smith (2001 cited in Sandberg 2006, P. 629) who argued that speech impairment may have a negative influence on skills needed to develop literacy such as phonological skills. In addition, Lundberg et al. (1988 cited in Sandberg 2006, P.1), highlighted the fact that phonological awareness is an important precursor to literacy acquisition. Therefore, given the fact that majority of the children's speech impairment occur at the phonological level it stands to reason that their inability to acquire literacy is in part due to damaged phonological components that aide in the appropriate production of sounds.

The above analysis indicates that individuals with ID and associated NDDs face serious difficulties with speech which affects their day-to-day activities.

3.4 Some Therapeutic Measures to Ameliorate Speech Production Problems in Individuals with ID and Associated NDDs

This section handles some therapeutic measures employed by teachers to ameliorate the speech abilities of the participants. The study identifies therapeutic measures such as; articulation therapies/ speech therapy exercises, fluency therapies and voice disorder therapies that aide in ameliorating the speech prowess of individuals with ID and associated NDDs.

Data Presentation on Therapeutic Measures Used to Ameliorate Speech Production Problems in Individuals with ID and Associated NDDs

This part tackles the various therapeutic measures gotten from some secondary sources backed- up by the data collected from interviewed teachers for speech amelioration. The aforementioned therapies are elicited as follows.

3.4.1 Articulation/Speech Therapy

Regarding articulation/speech therapies, McLeod and Baker (2017) present traditional articulation therapy which focuses on teaching correct placement and movement of the articulators (the lips, tongue and jaws) to produce specific speech sounds. With this articulation therapy, children are brought to practice sound and word production. The authors present oral motor exercises wherein the therapists drill children on how to position their speech organs in order to produce certain sounds to target specific speech sound errors. This therapeutic measure is highly used by the teachers from the schools the current research was carried. When interviewed the teachers actually testified that this therapy works well in most circumstances except in cases with severe associated neurodevelopmental disorders. A teacher stated that “in order to aide articulation, a child is made to repeat sounds after the teacher. Children are placed in front of mirrors with their teacher. The children are made to observe their teachers produce sounds and imitate how their teachers are producing these sounds. The teachers make sure that the children observe carefully how they move their articulators and do the same until they get it right”. This articulatory therapeutic exercise is widely appreciated by the teachers as one goes ahead to state that “the children take interest in observing the mouths of their teachers and do everything possible to replicate it. This helps them move their articulators more frequently especially for children who find it difficult to do so due to the nature of their disability”. With this therapy, the children are more focused on capturing the movements of their teachers’ articulators while producing sounds as a teacher went ahead to say that “if the child sees your

mouth go up, he will do the same. For a sound like the /l/ sound where your tongue moves, the child imitates the movement of your tongue by observing the mirror".

Still on articulation/speech therapies, the teachers went ahead to talk about a candle blowing technique. A teacher stated that "this candle-blowing technique enables a child open the mouth since some children find it difficult to do so". Another teacher continued that "A candle is lit in front of a child and the child is made to blow off the candle. This is so that the child can open the mouth". This technique is also well received by the teachers for one stated that "the technique helps the children produce sounds like the /b/ sound since the child needs to open the mouth to realize the sound". Another teacher added that "you use this technique to see if a child can actually close the mouth since children with profound disabilities find it difficult to close their mouths".

3.4.2 Fluency Therapy

As for fluency therapies, Guitar (2014) expatiates on fluency exercises such as slow and controlled speech, breathing exercises, rhythmic speech patterns, and strategies for reducing stuttering- like behaviours. The interviewed teachers expressed their acceptance of the breathing exercises as a teacher said that "La technique respiratoire les aides à contrôler leur respiration quand ils parlent. Quand l'enfant apprend à respirer en parlant, ça l'aide a réduit le bégaiement". According to the teachers, teaching the children the breathing technique reduce their rate of stuttering. A teacher further explained that "Avec cette technique, l'enfant est amené à inspirer et expirer après avoir produit un son. Cela aide a réguler sa respiration entre chaque production sonore". This technique helps the children speak fluently especially for a child who stutters since as a teacher said, "Ça laide à prendre les poses quand il parle qui lui donne assez de temps de recommencer son discours plus couramment".

