PHONOTACTICS OF AUTISTIC CHILDREN IN LAGOS STATE, NIGERIA

BY;

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CERTIFICATION

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DEDICATION

To the Glory of God and for the service of humanity!

Dad, I wish I could see the pride on your face one more time. This is for you.

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First to God, the author of life, for the strength and grace to commence and complete this work; Father, without Him, I am nothing. All that I am, all that I own, and all that I will ever be, I surrender everything at His feet. A billion tongues are not enough to give Him thanks.

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ABSTRACT

Phonotactics, which accounts for sound patterning, is affected by language regression in children with autism. Existing linguistic studies on autism in Nigeria focused mainly on general description of the disorder and developmental challenges. However, little attention was devoted to systematic description of their phonological patterns. Therefore, this study was designed to examine the speech production of autistic children in Lagos State, Nigeria, with a view to describing the phonological processes involved in the production of phonemes and syllables and the constraint ranking responsible for them.

Alan Prince and Paul Smolensky's Optimality Theory served as the framework, while the descriptive design was adopted. The convenience sampling technique was employed to select four special-needs facilities in three local government areas (Amuwo-odofin, Badagry, and Ikeja) of Lagos State. Availability of and accessibility to relevant data necessitated the selection of the facilities. Twenty-four children with autism under the age of 17 years (Amuwo-odofin: 17, Badagry: 2, and Ikeja: 5) accessing the facilities were purposively selected. Speeches of the participants were audio-recorded twice a week for two years. The data were subjected to phonological and acoustic analyses.

Three phonological processes were dominant: deletion, substitution and epenthesis. Vowels were generally modified. Deletion was dominant in the rendition of consonants, with the lateral sound /l/ mostly affected. Substitution and epenthesis affected mainly vowels. Central vowels /ʌ, ɜ, ə/ were strengthened and /ɔ/, /e/, /æ/ were used for each, respectively. Epenthesis was prominent in the realisation of vocalic phonemes, with /ɪ/ and /ə/ substituted as /i:/ and /æ/, respectively. It was also dominant in the articulation of triphthongs /eɪə/ and /ɔɪə/. Monophthongs were either retained or substituted with long or strong vowels. Diphthongs were monophthongised or substituted with stronger versions. Triphthongs were either substituted with diphthongs or epenthesised with an intrusive /j/, creating disyllabic sounds. With regard to syllables, simple onsets were produced comfortably more than complex onsets, while both simple and complex codas were deleted, reduced or produced with great difficulty. Constraint ranking favoured markedness over faithfulness. The constraints responsible for vowels were *SCHWA, NOCODA, NODIPH and *HIATUS. *COMPLEX ONSET and *COMPLEX CODA were the markedness constraints accountable for the simplified outcome of complex onsets, complex codas, open and closed syllables. *HIATUS was ranked above MAX-V for the emergence of minimum syllables. Consonant clusters, especially at coda positions, were reduced or rendered open, as *COMPLEX CODA was preferred above MAX. There were inconsistencies in the intensity values. The values were either abnormally high (73.94dB) or low (52. 89dB). Against a threshold of 63.42dB, their pitch values were either extremely high or low.

The phonotactics of autistic children in Lagos State, Nigeria is characterised by simplification of difficult phonemes and syllables through deployment of deletion, substitution and epenthesis. Therefore, multidisciplinary therapists should be employed to improve the treatment and rehabilitation of autistic children.

Keywords: Phonotactics, Phonological processes, Syllabic structure, Nigerian autistic children

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CHAPTER ONE
INTRODUCTION

1.1 Background to the study

Communication between typical and atypical language users can be challenging because of the speech impairments that characterise the latter. These impairments characterise atypical conditions such as dyslexia, Down syndrome, and autisms, and help to detect the conditions. In developing countries, however, this linguistic basis for diagnosis is underexplored, especially for autism. The possibility that communication challenges, particularly phonological impairments, suggest the earliest indicators of autism, as well as other atypical conditions, is ignored in these parts of the world (Tager-Flusberg, 2005). These language indices are a major criterion for autism detection in children because unlike other conditions, autism is not associated with any physical deformity or feature detectable by the eyes (Loftus, 2021).

Autism spectrum disorder (ASD) can be detected in children through their communication regression because the level of language competence attained before eighteen months is often suddenly lost or greatly reduced. This language regression is also often accompanied by social, developmental, and behavioural uncertainties (Lord, Shulman & DiLavore, 2004). Bhandari (2019) states that ASD is a lifelong condition which is usually diagnosed in younger children between 18 months and 3 years in most developed countries and can be managed by medication, education, therapy, and alternate medication. Otherwise, language development and competence in autism would be marked with difficulty, unlike that of a typically developing child (TDC) which it can be measured against (Kwok, Brown, Smyth & Cardy, 2015; Nordgren, 2020).

Therefore, language is central to identifying and understanding autism and, although this knowledge has not prompted enough related research in the field of linguistics, numerous studies have been carried out in several other fields to understand this condition better. Thus, there is a need for more language-oriented investigations of this phenomenon so as to engender more wholesome studies.

Moreover, there is a relatively low knowledge and awareness level about autism among medical personnel, health workers, parents and guardians in developing countries, unlike the advanced information, sophisticated medication, treatments, therapies, and case management techniques that have been developed for autistic and other atypically developing patients over time in developed nations (Bakare, Ebigbo, Agomoh & Menkiti, 2008; Igwe, Ahanotu, Bakare, Anchor & Igwe, 2011; Bakare, Tunde-Ayindmode, Adewuya, Bello-Mojeed, Sale, James, Yunusa, Obindo, Igwe, Odinka, Okafo, Oshodi, Okonoda, Munir & Orovwigho, 2015; Adeosun, Enye, Ayorinde, Ogundele & Adewole, 2017). In these advanced nations, professionals like medical doctors, psychologists, speech therapists, physiotherapists, and special educators are readily available to assess, diagnose, and develop an individualised educational plan for each child with ASD (Nwokolo, 2010; Alli, 2019). Apart from the fact that this level of advancement is unavailable in Nigeria, Nwokolo (2010) also notes that there are many undiagnosed children affected by autism in Nigeria but who are labelled imbeciles, fools, and even witches. As a result, these children do not benefit from the treatment available in hospitals.

Wolk, Edward, and Brenan (2016) suggest that there are about 600,000 autistic people in Nigeria, and Guaranty Trust Bank Orange Ribbon Initiative (2015) report that the number has increased to over 1 million known cases. World Health Organisation (2018) report that there may be 1 case of autism in every 125 children born in Nigeria and this brings the estimated number of autistic children to 662,400 children in a population of 180 million, with 46% below fifteen years (UNICEF- United Nations Children's Fund, 2021). The figure is not commensurate to the number of autistic children registered in special schools around the country, where customised education is being received.

Considering the above, there is a need for a higher rate of autism diagnosis among Nigerian children, as well as an application of the resources of language to benefit autistic children as early as possible. Specifically, phonological studies can assist autistic detection because it covers the intricacies of speech sound production, profiling of speech sounds and syllabic structure which are central to autism diagnosis. This research investigates the sequence of sounds in the utterances of autistic children.

1. 2 Statement of the problem

Studies in language and autism are so limited that Boucher and Anns (2018) assert that significant clinical language impairments in ASD are under-researched. Being a relatively common developmental disorder, lack of thorough research in this area exposes it to speculative interpretation which may be misleading. Hence, there is an urgent need to focus on expanding the literature on ASD diagnosis and intervention in developing countries, particularly, Nigeria.

It is worthy of note that language regression is a major factor for detecting and understanding autism in children (Lord, Shulman & DiLavore, 2004) and there is a relatively low knowledge of, and response to autism in Nigeria (Bakare et al., 2008; Igwe et al., 2011; Bakare et al., 2015; Adeosun et al., 2017). Although remarkable language studies have been carried out on language use by autistic people (Tager-Flusberg, 2006; Schoen, Paul & Chawarska, 2011; Nwanze, 2013; Akinmurele, 2019), only a few focused on phonology (Ojo, 2012; Esan, 2018). Most studies on phonological descriptions of atypical language users have focused mainly on monolingual speakers of English or other foreign languages from advanced countries. Examples of such studies include Luce and Large (2001), Leonard, Davis and Deevy (2007), Yu, Abrego-Collier, and Sondergger (2013), An, Brizan, Morales, Syed and Rosenberg (2015), Nordgren (2015), Boucher and Anns (2018), and Synder, Cohn and Zellou (2019). The few studies that focused on autistic phonology in Nigeria (Ojo, 2012; Nwanze, 2013; Esan, 2018) carried out these investigations mostly from the perspective of adults and did not focus on the word construction level of the participants, where their phonotactics can be generated.