3.4.3 Voice Therapy

Looking at voice therapy, Boone et al. (2014) state that these therapies target vocal production and vocal quality. They involve activities such as vocal warm-ups, pitch and volume modulation, and resonance exercises to promote healthy vocal functioning. The interviewed teachers actually affirmed to the usefulness of this therapeutic techniques especially for children with disorders such as, dysprosody and hypernasality. The teachers stated that they make use of all three voice therapies to ameliorate the children's speech production. The teachers elaborated that "the warm-up technique is used in that the children are made to sing songs early in the morning before they begin classes. This is to make their vocals active before classes since most of them do not talk much and might have stayed without using their vocals for some time".

For pitch and volume modulation, a teacher stated that “the children are made to repeat the pitch of the teacher when he/she produces a sound for example if a teacher produces the /a/ in a high pitch, the children imitate it and the teacher produces that same sound in a low pitch and the children do the same”. Another teacher explained that this technique is to “explore the children’s pitch range and develop control over pitch modulation”. The teachers showed positive reactions when it came to resonance exercises for to them “the children enjoy this exercise which makes it easier to teach train them” stated a teacher. A teacher stated that “the children are made to hum in order to control their nasal airflow. The children are also made to constantly produce the sounds /n/ and /m/”.

All therapeutic measures are very useful to the children with ID and other neurodevelopmental disorders as affirmed by the interviewed teachers.

3.3.2 Discussion of finding on therapeutic measures used to ameliorate speech production problems on individuals with ID and associated NDDs

The above presented data on therapeutic measures used to ameliorate speech production in participants with ID and associated NDDs is further discussed in this section.The therapies gotten by the researcher include; articulatory/speech therapies, fluency therapy exercises and voice therapy exercises. According to the teachers, the therapies are quite effective since “most children improve after being administered these therapies” as voiced a teacher.

The researcher observed that therapies like the articulatory therapy exercises which are meant to help with sound production are very much effective as most research participants with ID especially with associated CP face a lot of problems when trying to move their articulators to produce speech. The mirror exercise proves very effective since the research participants could be seen pronouncing some sounds after observing how the teachers were pronouncing and imitating. Even though without looking at the teachers producing the sounds the participants still tend to mispronounce, this exercise enables them move their articulators more frequently and makes them get use to talking. This helps to facilitate the speaking process.

The fluency breathing technique is also useful when it comes to regulating the research participants breathing in between speech. This helps limit their stuttering tendencies most especially P2 who suffers from stuttering. Even though it is a slower process when it comes to speech amelioration, the participants learn to take a break and regulate their breathing when talking so as not to stutter. This technique is very good and also helps to relax the mind.

The voice therapy exercises as presented above are very useful as stated by the teachers for though they are quite slow when it comes to ameliorating the speech prowess of the research

participants, they them familiarize themselves with sound vocalization. This enables the children get used to producing speech sounds thereby easing their learning process. A fun exercise like the resonance "humming" exercise is well received by the participants which help regulate their resonance and vocal with little to no resistance from the children.

The above therapies are very useful in speech amelioration in children with ID and associated NDDs for those with mild or moderate cases have equal chances at school and other opportunities at communicating better and having meaningful social interactions with outsiders a part from their teachers. Whereas extreme cases find a greater chance at being able to express their needs overtime. The researcher hence suggests that early therapeutic interventions can go a long way to help ameliorate the speech of children with ID and associated NDDs as posited by Jacob et al. (2015).

3.5 Conclusion

This chapter had as aim to answer the research questions in order to bring scientific backings to the research study. By identifying the speech production problems faced by the individuals and shedding light on the negative impact of these speech problems on the individuals, along with some therapeutic measures to ameliorate the speech defects, this chapter provides a clearer understanding of the communication situation of individuals with ID and associated NDDs.

General Conclusion

This chapter stands as a conclusive chapter of the entire research study. The chapter is divided into five sections: the first section presents a summary of the study's main findings and the verification of hypotheses, the second section presents recommendations to stakeholders, the third section discusses the problems/difficulties encountered on the field, the fourth section proposes directions for further research and a conclusion.

Summary of the findings

Speech production problems in individuals with ID and associated NDDs

The findings revealed that all fourteen participants experienced speech production difficulties, including articulation disorders such as, substitution, and addition. However, not all participants exhibited every articulation disorder. Addition was a rare disorder, with only one participant demonstrating the addition of a nasalized [h̃] sound. Substitution of sounds was prominent in all participants, indicating the prevalence of this disorder in individuals with ID and associated NDDs. Participants with ID associated with cerebral palsy (CP) showed the highest incidence of articulation disorders, likely due to various factors such as neurological disorders, physical abnormalities, developmental delays, and structural issues affecting the organs of speech.

As regards the instances of substitution, the study reveals that the research participants greatly substitute sounds in the need to simplify speech examples include

- The substitution of voiceless post-alveolar fricative /ʃ/ for the alveolar fricatives [z] and [s] in words such as; /ʃapəlɛ/→[zapəlɛ]/ [sapəlɛ] “chapelais”.
- The substitution of alveolar fricatives for post-alveolar fricatives for example /s/ and /z/→[ʃ] and [ʒ] in words like, /bizu/→[biʒu] “bisou” and /jɛs/→[jɛʃ] “yes”
- The substitution of liquid trill /r/ for the liquid lateral approximant [l] for example /r/→[l] in /raɪt/→[lat] “write”.
- The substitution of liquids for glides for example, /r/→[w] in /rʌbə/→[wɔba] “rubber”.
- The substitution of the palatal nasal /ɲ/ for the alveolar nasal [n] or liquid [l] or approximant [l] for example /mɔ̃taɲ/→[mɔ̃tan]/ /[mɔ↑tal↓]/[mɔtaj] “montagne”.
- The substitution of the fricative uvular /R/ for a liquid or lateral approximant for example /zeRo/→[zelo]/ [zejo] “zero”.

- The substitution of vioceless affricate /tʃ/ for the voiceless fricative [ʃ] in /kætʃ/→[kaʃ] “catch”
- The substitution of diphthongs /aɪ/, /eɪ/, and /ɔɪ/ for monophthongs /a/, /e/ and /ɔ/ in words like, /raɪt/→[lat] “write”, /feɪs/→[fe] “face”, /baɪsɪkl/→[bakə] “bicycle”.
- While in the case of addition, it was noticed that this linguistic deviation is not very common even though the following could be spotted: /w/ is added before the plosive /p/ and fricative /v/ for example /pyblik/→[pwyblik] “publique” and /vɑlœR/→[vwɑlœ] “valeur”. /r/ is added for slurriness for example /ʃugə/→[ʃurga] “sugar”.
- Insertion of a nasalized [h̃] due to hypernasality for example /bɔ̃ʒu/→ [bɔʒh̃u] “bonjour”.

Apart from articulatory disorders, Phonological process disorders were also present in all fourteen participants, although the specific disorders varied. Difficulties with pronouncing final consonants were common among all participants. Notably, six participants had challenges with initial consonant deletions, while only six participants struggled with gliding, leading to a slurry speech quality. Cluster reduction and devoicing were also prominent disorders, while denasalization affected eight participants who were French speakers. The researcher concluded that individuals with ID and associated NDDs face a range of phonological process disorders, particularly those with ID associated with CP. These disorders stem from difficulties in assimilating the sound system of their first language, making it challenging for them to express themselves accurately.

- Deletion of plosives /p, k, d, t/, nasals /m, n, ɲ/, fricatives /ʃ, R, s, ʒ /, glide /j/ and liquid /l/ at word final positions preceded by vowels such as /a/, /ɛ/,/ɔ/, /i/, /u/, /ɔɪ/,/ ʌ/, /ə/. For example, in words like, /ɑvɛk/→[ɑvɛ] “avec”, /tɔnad/→[tɔna] “tornade”, /ɑ̃kɔR/→[ɑkɔ]/[kɔ] “encore”, /su:p/→[du]/ [su] “soup”.