Also, a few existing studies on phonotactics are on educated users of English in Nigeria (Soneye and Faleye, 2015); others exist on second languages (Mbah & David, 2013; Unubi & Ikani, 2018). The phonological aspect is considered to be relevant because it covers speech sounds production and the way these sounds are strung together to make syllables and words. Thus, the phonotactics of language as spoken by autistic children can help to establish a phonological system. Therefore, there is a need to carry out a phonological study of Nigerian autistic children’s English, particularly those who are still undergoing the language acquisition process. This is for the purpose of establishing the phonotactics of English as used by autistic children in Nigeria, thus providing a phonological profile of their speech and aiding higher rates of diagnosis and intervention in Nigeria.

1.3 Aim and objectives

The aim of this study was to establish the sequence of sounds in the utterances of English-speaking autistic children in Lagos State, Nigeria. The objectives were to:

i. describe the phoneme sequences employed in autistics' utterances,
ii. establish the patterns of consonant clusters,
iii. identify the structure of their syllable,
iv. determine the constraints responsible for these patterns, and
v. investigate the impact of intervention on their phonotactics.

1.4 Scope of the study

The focus of this research is autistic children's spoken English, with specific attention to their phonotactics. Twenty-four English-speaking autistic Nigerian children with varying degrees of language competence and at different levels of intervention constituted the sample population. The study covers their vowels and consonant renditions at initial, medial, and final positions. It also considers consonant clusters at onset and coda positions, and syllabic structures including the English syllabic structure C^{0-3} V C^{0-4} and monosyllabic and polysyllabic words.

1.5 Significance of the study

By investigating the phonology of this population, this study helps to provide enlightenment on the description of the sound patterns and syllabic structures of autistics' phonology. Also, the study contributes to the literature on the phonology of special needs population in Nigeria which is also useful for medical personnel, clinicians and special educators, as well as speech pathologists and therapists concerned with ASD. Additionally, specialists like neurologists, psychologists and others concerned with diagnosing the disorder will be more informed about the language peculiarities of autistic children and diagnosed people; thus, this study will improve diagnoses and intervention.

To a greater degree, the findings of this study will arm special educators with the relevant information to develop a much more comprehensive lesson plan with achievable aims and objectives that have tangible and measurable results. In addition to this, having established the scarcity of literature in the phonotactics of special needs people in Nigeria, this study will indeed be a springboard for upcoming researchers in this field.

The social implications of this study are that it will aid intelligibility between ASD and typical language users in the society where they are found, thus, bridging the communication gap and breakdown between typical language users and ASD speakers. This will further aid the integration of ASD patients into different spheres of the society without side-lining or stigmatising them as the norm still is today. Moreover, this will aid the standardisation of Nigerian English status which will have an aspect of ASD phonology catered for.

Finally, this research will contribute to the existing literature on autistic children's spoken English phonology. It will aid the language profiling of autistic children's phonology of English, thus, creating a template of what to expect in the language of an autistic Nigerian child. Also, this study will be a guide to medical practitioners, parents and teachers for detecting autism much earlier in children.

1.6 Summary

This chapter presented the introductory aspects of the study. It contained the objectives, the scope and the significance of the study. The next chapter focuses on the review of relevant conceptual and empirical literature to the study.

CHAPTER TWO

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.0 Preamble

This chapter explores relevant conceptual and empirical literature available on autism, syllabic structure, phonology of atypical people and phonotactics studies. The chapter also covers related topics to the present study as well as the theoretical framework engaged in this study.

2.1 Review of relevant studies

This section examines relevant literature to the study and they are presented under the following sub-headings below.

2.1.1 Autism

Autism spectrum disorder (ASD) is a neurological condition which mostly interferes with communication, language, social and developmental behaviour. It is a psychiatric disorder which is characterised by trouble with social interaction, restricted interests, repetitive behaviour and others as particular to each autistic person. Autism is a lifelong condition which is usually diagnosed in younger children within the ages of 18 months and 3 years in most developed countries and can be managed by medication, education, therapy, and alternate medication (Bhandari, 2019).

Associated with medical and mental health issues, ASD can have a wide-ranging impact on the body. More than half of an estimated 30-61% of autistic children are affected with one or more chronic sleep challenges (Mazurek & Petroski, 2015). Anxiety disorders are thought to affect approximately 11-40% of ASD children, while depression affects an estimated 7% of autistic children. Up to 26% of adults with ASD are likely to suffer 8 times more from one or more chronic gastrointestinal disorders than other children. Furthermore, about one-third of ASD children suffer from epilepsy (Alli, 2019). Autism-associated health problems extend across a person's life span, from childhood to old age. There are medications to help manage autism, however, Risperidone and Aripiprazole are the only medications approved by Food and Drug Administration (FDA) for assisting agitation and irritation in ASD people.

2.1.1.1 Brief history of autism spectrum disorder

Autism was first referred to as a range of neuro-psychological conditions in the early 1900s. The term was got from a Greek word, "autos" which means "self" and which describes a condition in which a person is removed from social interaction and becomes isolated. Researchers from the United States of America began to use the term "autism" in the 1940s to describe emotional or social problems in children though the term itself was first used by Eugene Bleuler, a German psychiatrist in 1906. Asperger's syndrome was also adopted around the same period to describe similar conditions in Germany. In the 1960s, however, professionals began to separate the understanding of autism from schizophrenia. Before then, early researchers had linked autism to schizophrenia (Wolff, 2004; Evans, 2013; Zeldovich, 2018).

The 1960s and 1970s witnessed the search for cure, treatments, and medications; as such, some experimental and sometimes extreme measures were taken to cause a behavioural change, these measures relied on pain and punishment. In the 1980s and 1990s, therapy was introduced and the use of higher controlled learning environments emerged as the primary treatment of autism and related conditions. Today, behavioural therapy and educational interventions remain the approved FDA mainstays of treatment for autism. As of June, 2021, FDA has approved a device for diagnosing. Other treatments are added as needed (Evans, 2013; FDA, 2021; Pathak, 2021).

2.1.1.2 Prevalence of autism

According to Centers for Disease Control and Prevention (2018), autism is said to affect an estimate of 1 in 59 children in the United States, and 4 in every 5 affected, are said to be boys. In 2018, it was determined that 1 in every 59 children was diagnosed with ASD and among every 151 autistics, 1 is a girl, while 37 are boys; indicating that boys are more likely to be diagnosed with ASD than girls. The reasons for this are still unknown. Contrarily, in a study conducted by Chinawa, Manyike, Aniwada, Chinawa, Obu, Odetunde, Nwokocha and Ibekwe (2016), they discovered that there are no gender differences in the cases studied. Ahmed, Ahmed, Baba, Legbo, Nauzo, Omar, and Tahir (2019) contradicted earlier research, stating that more females were affected by the disorder than their male counterparts, however, they stated that a possible reason for this finding could be the setting of the research.

According to GTBORI (2015), there are about a million cases of autism in Nigeria today. This number is still uncertified because UNICEF (2021) claims that there is at least 1 case of autism in every 125 births in Nigeria. Many are yet to be diagnosed as a result of ignorance and some other reasons. Nwokolo (2010) submits that there are also some misgivings about ASD, for instance, it was misconstrued to be a "Whiteman" disease, and later, it was perceived to be the sickness of the rich. Nwokolo (2010) and some other studies refuted these claims, correcting the misgivings. Regarding the misconception of ASD being a "Whiteman" disease, this was as a result of advanced research in advanced countries, whereas none whatsoever existed in developing countries, and about ASD being a sickness of the rich, the high cost of diagnosis and intervention was such that only the rich could afford it. Thus, these reasons birthed the misconceptions, however, studies have shown that ASD can affect all ethnic and socioeconomic groups and early intervention provides the best opportunity to promote a healthy development and discover benefits that can last a lifetime. Also, early intervention is very important because there is no cure yet, the condition can only be managed.

2.1.1.3 Characteristics and types of autism

Autism spectrum disorder (ASD) is a broad range of disorders characterised by difficulties with social skills, repetitive behaviours, speech and nonverbal communication. As a spectrum disorder, each autistic challenge varies from highly skilled, mildly to severely challenged, and affected people may require from significant to lesser support in their daily lives, while for some others, in a few cases, live entirely independently.

Because of the broad spectrum disorders that variously differ from one autistic to the other, all ranges of autism now fall under the term autism spectrum disorders (ASD). It is worthy of note that irrespective of the social type of autism, communication impairment is common to them. In 2013, the American Psychiatric Association (APA) combined four distinct Autism diagnoses under ASD. These diagnoses are autistic disorder, childhood disintegrative disorder, pervasive developmental disorder and Asperger's syndrome according to Diagnostic by Statistical Manual of Mental Disorders IV (DSM-4).