- Fricatives /s, R, ʒ/ and the plosive /t/ are deleted at word initail positions when followed by other consonant sounds like the fricative /f/, the plosives /t, p, k/, the nasal /m/ and glides /j, w/. Additionally, the alveolar nasal /n/ and the liquid /l/ are deleted at word-initial positions when followed by vowel sounds such as /y/ and /e/. Examples of some words include; /sfɛR/→[fɛ] “spère”, /Rjɛ̃/ →[jɛ] “rien”, /ʒwe/→[we] “jouer”.

- First syllables are deleted at word-initial positions in two- and three-syllable words. Median syllables are deleted in three syllable words. For example, /lepe/→[pe]“lepe”,/lavabo/→[bo]/[labo]/[jabo],/ɛləfənt/→[ɛfa]“elephant”and

/baɪsɪkl/→[bakə] “bicycle”.

- Consonant clusters such as /sw, pR, lj, kt, kl, tR, pj, bl, pw, st, kR, Rj, dr, sp/ are simplified. This is proof that the particpants find it difficult to maneurver some of their articulators from one consonant sound to the next without the presence of a vowel sound. For example in words such as, /swi/→[si] “suis” , /ɛpakt/→[ɛpak] “impact”.
- Gliding is very much common as the liquids /r/ and /l/ and the uvular fricative /R/ are mostly substituted for the glides [w] and [j]. For example /l/ → [w] and /l/ → [j] in words such as; /plɥi/→[pwi] “Pluie”, /plɛ̃/ →[pjɛ]/[pja] “plein”, /r/ → [j] and /r/ → [w] in words such as; /rʌbə/→[wɔba] “rubber”, /zero/→[jɛjo] “zero” and /R/ → [j] and /R/ → [w] in words like; /nuRiR/→[nuwi]/[nuji] “nourrir”, /aRiko/→[jiko]/ [ajiko] “haricot”.
- The findings indicate that voiceless consonants such as, /s, tʃ, k, t, p,/ become voiced /d,g,j/ when they are surrounded by vowels. For example, /ʃapəlɛ/→[zapəlɛ] “chapelais”, /ɔs/→[ɔj] “os”, /sup/→[hup] “soupe”, /ʒyp/→[ʒyb] “jupe”, /sykR/→[tigə] “sucre”.
- The findings indicate that, voiced sounds become voiceless in between vowels, preceded or followed by vowels. This is seen in the general rule below.

$$C \rightarrow \underset{\circ}{C} \;/\; \begin{matrix} V\_\_V \\ \#\_\_V \\ V\_\_\# \end{matrix}$$

- Following the analysis, it is concluded that individuals with ID associated with NDDs with the exception of P1 and P9 (PDD-NOS) denasalize vowels at word position preceded by consonants or in between consonants. For example, in words like, /lwɛ̃/ →[lwɛ] “loin” and /tɑ̃t/→[tɑ] “tante”.

General Rule: $\tilde{V} \rightarrow V \;/\; \begin{matrix} C\_\_\# \\ C\_\_C \end{matrix}$

- Voice disorders were found in only three participants out of the fourteen. Two participants experienced hypernasality (P9 and P14), which affects resonance due to disturbances in the velopharyngeal structures. One participant exhibited dysprosody

(P3), which impacts the rhythmic and melodic aspects of speech. Voice disorders were less prevalent among the research participants.

- Out of the fourteen participants, only one showed signs of a stuttering disorder. P2 exhibited disruptions in the forward flow of speech, including repetitions of sounds and syllables, blockages, and prolongations. The participant often relied on hand gestures to supplement their speech, which requires careful observation of their gestures and facial expressions to better understand their intended message. This study suggests that stuttering is not commonly observed in individuals with intellectual disability (ID) and associated neurodevelopmental disorders (NDDs).
- The study examined two main types of muscle speech disorders: dysarthria and apraxia of speech. Six participants were found to have dysarthria (P6, P11, P8, P10, P13 and P14) while six participants had apraxia of speech (P6, P7, P10, P11, P13 and P14). Interestingly, individuals with ID associated with pervasive developmental disorder, microcephaly, and macrocephaly did not exhibit muscle speech disorders. However, those with ID associated with cerebral palsy (CP) experienced a high prevalence of muscle speech disorders.

Overall, the study's findings support or validate the hypothesis that individuals with ID and associated NDDs encounter speech production problems. These problems include articulation disorders, phonological process disorders, and, to a lesser extent, voice disorders, fluency disorders with muscle speech disorders. The research objectives (1) which had to do with identifying speech production problems in individuals with ID and associated NDDs was met as the researcher was able to bring out the aforementioned speech problems observed in the research participants. The specific speech challenges vary among the individuals and are influenced by factors such as associated NDDs, physical abnormalities, and developmental delays. Understanding these findings can inform speech therapy interventions and highlight the need for targeted support to address the speech production difficulties faced by individuals with ID and associated NDDs.

Impacts of speech production problems on individuals with ID and associated NDDs

Three main negative impact factors are identified. They include; social interaction difficulties, academic difficulties and communication difficulties as discussed below.

Social Interaction Difficulties:

The data collected from six teachers indicated that the participants faced significant challenges in socializing with individuals outside their immediate circle. Their limited speech

production abilities hindered their ability to understand and use complex speech patterns, resulting in limited interaction with the outside world. Many participants remained quiet and were unable to express themselves effectively to others.

Academic Difficulties:

The teachers' testimonies revealed that the participants struggled academically due to their speech problems. Their inability to acquire literacy skills, such as reading and writing, resulted from difficulties in memorizing speech sounds or using them appropriately. Consequently, some teachers shifted their focus from teaching academic skills to training the participants in life skills, such as self- care activities.

Communication Difficulties:

The research participants' poor speech production abilities align with the teachers' observations during the interviews indicate that individuals with ID and associated NDDs face challenges in communicating effectively due to their limited fluency in speech. Their speech production problems heavily influence their overall communication abilities.

These findings underscore the negative consequences of speech production problems on individuals with ID and associated NDDs. This validates the second research hypothesis which stated that speech production problems have negative impacts on individuals with ID and associated NDDs. Hence, the second objective of the study which was to determine the impact of these speech problems in individuals with ID and associated NDDs was met for the difficulties the participants face socially, academically and communicatively were highlighted.

Therapeutic measures to ameliorate speech production in individuals with ID and associated NDDs

The research finding revealed that there are three main therapies employed to ameliorate the speech production of individuals with ID and associated NDDs. These include; articulatory/speech therapy exercises, voice therapy exercises and fluency therapy exercises.

Firstly, articulatory/speech therapies are effective in enabling the children learn how to produce sounds and move their articulators in the manners when producing sounds. This conclusion was drawn from the positive feedbacks the interviewed teachers gave regarding articulatory exercises such as, candle blowing and mirror exercises.

Furthermore, fluency exercises help the children reduce the rate of stuttering when they are producing speech most especially those suffering from sutttering. The breathing exercise is a very useful when it comes to regulating breathing amidst communication.

Lastly, voice therapy though indicated by the interviewed teachers as being slower in the speech ameliorating process, exercises like vocal warm-ups go a long way to enable the children get use to using their vocals. This in tend eases or facilitates speech production for it helps the children familiarize themselves with sounds.

Conclusively, the above findings validate the third research hypothesis which stated that speech and language therapies can be used to ameliorate the speech production prowess of individuals with ID and associated NDDs. Also, the third research objective was met for the finding led to the suggesting of therapeutic measures such as articulatory/speech exercises. Fluency exercises and voice exercises in order to alleviate or lighten speech production problems in individuals with ID and associated NDDs for the above therapies were proven useful and effective by the interviewed teachers.

Recommendation to stakeholders

This section tackles the recommendations to the stakeholders who are central in this work. They include: parents, the society as a whole, educational milieu, and science.