1. Autistic Disorder: This is the most common and is characterised by social interactions, communication and imaginative play in children younger than 3 years. It is the severe kind along the spectrum disorder.
2. Childhood Disintegrative Disorder: These children develop normally for at least 2 years and then lose some or most of their communication and social skills. This is an extremely rare disorder and its existence as a separate condition is a matter of debate among many mental health professionals.
3. Pervasive Developmental Disorder (PPD) is also known as typical autism. This is a type of catch-all category for children who have some autistic behaviour but who do not fit into other categories. PDD is not as severe as autistic disorder, neither is it as mild as Asperger's, it is therefore tagged Moderate along the spectrum.
4. Asperger's syndrome: Children with Asperger's syndrome do not have language impairments; in fact, they typically perform averagely or above the average limit on their intelligent test results. Nonetheless, they share the same social issues and narrow interests as children with autistic disorder. Their typical to strong verbal language skills and intellectual ability distinguish them from the other forms of autism and they are considered Mild on the spectrum.

Recently, however, autistic disorder, pervasive developmental disorder, and Asperger's syndrome have become popular as some researchers have shown that delayed language and loss of language characterise other autistic types and so should not be the characteristic of a subtype. Some special schools in Nigeria still identify affected children by these subtypes, while others have adjusted to grouping them according to their level of severity, that is, mild, moderate or severe autism.

In accordance to Diagnostic by Statistical Manual of Mental Disorders V (DSM-5) classification of autism, it is safer to identify affected population in levels – levels 1 – 3, where 1 is mildly impaired; 2 is moderately impaired and 3 is severely impaired. These different levels need assistance accordingly. This is because when early intervention is introduced to autistics, the severity of the disorder tends to become moderate and even mild, such that they could be adopted into mainstream education and compete with typically developing children as they grow. The DSM-5 classification of autism has been adopted for this work.

As stated by Wing (1981), three main diagnostic features of ASD are identifiable based strictly on behaviour known as Wing's triad: lack of social responsiveness, compulsive, ritualistic behaviour and impaired communication, and language skill. The diagnostic criteria related to language are lack of, or late development of language without any attempt to compensate with gestures, impairment in the ability to initiate or sustain conversation and stereotypical, repetitive, and idiosyncratic language.

However, it is worthy of note that the severity of the disorder can be categorised based on the various diagnostic features of Wing's triad. It is possible for a child to be severe in one feature and be moderate or even mild, in the others. The level of severity adopted for this work is strictly in relation to language and communication. Hence, a child categorised as mild in this study (language), may be moderate or even severe in social or behavioural development.

2.1.1.4 Facial features of autistic people

Some arguments about autism being identifiable by some facial features have mandated this subject to be re-examined. There might be physical facial features similar to autistics but these are not palpable to the human eye without the use of advanced technology with specialised equipment to detect these features. Aldridge, George, Cole, Austin, Takahachi, Duan, and Miles (2011) applied the use of a high technology, stereophotogrammetric, to mark the facial characteristics in 65 pre-pubertal boys from different subgroups of autism. They found that the distance between the eyes and the nose or the nose to the mouth is slightly shorter than those of 45 typically developing children. This information cannot be detected by merely looking at those affected with the disorder and there is no indication if it is the same in pre-pubertal girls with ASD as well. The findings were sustained in another study by Gilani, Tan, Russell-Smith, Maybery, Mian, Eastwood, Shafait, Goonewardene, and Whitehouse (2017).

In a follow-up study by Tan, Gilani, Maybery, Mark and Whitehouse (2017), it was discovered that autistics had lesser muscular features in their facial makeup. Both the boys and the girls tend to have plumper facial features than their typically developing counterparts. Still, these findings are not very satisfactory to parents and guardians of affected children because these features are not distinct enough to eradicate doubts (Loftus, 2021). These parents believe that people would have been easier on their children if their conditions and struggles were immediately visible.

2.1.1.5 Challenges of autism

As part of the challenges encountered by the population of autistic people, it has been estimated that one-third of them are non-verbal, while 31% of them have intellectual disability with significant challenges in their daily functions (Tager-Flusberg & Kasari 2013); they are faced with bullying and about 28% are reputed to be self-injurious. In consonance with a report submitted by National Autism Association (2014), drowning remains the leading cause of death among them, as 80% of deaths are associated with wanderings and bolting by those younger than 14 years. They are mostly marked by difficulty to interact socially, restricted interests, sameness of activity, and they are hypersensitive to lights, sounds, tastes, and so on. Also, they exhibit difficulty in corresponding conversation and nonverbal conversation skills such as distance, loudness, tone, and so on (Edward-Elmhurst, 2022). Their movements are uncoordinated and clumsy, and they suffer anxiety and depression. With early diagnosis and intervention, many are able to overcome some or most of these challenges.

2.1.1.6 Causes of autism

Although there are no known causes for ASD, some researchers have identified some of the contributing factors that could influence the presence of the disorder in a carrier.

i. Some genetic factors that contribute to the disorder are largely present in some families which increase the risk that a child born in that family may develop autism. These genes in themselves do not cause autism but contribute to the chances of the disorder (Chaste & Leboyer, 2012).

ii. Children born to older parents may have increased risks of developing ASD (Deweerdt, 2020).

iii. Parents who already have a child with ASD have a 2 to 18% chance of having a second child who is also affected (Meyer, 2013).

iv. Studies have shown that among identical twins, the chances of the other developing the disorder when one has autism is about 36 to 95% and there is a 31% chance in non-identical twins (Frazier, Thompson, Youngstrom, Law, Hardan, Eng & Morris, 2014).

v. The notion of childhood vaccination being a contributing factor to ASD is false (Nwokolo, 2010).

vi. Other contributing factors may include advanced age of either or both parents, complications during pregnancy or at birth, such as extreme prematurity, low birth weight, multiple pregnancies, and pregnancies spaced less than a year apart.

2.1.1.7 Language in autism

Siegal and Blades (2003) submit that autism is characterised by varying degrees of disorders in language, communication, and imagination. It has disproportionate language impairment that requires further investigation. Tager-Flusberg and Joseph (2003) aver that low intelligence quotient is consistent with the evidence that the level of language ability which is linked to the severity of autism correlates with lack of communication and reciprocal social interaction that is symptomatic of autism. Many ASD carriers share characteristics of children without ASD but have specific language impairment (SLI), in that although both have similar grammatical errors, ASD communication has more interest in objects than in people.

According to American Psychological Association (1994), issues affecting autism are abnormal language, atypical intonation, vocal quality, idiosyncratic use of words and stereotypical phrases, echolalia and pronoun reversal. Because of the versatility of language behavioural display in autistics, Tager-Flusberg and Cooper (1999) suggest that autism cannot be defined by any individual language phenotype. Tager-Flusberg and Joseph (2003) further submit that language investigation can be more homogenous within a particular subtype population of ASD.

Generally, from year 1, young children with autism are less responsive to their names or their mother's voice. They usually acquire some words at 12-18 months, and then lose them in what Lord et al. (2004) describe as 'language regression'. During this time, the child does not learn new words and they fail to engage in communicative routines which they may have been participating in before. They also experience loss of social skills. At age 2, they have the expressive and receptive competence of a typical 9-month old baby and exhibit severe delay in language development. This delay continues till age 5. From then, Tager-Flusberg (2001) notes that there is often a significant correlation between intelligence quotient and language outcomes, although higher levels of nonverbal intelligence quotient IQ are not always associated with a higher level of language skills. Their level of language improvement can be related to their social relations and background in late adolescence. Paul and Cohen (1984) submit that, all through adolescence and adulthood, comprehensive and expressive abilities continue to improve in ASD carriers and the latter shows greater improvement rates. Cantwell and Baker (1989) say that ASD adult carriers show substantial improvements in formal aspects of language but are deficit in receptive language skill which becomes more severe than it was at adolescence or in early childhood. Tager-Flusberg (2005) concludes that there is some optimism for children who receive early diagnosis and access to intensive intervention, especially in language and communication skills.

2.1.1.8 Language behaviours among subtypes

Pervasive developmental disorders profile children with a milder form of ASD and might reveal lesser impairments because carriers tend to have better developed language skills and lower levels of developmental delays. Chawarska and Shic (2009) and Streiner et al. (2016) report that the social identification of ASD appears from the age of 2; this social identification ranges from limited to declining interest in the social world. Carriers have a limited interest in social face-to-face interactions and they seek physical comfort in their parents. They respond infrequently to being called for social interaction, and do not return a social smile. They exhibit poor facial gestures including eye contact, and their affective expressions and gaze cues are unrelated to the activities of others.

Asperger's syndrome is not mostly characterised by lack of language delays and cognition but by marked social deficits. Carriers may possess a slower ability to interpret or understand verbal and non-verbal language, such as gestures, tone of voice and lack of social skills themselves (Tager-Flusberg & Kasari, 2013). Its existence suggests that even though abnormalities in communication are a core feature of pervasive developmental disorders, slower language acquisition is not sufficient for a conclusive diagnosis within the spectrum disorders associated with autism, however, other aspects of language such as comprehension may be indicative.

Paul, Shriberg, Black and Santen (2011) note that delayed vocalisations appear very early in ASD and may be the first indication of ASD. By the end of the second year, deficit in understanding other people’s gestures and verbal communication or the inability to initiate communicative acts become very pronounced. The ability to understand and respond to language is often more impaired than the ability to produce speech sounds (Chawarska & Shic, 2009; Ellis, Venker, McDuffie & Abbeduto, 2012). Toddlers with ASD direct their vocalisations to others less frequently and show atypical intonation in their speech (Brian, Bryson, Zwaigenbaum, McDermott & Rombough, 2008). Streiner (2016) continues that, gestures such as pointing, showing or giving objects for the purpose of sharing interests or making requests are absent; hence, these characteristics differentiate ASD from other language delays without disability. The unusual linguistic features in ASD include echolalia and scripting, that is verbatim repetition. Other features include repetition of utterances and phrases previously heard from books, movies, and other sources and abnormal pitch or intonation becoming apparent (Schoen et al. 2016).

2.1.1.9 Autism in Nigeria

According to Nwokolo (2010), the first mention of autism in Nigeria can be traced to 1943 when children with ASD were thought to be mentally retarded, deprived of maternal affection and the condition was thought to be spiritual. Unfortunately, many years after, this is still the norm in most rural communities where there are poor healthcare systems. People living with autism are thought to be possessed or evil. The level of awareness as to the nature of the condition is pathetically low, even within the medical community and it affects the social interaction and language development of autistic people in Nigeria (Bakare et al., 2008; Igwe et al., 2011; Ojo, 2012; Bakare et al., 2015; Adeosun et al., 2017).

Many children are undiagnosed or misdiagnosed, hidden at home or labelled as mentally ill, deaf and dumb, or in other cases, they end up on the streets tagged as insane. However, this is not the case in advanced countries, where a multidisciplinary team is available to assess, diagnose and develop an individualised educational plan for each child with autism. Exorcism seems to be the most common treatment in Nigeria. The prevalent ignorance about ASD in the Nigerian society affects the country to such an extent that mothers are blamed for their children's autism. They are stigmatised and discriminated against even within the medical community, where such has gone for help. Other issues are the lack of welfare programmes to cater for carriers, the absence of governmental funding for special needs and very poor educational plan. Mostly, parents are left to cater to their affected children on their own. Only a few affluent ones are able to afford the best management and remedy for their wards (Falodun, 2021).

Currently, a handful of special needs schools have been established in some parts of the country to cater for autistics and other atypical children at a price that is unaffordable by the poor. Some of the coordinators of such places are not fully trained, while some of them are self-motivated parents, educators and medical personnel who started the school as a means to cater for their own atypical children. Falodun (2021) submits that the problems that still characterise the autism situation in Nigeria include delayed diagnosis due to parents and medical personnel's lack of knowledge about ASD, inadequately trained personnel, dearth of adequately trained personnel, lack of health facilities, and financial obstacles.

Another major problem of autism in Nigeria is the lack of information about the actual number of autistic population because there is yet to be any exercise to discover the actual number of cases across the states. What exists are sectional studies of prevalence in some parts of Nigeria such as Ojo (2012) and Adeosun et al. (2017) from south-western Nigeria; Chinwa et al. (2016) from south-east; and Ahmed et al. (2018) from north-east Nigeria. These do not give a holistic view of what the autistic population in Nigeria is, as the studies were not homogenously carried out. There is a need for a larger research in which every state in the country will be represented in order to get a better idea of the ASD population in Nigeria. Nwokolo (2010) concludes that there are still so many cases of undiagnosed children with ASD in Nigeria today and even those that have been diagnosed do not enjoy adequate care. There is a need for the government to include the welfare and funding of atypical children in their policies as many still rely on aids and funds from international communities like USAID, UNICEF, and UN which are barely adequate and mostly misappropriated.

2.1.1.10 Intervention in Autism

Intervention is the action taken to improve a medical condition or disorder. With so much emphasis laid on the benefits of intervention, there has been much optimism and advocacy for early diagnosis and intensive intervention as being the basic means of improving and managing ASD over the years; thus, this has made it necessary to examine intervention in this study. The main goal for early diagnosis is to provide optimal strategies for facilitating the child's development and optimise short and long term outcomes. There are numerous studies that report the effectiveness of early intervention on preschool children (Golan and Baron-Cohen et al. 2006). Current Best Practices (CBP) of the National Research Council (2001) suggest that programmes should begin early, as soon as the child is diagnosed and that these programmes should be individualised to each child’s needs. Additionally, they must be intensive and comprehensive, with a minimum of 25 hours per week, addressing various areas of developmental needs, such as parent education and training. Furthermore, there should be a database for keeping the records of the child’s progress (Woods & Weatherby, 2003).

Goldstein (2002) avers that non-speakers within the autistic population are decreasing with the prevalence of early intervention. This is reiterated by Tager-Flusberg (2005) who says that the proportion of children with ASD who fail to acquire functional language is diminishing; the increase in diagnosis equals an increase in improvement through intervention. Myles (2002) submits that written materials have been shown to provide a helpful medium of intervention for ASD which helps to increase communicative and social behaviour. Bakare et al. (2008) and Bakare et al. (2011) further state that early diagnosis and intervention have been known to improve prognosis in children with ASD. Therefore, late presentation for diagnosis leads to late intervention.

In Nigeria, children averaged eight years old are diagnosed with ASD due to low levels of knowledge and awareness about the disorder, and this in turn affects intelligibility because early diagnosis and intervention aid speech and language development. Therefore, it is of utmost importance to diagnose and intervene early for an improved quality of life. Most popular and available special needs intervention services in Nigeria are accessed at prices which are mostly affordable only by the rich in the country. Most popular among the services rendered in the country are Behavioural, Speech and Educational therapies/services. However, the following services are proposed by the Autism Speakers Resource Guide (2019) among others.

1. Cognitive behavioural therapy can help to address anxiety and other unwanted personal behaviours that challenge affected children.
2. Social skills training classes can help to understand conversational skills and social cues in order to aid better social interaction in public.
3. Speech therapy can help with voice control to effectively improve communication and interaction skills. This will encourage improved social skills in communication and language development.
4. Occupational therapy can improve coordination. The therapy is useful for building up coordination skills which should match their levels of need.

5. Physical therapy helps to create activities that will encourage exercises. These exercises will aid good posture and balance, and will develop motor control in games or sporting activities.
6. Psychoactive medicines help to manage associated anxiety, depression and attention deficit and hyperactivity disorder (ADHD).
7. Training for parents, guardians and service providers is a crucial aspect of management that cannot be overlooked. Everyone who wants to handle an autistic child must be armed with the necessary skills to assist people living with autism and other special needs.

2.1.2 Phonotactics

Phonotactics is the study of the rules governing the possible phoneme sequences in a language. The word is formed from a Greek word 'phone' which means sound or voice, and 'tacticos' which has to do with arrangement. It is the part of phonology that restricts the possible sound sequences and syllable structures in a language. Syllables cover onsets, codas and nucleus. The syllabic structure of English is (C^{0-3}) V (C^{0-4}), where C^{0-3} and C^{0-4} are the optional elements and V is mandatory (Crystal, 2003; Roach, 2010; Yule, 2010; Osisanwo, 2012).

Furthermore, phonotactics is concerned with the rules and constraints that govern a language. In English, some sounds do not begin a word or syllable and some other sounds do not end a word or syllable either. For example, /ʒ, ŋ/ do not begin a word and /h/ is not accepted at the final position of a word. The rare example of *genre* that begins with /ʒ/ in English is a loan word. Even though English allows C^{0-3} and C^{0-4} to cluster at initial and final positions, respectively, it restricts the choice of phonemes allowed to occupy those positions and sonority constraints must be applied on the choice of phonemes combined. For instance, at the onset position, mainly stops, fricatives or glides, liquids or voiceless stops, nasal + voiceless stops + liquid, glide can occupy this position, while at the coda position, nasals may precede voiceless plosives, but only if they share the same place of articulation as we have in words like *jump* /ʤʌmp/, *stunt* /stʌnt/, and *stink* /stiŋk/ (Cystal, 2003; Bailey & Hahn, 2005).