Parents

Parents of children with intellectual disability and associated NDDs should ensure early identification and intervention for speech production problems. This may involve working with healthcare providers, educators, and community organizations to ensure that their child receives appropriate screening and treatment. They should encourage communication with their child, using a variety of methods such as gestures, visual aids, and augmentative and alternative communication (AAC) systems if necessary. They should also seek out resources and support to help their child develop social communication skills. Again, Parents should participate in interventions for speech production problems, working collaboratively with speech therapists and other professionals to support their child's progress. They should also follow through with home-based activities and exercises recommended by the intervention team.

Society

Society as a whole should work to increase awareness and understanding of the impact of speech production problems in individuals with intellectual disability and associated NDDs. This may involve promoting public education campaigns, providing resources and support for

families, and advocating for policies that prioritize the needs of individuals with intellectual disability and associated NDDs. It should work to increase access to interventions for speech production problems, particularly in underserved communities. This may involve advocating for increased funding for healthcare and education, as well as promoting the use of teletherapy and other remote interventions to reach individuals who may not have access to in-person services. It should also promote inclusion of individuals with intellectual disabilities in all aspects of community life, including education, employment, and social activities. This may involve promoting policies that support inclusion and providing resources and support to individuals and families.

Educational milieu

The Educational institutions should provide screening and intervention services for speech production problems, working collaboratively with healthcare providers and families to identify and address speech difficulties early on. Also, educators and support staff should receive training on the unique needs of individuals with ID and associated NDDs and strategies for supporting their communication development. This may include training on AAC systems, visual aids, and other alternative communication methods. Again, they should foster inclusion of individuals with intellectual disabilities in all aspects of school life, including extracurricular activities and social events. They should also work to promote positive attitudes towards individuals with disabilities among all students and staff.

Science

Scientists should work to develop new interventions for speech production problems in individuals with intellectual disability, including the development of new AAC systems, assistive technology, and alternative communication methods. Also, they should disseminate their findings to relevant stakeholders, including families, healthcare providers, educators, and policymakers. They should also work to translate their research into practice, ensuring that interventions are evidence- based and effective.

With the above recommendations, there sure will be better handling of the problem of communication in individuals with ID and associated NDDs.

Difficulties Encountered on The Field

This section tackles some difficulties the researcher encountered while carrying out the research. They include the following.

- Getting the medical records of some participants was not an easy task for some parents were not very open to let the various schools hand them over.
- There was lack of instruments such as spectrograms and others for the researcher to fully assess the speech prowess of the participants leading to a more descriptive approach.
- Difficulty in obtaining language test leading to individualized language test.

Proposals for further Research

This section presents the following directions for further research;

Based on the findings of this study, further research is needed to explore the effectiveness of different speech therapy interventions in individuals with intellectual disability. One proposal for further research is to conduct a randomized controlled trial to compare the effectiveness of different types of interventions, such as those targeting articulation, phonological, muscle speech disorders, and fluency disorders.

Another proposal for further research is to explore specific speech defects in other syndromic cases associated with intellectual disability such as; Fragile X syndrome and William syndrome.

Also, it may be useful to develop assistive communication devices and aids customized for speech production challenges face by individuals with ID and associated NDDs.

Lastly, research on the impact of improved speech production on social skills, behaviour, independence and quality of life for individuals with ID and associated NDDs.

Conclusion

In conclusion, this study highlights the need for speech therapy interventions that are tailored to the specific needs of individuals with intellectual disability. Future research should focus on exploring the effectiveness of different types of interventions, the impact of co-occurring conditions, and different therapy delivery methods to inform more effective and accessible speech therapy interventions.