According to Gaygen (1997), prohibited sound sequences may occur for different reasons including borrowing from other languages. For example, *Tsunami* is realised as /sunæmi/ (for non-Japanese speakers) or /tsunæmi/ for Japanese speakers. Also, putting prefixes and words together may bring about prohibited sequences. For example, ‘sts’ in *posts*, and ‘stst’ in *textstore*. The following phonological processes have been found to be employed in treating sequence overlaps in English.

i. **Deletion:** a sound is deleted to make the process acceptable. For example, it is possible for *textstore* /tekststɔ/ to become /tesstɔ/, deleting the voiceless velar stop /k/ and the voiceless alveolar stop /t/, and allowing the merge of the voiceless alveolar fricatives /s/. while Roach (2010) sees this as a form of mastery of language in a connected speech, Soneye and Faleye (2015) attributed it to a feature of Educated Nigerian Speaker of English (ENSE) because voiceless velar stop /k/ in a triple consonant cluster at coda segment is always deleted. Also, alveolar clusters are not permitted in word medial position of an ENSE.

ii. **Insertion:** sometimes, a sound is inserted to make the sound sequence in a word obey the phonotactic rules in a language. For instance, among the uneducated Yoruba English speakers, some words with clusters like *bread* may experience insertion and become ‘buredi’, inserting /u, i/ into the word (Osisanwo, 2012). This claim was also made by Adegite and Akindele (1999), however, this assertion is due for review because ‘buredi’ is a Yoruba rendition of the English word *bread* and is only used within Yoruba sentences and structures, not English ones. Thus, ‘buredi’ in a Yoruba construction is linguistically equivalent to *bread* in an English construction.

iii. **Assimilation:** a situation where the place of articulation tends to change to the place of articulation of the following phoneme is known as assimilation. In phonotactics, this process disallows adjacent stops if they differ in voicing. For example, talk + ed – [d] becomes /tɔ:kt/

Orthography and pronunciation are a major issue in phonotactics. Phonotactics guides the number of syllables permissible in words; it guides what phonemes are permissible in what positions; it dictates the types of consonants and vowels that can combine within a syllable. Furthermore, it determines the presence or absence of consonant clusters at the beginning or ending of a syllable, it determines the number, type and sequence of consonants that constitute a consonant cluster. Phonotactics is the area of phonology concerned with the analysis and descriptions of permitted sound sequences in a language.

Word phonotactics means that only clusters that can begin or end a syllable can also begin or end a word. In multisyllabic words, clusters consist of syllable-final and initial sequences. Phonotactics is highly language-specific. Glottal sounds are not permitted to come before nasal sounds as we have in ‘kn’ and ‘gn’ in English words – this accounts for the silencing of such glottal sounds.

The internal structures of syllables are as follows: onset, nucleus and coda. The onset and coda are the optional elements of a syllable, while the nucleus is the only obligatory item. The syllable is further divided into two parts – the onset, which is the optional element, and rhyme, the obligatory element comprising nucleus and coda. Nucleus is the only obligatory element in a syllable, thus, it is able to form a vowel-only syllable, while coda, just like the onset, is optional. Syllabic consonants, represented by semi-vowel glides and liquids, can also stand in for a nucleus in a syllable (Hammond, 2004; Roach, 2010).

Phonotactics has been known to have an effect on the process of second language vocabulary acquisition. According to Harley (2003), constraints that affect the English phonotactics are

1. Syllables must have a nucleus.
2. Consonant doubling is prohibited, that is, gemination.
3. The velar nasal sound /ŋ/ cannot occupy an onset position.
4. The glottal fricative /h/ cannot assume the coda position.
5. Affricates or glottal fricative /h/ cannot be in a complex onset
6. An obstruent (plosives, affricates and fricatives) must be the initial consonant in a complex onset for example, a blend of obstruent sounds such as *ntat or *rkoop are not permitted.
7. It is impossible for the alveolar fricative /s/ to come after an initial obstruent in a complex onset. It has to be a liquid /l, r/ or a glide /w, j/.
8. All relevant phonotactic rules must be obeyed when there is a subsequence within a sequence of consonants (the substring principal rule).
9. Glides are not permitted in the coda of a syllable, except the off-glides in diphthongs.

10. These approximant, nasal and fricatives /r, ŋ, ʒ or ð/ cannot occupy the second consonant in a complex coda, for example, asthma is mostly pronounced as /æzmə/ or /æsmə/ but rarely as /æzðmə/.
11. There is an assimilation interplay in a complex coda between the second consonant which may become voiced if the first consonant is voiced.
12. Any stop coming after the nasals /m/ or /ŋ/ in the coda must assume the same place of articulation with them and become homorganic with the nasals.
13. It insists on voice sharing for any two obstruents in the same coda position. For example, kids /kɪdz/ and kits /kɪts/.

2.1.2.1 Sonority sequencing principle

The elements of a syllable are not just assumed, they must be universally distributed following a set of rules known as the sonority sequencing principle (SSP). The SSP posits that the nucleus has the highest or maximal sonority in any syllable and that the farther a phoneme is from a nucleus, the less sonorous it is. The ranking of sonority in the hierarchy of any speech sound is language-specific but it is hardly different from one to the other. This is because almost all languages of the world create their syllables approximately in similar ways when it comes to sonority (Jany, Gordon, Nash & Takara, 2007).

The voiceless alveolar fricative, /s/, has a lower sonority hierarchy in comparison to the alveolar lateral approximant /l/, thus, permitting /sl/ to co-exist at the onset and /ls/ at the coda is also allowed, but not the other way around. Therefore, /slɪps/ and /pʌls/ are permitted but not /lsɪps/ or /pʌsl/. The SSP has a cross-lingual proneness but refrains from accounting for patterns with complex syllables which may violate the rule (Robert, 2001).

2.1.3 Syllable

A syllable is the smallest unit of sound which can be produced (Egbokhare, 1994). It mediates between the individual segment units: consonants and vowels, and combines them into words. Roach (2002: 277) and Yule (2010: 46) describe the syllable as a beat in an utterance, which must contain a vowel or a vowel-like sound. It may or may not be accompanied by a consonant sound(s) preceding or following it. Esan (2018:7) simply describes it as the minimum feature of prosody.

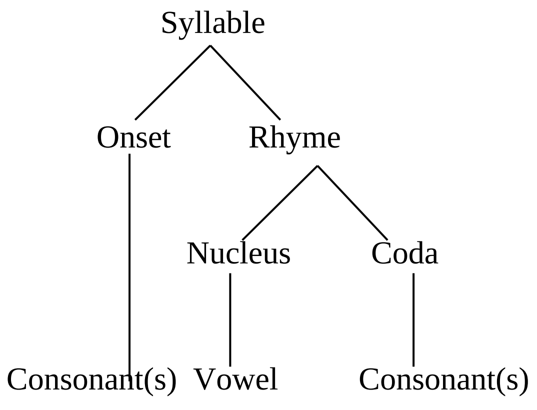

Figure 2.1 The syllable schema (Adapted from Yule 2010: 46)

Roach (2010: 56) describes four types of syllables as follows:

a. Minimum syllable containing only a single vowel in isolation, 'are' /ɑ:/, 'or' /ɔ:/, 'err' /ɜ:/
b. Syllable with onset, for example, 'bar' /bɑ:/, 'key' /ki:/, 'more' /mɔ:/
c. Syllable with coda, for example, 'arm' /a:m/, 'ought' /ɔ:t/, 'ease' /i:z/
d. Syllables with both onsets and codas, for example, 'ran' /ræn/, 'sat' /sæt/, 'fill' /fɪl/

2.1.3.1 The syllabic structure

The syllabic structure suggests the presence of consonant clusters in English. Consonant clusters do not exist in some Nigerian languages, especially the Yoruba language. The nucleus is the important part of the syllable which is mostly represented by a vowel or a vowel-like sound. It may, or may not have an onset or a coda, that is, consonants before or after the vowel. Syllables like these with an onset like 'no', 'me', 'to', and so on are open syllables because they have no codas. They are also referred to as zero coda (Roach, 2010); words like 'up', 'at', 'cup', 'at', and so on are closed syllables whether they have onsets or not. Roach (2010) expresses this in the following schemata:

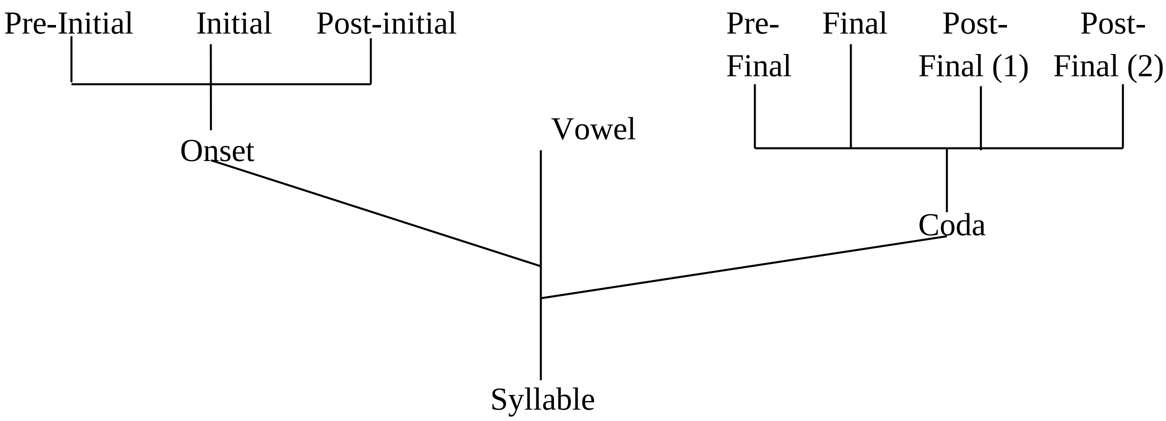

Figure 2.2 The syllable structure (Roach 2010)

1. Onsets and codas

Onsets and codas can have more than one consonant – an onset can have up to three consonants at the onset position and up to four for coda. However, the appearance of /ŋ, ʒ/ as onset is rare. Combinations that are acceptable in lesser clusters, that is, a CC or C^2 structure, are stops and fricatives at the pre-initial onset position and liquids /l, r/ or glides /w/ at initial position. However, clusters in a CCC or C^3onset structure must be an 's' at the pre-initial, followed by a voiceless stop /p, t, k/ at the initial position and then at the post initial position is a liquid /l, r/ or a glide /w/. For example, C = 'to', 'see', 'me'; CC = 'free', 'tree', 'dew'; CCC = 'splash', 'strong', 'scream', 'square'.

In English, no words end with more than four consonants. Nevertheless, /h, w/ at the coda position are also rare. At the coda position, the pre-final position is mostly represented by /ŋ, n, m, s/, while the final position constitutes /p, t, k, d, Ɵ/; at the post final position, (1), /s, z, t, d, Ɵ/ are usually found, and at post final position (2), /s, t/ are found. For example, C = 'sees', 'boys', 'kissed', 'bored', 'teeth', 'sing', 'corn', 'come'; CC = 'bump', 'bumped', 'bank', 'bald', 'eighth'; CCC = 'helped', 'banks', 'fifths', 'bonds', 'lapsed'; CCCC = 'twelfths', 'prompts', 'attempts', 'strengths', 'texts', etc.

2. Nucleus/Peak

The only obligatory segment of a syllable is the nucleus, represented by vowels or syllabic consonants. Roach (2010) describes the syllable represented by vowels as a minimum syllable and submits that any vowel can represent a minimum syllable. However, /ʊ/ is rarely a minimum syllable. Mohamed (2018) analysed the nucleus as V, V:, VV, VVV, and C, quoting Harris (1994). Expressed as monophthongs: V = short vowel, V: = long vowel, VV = diphthongs, VVV = triphthongs mostly at word final, further realised as $V^3 = V_1\ V_2\ V_3$ (author's concept).

Simple nucleus + coda = hut, bit
Simple nucleus + complex coda= felt, hands, tempt
Complex nucleus + complex coda = feels, joint, fields, points.
The rhyme template is presented as V, VCC, VCCC, VCCCC; V:, V:C, V:CC, V:CCC, VV, VVC, VVCC, VVCCC.

Mohamed (2018) presents 20 possible syllabic/monosyllabic structures as: V, CV, CCV, CCCV, VC, CVC, CCVC, CCCVC, VCC, CVCC, CCVCC, CCCVCC, VCCC, CVCCC, CCVCCC, CCCVCCC, VCCCC, CVCCCC, CCVCCCC, CCCVCCCC.

From the foregoing, it is worthy of note that the syllabic structure can also be written as $C^{0-3}V^{1-3}C^{0-4}$, which can further be expressed as $C_1C_2C_3V_1V_2V_3C_1C_2C_3C_4$ in the expanded form.

Table 2.1 The syllable structure

Onset	Nucleus	Coda	Rhyme
C	V	C	V
CC	V:	CC	V:
CCC	VV	CCC	VC, VCC, VCC
	VVV	CCCC	V:C, V:CC, V:CCC
	C		VV, VVC, VVCC, VVCCC
			VVV

(Adapted from Mohamed, 2018: 107)

The above shows that monosyllables are words made up of one syllable or a segment in an utterance as seen above. Disyllables and poly/multi-syllable words imply words with two or more syllables that have varying phonotactic composition. However, the explanation above can account for syllabic segments in such multi-syllabic words.

2.1.4 Studies on autistic phonology

Schoen, Paul and Chawarska (2011) study the phonology and vocal behaviour of 30 autistic toddlers between the ages of 18 and 36 months. They were paired with 11 age-matched and 23 language-matched controls. The result showed that toddlers with ASD produced speech-like vocalisations similar to those of the language-matched peers, but produced significantly more atypical non-speech vocalisations when compared to both groups. Also, the speech-like sound productions made by the autistic toddlers can be linked to the level of their language acquisition as seen in the language of typically developing toddlers. However, the study is silent about the children's intervention, whether it was before or during the period of data collection, this would have impacted the progress that the children made, and should have been presented in the study. Also, phonology as referred to in the study is merely an observation of the vocal noises that the children made and not really their speech sounds. Thus, the phonological perspective which the study claims is quite questionable.

Ojo (2012) explores the phonological issues in twelve autistic people's speech. The phonological disorders discovered in their utterances were consonant elision at the initial and final positions, substitutions between sounds that have the same place or manner of articulation, and inconsistencies in English stress placement. The study emphasises that autistics have limited issues with vowels but are largely divergent with consonants. However, the study's attention on vowel and consonant phonemes is limited to the segmental level, while the peculiar combination of these segments is not explored. Furthermore, the focus of the study is on autistic people's English phonology for the purpose of description only, and not to create a template for identifying their phonology.

Nwanze's (2013) study investigates the arguable notion that language skills in autistic African children are inferior to those of the autistic children in the global west. This investigation engaged the Nigerian children to investigate the veracity of this claim. The spoken language of Nigerian children who manifested features of autism was used to carry out this investigation. The study sampled 145 children with ASD, aged 3-10 years with a ratio of 5 boys to 2 girls. The study reveals that 54% of children with ASD are non-verbal, while the verbal ones have a mean length utterance (MLU) of over three morphemes; also, the study concludes that there is minimal difference in the performance between boys and girls. However, the study is limited to the length and pace of the children's utterances, without in-depth consideration of any core area of phonology or the language acquisition process. There was also no clear conclusion to the research question that the study set out to answer, that is, whether the language skills of autistic children in Africa were inferiror to those in the global west.

Nordgren's (2015) longitudinal study of one autistic subject concludes that consistent and early intervention in children with ASD could improve their sound production qualitatively and quantitatively. Although this submission is widely corroborated in available literature on autism, Nordgren's other submissions are quite arguable because they are generated from the study of only one child and these submissions are unlikely to be generalisable because of such factors like idiosyncrasies. However, this assertion about a consistent and early intervention is corroborated by Wolk, Edwards and Brennan (2016) in their investigation of the phonological difficulties faced by children with autism.

In another study, Brennan, Wagley, Kovelman, Bowyer and Lajiness-O'Nell, (2016) use magnetoencephalography to test the cascading effects of speech sound processing in children with ASD and age-matched controls of 8-12-year-olds. Results show that autistic participants produced non-problematic sequences around 330ms after onset of critical phoneme which suggests that ASD affects phonological processing in autistics' speeches. Majority of the results were within the core of neurological studies, thus, sidelining linguists in the presentation of the findings. There is a need to discuss the results in relation to linguistics since it concerns language, that way, actual progress in autistic utterances can be measured. However, the study successfully reveals the extent to which advanced countries have gone in language studies.

Kjellmer, Fernell, Gillberg, and Norrelgen (2018) examine the speech and language profiles in 4 – 6 year-old intellectually capable children who have been diagnosed early with ASD. The result shows that almost 60% have moderate to severe language problem, and nearly half (46%) exhibited combined expressive and receptive language problems. Phonological speech problems were found in 21% of the total group and almost 1 in 4 show expressive but not receptive problems. These suggest that the level of developmental language disorder may be more damaging than expected. The study reveals that audible phonological speech problems tend to decrease with age. These findings also show that language challenges in autistic people is not as a result of intellectual disability because this study established that even intellectually capable children still experience language challenges because of autism.

Umera-Okeke and Iroegbu (2016) identify some features such as substitution, deletion, and epenthesis in children with autism and Down syndrome among others. Esan (2018) corroborates these findings in her investigation of the prosodic features of people with developmental and acquired language disorders which covered most special needs group including autism. In addition to the above findings, she observes that simpler syllabic structures are preferred to complex ones. However, only adults were mainly sampled in this study, also, only one autistic was sampled and there was no background information provided about this autistic participant, whether the subject had enjoyed some sort of intervention and for how long, or not at all. Also, one subject is not at all representative of the autistic population.

A few of the studies above have established that language is the first step to diagnose a child with ASD (Schoen et al., 2011; Baron-Cohen, Lambardo & Lai, 2013); some have examined the phonological disorders and difficulties that autistic children encounter as they grow older (Schoen et al., 2011; Ojo, 2012; Nwanze, 2013; Umera-Okeke, 2016; Esan, 2018); and others have investigated the influence of intervention on improving the speech outcome in autistic children (Nordgren, 2015; Wolk et al., 2016; Kjellmer et al., 2018). The most central to the current study is Esan (2018) which examines the syllabic structure of one autistic adult; thus, there is still much to do regarding the investigation of the phonotactics of autistic children's spoken English in Nigeria. This area of phonology is necessary because it creates an avenue to examine how this population connect segmental sounds to form syllables and words, thus, showing their language progression.