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Annex I: Observation Checklists

1. Identification

Traits / Participants	Age(s)	Sex	Disability	School	L1
P1					
P2					
P3					
P4					
P5					
P6					
P7					
P8					
P9					
P10					
P11					
P12					
P13					
P14					

II Environmental Data

Difficulties / Participants	Prenatal	natal	Postnatal	Live with both parents
P1				
P2				
P3				
P4				
P5				
P6				
P7				
P8				
P9				
P10				
P11				
P12				
P13				
P14				

III Speech data

Traits / Participants	Short paus es	Long paus es	Hesitation	Violence	Responsive ness	Gestures	cooperation	Friendliness	Articulation
P1									
P2									
P3									
P4									
P5									
P6									
P7									
P8									
P9									
P10									
P11									
P12									
P13									
P14									

IV Language Data

Associated NDDs / Speech Production Problems	PDD-NOS	CP	DS	Macrocephaly	Microcephaly
Articulation Disorders					
Phonological Disorders					
Voice Disorders					
Fluency Disorders					
Muscle Speech Disorders					

V Adaptive Behaviour Assessment

Adaptive Skills / Participants	Literacy	Understanding time	Understanding money	Social Judgement	Gullibility	Social Norms	Self-Care	Occupational Skills	Safety Skills
P1									
P2									
P3									
P4									
P5									
P6									
P7									
P8									
P9									
P10									
P11									
P12									
P13									
P14									

ANNEX II: Interview Questions to Teachers

- How can you describe your pupils' social life?
- How are their interactions with outsider?
- Do you understand them when they are talking?
- How does speech problems affect their academic performance?
- How well do they understand lectures?
- Do you think the children are good at communicating?
- What are some measures put in place by the school in order to help these children in terms of learning?
- What are some therapies you do to help them speak well?
- How effective are the therapeutic exercises?
- Do your teaching methods help improve their performance?
- With your experience can you say the children get better over the years?

ANNEX III: Language Test

ADs

French gloss	English gloss	French gloss	English gloss
Avec	fine	publique	biscuit
Après	spin	valeur	sugar
escalier	stick	bonjour	give
Sphère	pork	lapin	juice
Plat	drink	lundi	sing
Nuage	bread	répète	child
Suis	apple	montagne	rubber
Ligne	brush	pousse	catch
chapelais	write	Chaussure	whistle
Bisou	fish	banane	zebra
Aussi	yes	douze	
Zero			

FDs

French gloss
non
oui
pain
pied
policier
répète
tableau
salade
déficit
cabinet

PDs

French gloss	English gloss	French gloss	English Gloss	French Gloss	English gloss	French gloss	French gloss
abeille	soup	spère	Spoon	Lepe	sit	suis	chapelais
avec	pencil	nuage	Spat	Otage	fish	Proper	attacher
répète	bread	stress	Scope	Salade	cook	prier	jupe
jupe	voice	stylo	Smell	Colere	fire	atelier	tambour
encore	face	rien	Sweep	Cadeau	light	impact	sucre
lac	ball	trop	bicycle	Quitter	salt	classe	soupe
tornade	brush	lègume	elephant	Déficit	whistle	travail	Chanter
femme	rubber	jouer	telephone	Nourriture	apple	pied	stress
reine	zero	magasin	Dress	Parasol	happy	sable	os
tranquille	very	lavabo	Spin	Riz		poison	pantalon
massage	child	pharmacie	Stress	Tèle		Pluie	partir
montagne	shoe	comprendre	million	Plein		répète	crayon
fils	office	orange	Stylo	Laver		nourrir	trop
haricot		rire		Laide		ballon	rien
Dire		maladie		Chocolat		journée	égale
église		mondial		Vie		douze	chaise
Joseph		aller		Poison		serpent	loin
lèvre		visage				maison	pain
visage							
tambour							
tante							

VDs

French gloss	French gloss	French gloss
bonjour	Bonjour	oui
aussi	Banana	lion
encore	Rien	laide
voler	Maison	manger
poisson	Travail	dormir
nièce	Dormir	riz
fendre	chapelais	amis
poule	Café	sauter
descendre	Repète	serpent

MSDs

French gloss	English gloss	French gloss
manger	Finger	lavabo
igname	Spoon	legume
montagne	Medicine	zero
oignon	Sheep	mignon
jouer	Picture	mot
lendemain	Visage	chaussure
Bonjour	Cousin	léonard
parler	Sister	
lampe	Music	