2.1.5 Studies on phonotactics

Phonotactics as a subject matter has not enjoyed so much attention from scholars, thus, there are sparse scholarly materials on phonotactics which constitutes a major focus of the study. The review of the available materials on this subject helps to establish the extent of phonotactic studies in Nigeria.

Luce and Large (2001) examine phonotactics, density and entropy in spoken word recognition to extract the combined effects of probabilistic phonotactics and lexical competition. This is done by generating words and non-words that are varied orthographically and in phonotactics. Forty-five English-speaking adults were give 45 CVC words to produce in a sophisticated technology laboratory. Each adult had about 3 seconds to respond to a pre-pronounced word, after which the computer automatically recorded correct or incorrect against each token after the allotted time limit. Result confirmed and extended previous studies, it also uncovered the effect that cannot be predicted by a simple combination of activation and combination at sub-lexical and lexical levels of representation under specific circumstances. Neighbourhood density and probabilistic phonotactics may combine to produce non-addictive or synergistic effects of lexical competition on processing time. This study, though very contributory, is not grounded in any phonological or linguistic theory, making the study less linguistically or phonologically inclined, since results were only presented and discussed statistically.

Btoosh (2006) used Optimality Theory to examine constraint interactions in Jordanian Arabic phonotactics. Karak-Arab (KA), which is the language of Btoosh's interest, treated the syllable using two major phonological processes: re-syllabification and epenthesis. The study compares past Arabian studies in phonotactics to the current study and then goes on to problematic words that were previously ignored by those studies. Its analysis revealed the ideologies in previous studies, the assignment of unlicensed segments to semi-syllables, the representation of geminates and the reduction of unlicensed segments in ultra-heavy syllable by morphology. The findings show an extremely tiny difference between substitution of ALIGN (R) and ALIGN (W) dominating Arabic. Syllables in KA, a CV language, are full of compliance to default onset constraint and without an onset, the language resorts to either an onset-motivated epenthesis or an onset-motivated re-syllabification process to repair such a syllable. As rich as the contributions of this study are, the paper lacked proper structuring and this downplayed the various aspects of the work. Also, the constraints relevant to the study are not presented systematically, making the constraints difficult to follow. The researcher is also an informant in the study; thus, the objectivity of the work is quite questionable. Finally, no justification was provided for the choice of data used.

In another study where a group of pre-school-aged children with specific language impairment (SLI) were presented for study along with some typically growing peers, Leonard, Davis, and Deevy (2007) found out that items of low phonotactic probability distinguished the children with SLI and Typically Developing children matched for Age (TD-A) from Typically Developing children matched for Mean Length of Utterance (TD-MLU). The study examined phonotactics and the use of regular past tense morphemes and inflections in novel verbs, this differed from their phonotactic probabilities. These children were less likely to use the past tense inflection '–ed' with novel verbs of low phonotactic probability than with novel verbs of high phonotactic probability. As insightful as the study is, it lacks the proper use of basic terminologies in presenting the processes involved in the children's interactions with data. Result was only discussed statistically; it did not employ any linguistic or phonological theory in the study.

In another study, Mbah and David (2013) examine the constraint-based study of Tiv learners of English phonotactics in order to note the possible constraints the Tiv learners of English as L2 encounter. The objectives of the study are to analyse, ascertain and unveil the challenges that Tivs encounter in sonority hierarchical arrangement of phonemes in the syllable structure of the English language. The study reveals that Tiv learners of English violate the phonotactic rules of English in their realisation of consonant assimilation and vowel harmony and that these learners experience difficulties in realising English syllables with consonant clusters and this causes transfer of features from L1. The result also shows that Tivs have onset restrictions for syllables that is, no vowel can begin a syllable except a word. Aside updating the literature, this study contributes no new knowledge to what has been presented by earlier studies as reviewed in the work except the adoption of Optimality Theory in the analysis which gave a new perspective, although it was not explore in-depth. Analysis did not really match the objectives set. In other words, the objective of the study should have indicated that the work would rank the constraints responsible for the Tiv phonotactics; hence, these weakened the findings of the study. Also, no methodology was presented to provide information about how the study was carried out, if the participants were educated, if their socio-cultural background affected the way they spoke or, if all Tiv phonotactics were expected to be such.

Soneye and Faleye (2015), in their study of syllable phonotactics in Educated Nigerian Spoken English (ENSE), aimed to bridge the gap aiding the dearth of corpus-driven research in the area of focus. Using 31 postgraduate respondents, with a higher percentage of respondents from the southwestern region of the country, the study revealed that whenever C1 is /k/ in a triple-consonant-clustered coda environment, /k/ was always deleted. Substitution was rarely employed in the data, it occurred only when voiced alveolar plosive /d/ replaced its voiceless counterpart and voiced alveolar fricative /z/ is devoiced. The lateral /l/ is usually deleted in post-vocalic pre-consonantal positions. Alveolar clusters [str] at medial position is not permissible in Educated Nigerian Spoken English (ENSE), examples are 'registration', 'restriction', 'infrastructure', and so on. These were pronounced without the /t/. Deletion of consonants in 3-consonant-cluster English words was a prominent feature in ENSE and may be attributed to other social factors since most respondents were from the south-west. Reduction and simplification could lead to different productions which could also lead to wrong perceptions and serious implications. As insightful as these contributions are, they are incomplete without the onset. The authors admit that participants from the south-west were more than the other respondents and this may have influenced the results to some extent. A reconfirmation of data may be needed from the northern and eastern regions of the country to ensure that the findings are substantial.

Young children's sensitivity to probabilistic phonotactics in their developing lexicon was the focus of Coady and Aslin (2017) who examined 24 children - 12 two and a half and 12 three-and-a-half year olds - to test their sensitivity to probabilistic phonotactic structure. The high-phonotactic frequency contained non-words with phonemes that were always frequent in syllable segments while the low-phonotactic frequency group contained least frequent sounds in a syllable segment. The result showed that these children responded mostly to the high phonemes than the low ones, indicating sensitivity to phoneme frequency. Also, additional sensitivity to individual segments increased with age. Older children were more responsive to frequency of larger units. Young children are reactive to fine-grained acoustic-phonetic information in the developing lexicon, while sensitivity to all aspects of the sound structure increased over development and were mostly responded to by the older children, not the younger ones. These are relevant to the current study beacause the findings in Coady and Aslin (2017) can be measured against those in the present study to see how autistics perform in contrast to typically developing children, using actual words. A longitudinal study to observe how these children acquire phonotactics from simple to complex as they advance in age would have made this study a well-rounded one.

Unubi and Ikani (2018) studied Igala syllable and phonotactics using secondary data. The result showed that consonants are not allowed or permitted in word final positions in Igala; the pattern of monosyllabic and polysyllabic syllables were V, VC, and CV syllables, consonants could occur word-finally in idiophonic words and few others in the language but there are strict limitations to labial and velar nasal sounds /m, ŋ/. When consonants appear in word initial positions, the words are verbs and if in word medial positions, those words are nouns. Despite being an addendum to readership, the study seemed to lack depth as phonological theories could have been employed to give more authenticity to the analyses and discussions.

2.1.6 Phonological processes

It is expedient to review some relevant studies in phonological processes in relation to the phonotactics of autistic children. Phonological sounds can be explained in isolation but when these segmental sounds are found in the association of other sounds, some phonological processes are bound to take place. Among several processes identified by scholars, (Yule, 2010, 1996; Roach, 2010, 1991; Oyebade, 2008; Cruttenden, 2001; Gimson, 2001; Jones 2003, 1972), only three of these processes would be considered in this study: substitution, deletion and epenthesis. This is because most of the other processes can be subsumed under these three.

a. **Substitution:** This process involves replacing a sound with another. This can be done in various ways such as reducing the sound quality, changing the manner or place of articulation or out replacing a sound with another that shares nothing in common with the replaced sound. Atolagbe (2001) posits that substitution is the replacement of a sound with another sound or features of a sound in a specific environment. Alabi (2007) submits that it is a major phonological interference triggered by language contact phenomenon. Alabi's suggestion interprets the situation in which substitution occurs and that the unavailability of an L2 sound in a speaker's first language (L1) is responsible for a substitution with an available sound in the speaker's L1. Most of the other processes such as assimilation, fronting, devoicing, stopping, and so on can be grouped under substitution. Dollaghan and Campbell (1998) describe substitution as an error.

b. **Deletion/elision:** This term is interchangeably replaced with elision (Yule, 2010:47; Roach, 2010:114). According to Yule (2010), elision is a show of efficiency in the language using illustrations as 'you and me', /ju:ənmi:/ and 'friendship', /frenʃɪp/. Roach (2010) identified four reasons for elision: (i) loss of weak sounds, especially the schwa sound /ə/, which occurs after aspirated voiceless plosives. This is not the case when these voiceless plosives /p, t, k/ come after the voiceless alveolar fricative, /s/, Roach (2010) employed the following examples: 'potato', /pʰteɪtəʊ/; 'tomato', /tʰmɑ:təʊ/; 'canary', /kʰneəri/; other reasons provided for elision were: (ii) weak vowels with syllabic consonants, (iii) avoidance of complex consonant clusters, and (iv) loss of final /v/ in 'of' before consonants. The author expressed doubt about whether all other cases of contractions of grammatical words should be categorised as elision or not.

Osisanwo (2012: 179) describes deletion as the disappearance of one or more sounds in rapid speech and identified two cases of deletion -- vowel and consonant deletions. The explanations on vowel deletion tallies with Roach's (2010) explanation provided in the previous paragraph. Consonant deletion mostly occurs in cases where consonant clusters or simplification of clusters exist. This often involves the loss of alveolars /t, d/, especially when in combination with other consonants (Jones, 2003). Weak syllable deletion, cluster reduction and final consonant deletion are features of deletion which are also described as an error by Dollaghan and Campell (1998).

c. **Epenthesis:** This is a case of insertion of additional sound in a sequence of phonemes. According to Osisanwo (2012: 185), it occurs mostly when a word of one language is adopted in another language whose rules of phonotactics do not permit a particular sequence of sounds. Alabi (2007) describes epenthesis as a superfluous insertion of a vowel segment as a means of alleviating the complexity of consonant clusters -- a common feature of English. For example, the insertion of /i/ in the following words, /miliki/ or /milki/, for ‘milk’ and /girama/, ‘grammar’ by mostly Yoruba speakers of English explicates this. Palatal fronting and insertion are other examples of epenthesis which Dollaghan and Campell (1998) do not see as an error but as a process of language acquisition in children.

Sometimes, these processes overlap in an output. For example, ‘water’ becomes /wɑwɑ/; this output has undergone series of processes which overlap. Deletion, substitution and epenthesis can be deduced. First, ‘ter’ has been deleted from the output and substituted with /wɑ/. Also, the insertion of /w/ in place of /t/ can be termed epenthetic. Hence, although several phonological processes can be subsumed under some major processes as discussed above, it is also possible for these processes to work together, overlapping in an output.

Cleland, Gibbon, Peppe, O’Hare, and Rutherfore (2010) study the phonetic and phonological errors in children with high functioning autism and Asperger’s syndrome. Using 30 participants with high functioning autism and 39 who have Asperger’s syndrome and who were between the ages of 5 and 13 years, the researchers found that their speech was characterised mainly by developmental phonological processes, such as gliding, cluster reduction and final consonant deletion. However, non-developmental error types such as phoneme-specific nasal emission and initial consonant deletion were also featured in their speech. They conclude that the presence of these non-developmental errors pointed out speech disorders which could add additional communication and social barriers to affected children if not diagnosed and treated as early as possible. These findings are very relevant to studies like the current one and those concerned, however, the study still grouped affected children according to DSM-4 (high functioning autism and Asperger’s syndrome) and not DSM-5 (in accordance to their severity – mild, moderate or severe). Again, all these processes can be subsumed under deletion, substitution and epenthesis. This study is yet another from the vast expanse of available studies in the developed countries.

2.1.7 Appraisal of literature review

The studies of Schoen, Paul and Chawarska (2011), Ojo (2012), Nwanze (2013), Nordgren (2015), Wolk, Edwards and Brennan (2016), Brennan, Wagley, Kovelman, Bowyer and Lajiness-O'Nell (2016), Umera-Okeke and Iroegbu (2016), Kjellmer, Fernell, Gillberg, and Norrelgen (2018) outline the extent of language and phonological studies as well as the state of intervention as it relates to autism mostly outside and within Nigeria.

Also, Luce and Large (2001), Btoosh (2006), Leonard, Davis, and Deevy (2007), Cleland, Gibbon, Peppe, O'Hare and Rutherfore (2010), Mbah and David (2013), Soneye and Oladunjoye (2015), and Coady and Aslin (2017) mostly studied probabilistic phonotactics, or the phonotactics of a second language user or an educated language user. Most of these studies did not focus on autistics' phonotactics.

These reviews reveal the extent and depth of research carried out within the purview of autism, language and phonology, within and outside Nigeia. However, none of these earlier works considered the language sequencing in the utterances of autistic childrend which is the focus of this study. The present study employed Optimality Theory in the assessment of sound sequences, as well as the syllable structure of autistic utterances. This study also considered the impact of intervention on the phonotactics of autistic children which earlier studies have not been able to consider.

2.2 Theoretical framework

This section is dedicated to the theoretical framework employed in the study. The basic tenets and assumptions of the theory, its relation to phonotactics, child phonology, language acquisition and language disorder are considered in this aspect of the work.

2.2.1 Optimality Theory

The theory adopted for this study is Optimality Theory proposed by Alan Prince and Paul Smolensky (1993). Optimality Theory (OT) was expanded by Prince and McCarthy in (1993) and became prominent in (2002) through Prince's and Smolensky's work. Kager (1999) construed OT as a kind of theory that explores the capacity of human language. It is not a surprise that this theory, which was originally a phonological theory only, has been proven to be relevant in other aspects of linguistics such as morphology, grammar and even beyond linguistic occupation (Lengendre, 2001; Sunday, 2008; Esan 2018; Maha & Radwan, 2018).

Most phonological theories compare a speaker's competence to their performance where spoken language is concerned, and they tend to prescribe certain output forms with binding rules. However, OT does not employ rules, rather, it centres on investigations of universal principles that are violable and every violation shows how a language is marked. The main concept of OT is that the surface forms of language reflect resolutions of conflicts between competing demands or constraints (Kager, 1999).

2.2.2 Basic tenets and assumptions of Optimality Theory

Optimality Theory argues that universal grammar is a set of violable constraints (Sunday & Oyatokun, 2016) and the grammars of specific languages are products of language-particular rankings of those constraints (Kager, 1999). Each language is assumed to have a unique ranking of universal constraints, not just of constraints specific to such language. Optimality Theory grammar has an input-output mechanism that pairs an output form to an input form realised as the input to output mappings of OT. Optimality Theory mappings are achieved by GEN(erator) and EVAL(uator) operations. The theory is modelled as a network of systems which provide mappings from input to output.

Optimality Theory assumes that all constraints are grouped under FAITHFULNESS and MARKEDNESS constraints. Faithfulness constraints require outputs to be identical to input while Markedness constraints motivate change from the input underlying form to the surface form. The theory is preoccupied with the output of candidates provided by GEN(erator) and their interaction with the input. For the process of interaction with input to be done, OT depends on CON(straints). The highest satisfaction of opposing constraints makes Optimality Theory different from other phonological approaches that are rule-centred. The violability of a constraint is not due to the property of that constraint, instead, it is due to its position in that language (Sunday, 2013).

2.2.3 Basic components of Optimality Theory

There are three basic components identifiable in the tenets of OT: GEN, the generator; CON representing constraints and EVAL for evaluator. Two main components that assist the input-output mappings of OT are GEN which generates a limitless number of candidates to interact with the input and EVAL which evaluates these candidates by applying a set of strictly ranked constraints to supply the most harmonic output form. The interrelationship of these components is captured by McCarthy (2002:10) thus:

Input → GEN → candidate → EVAL→ Output

These components are closely examined below.

2.2.3.1 GENerator

GENerator is the generator of diverse universal candidates. It is permitted to generate as many members of output candidates as is required, no matter how much they deviate from the input. This is a feature of OT called freedom of analysis (McCarthy, 2002). Freedom of analysis reveals that GEN is allowed to source for an infinite number of candidates or forms with no restriction. Generator depends exclusively on the input forms. The schema below discloses how GEN functions.

Gen (input) {$cand_1$, $cand_2$ …$cand_n$}

Adapted from (Kager, 1999: 19)

These generated candidates compete with one another in the tableau and only one output is chosen as the winning or optimal candidate (Sunday, 2008; Esan, 2018). Optimaity Theory appeals to constraint rankings as a means of generating the output from the input. The input and output presentation is mediated by the GENerator and EVALuator functions. The EVAL operation evaluates the generated candidates, using the constraints relevant to them. It determines which candidate is most harmonic with the input (Barlow, 2001:243).

2.2.3.2 EVALuator

EVALuator is language-specific and ranks constraints in order of relevance in relation to the grammar of the given language. It compares constraints in relation to candidates generated and selects the optimal output. Furthermore, using constraints, EVAL mediates between the candidates and their interactions. It receives the set of candidates from GEN and evaluates them in a parallel order, applying a set of constraints to choose the output form which is the most harmonic with the input form. The chosen output is the optimal or the winning candidate. Optimality Theory is evaluated through ranked constraints which restrict the structure of possible output forms (Barlow, 2001: 243).

For example, when two competitors, A and B, perform a task, A surpasses B if A attracts a small number of violations of the highest ranked constraints. Thus, Candidate A is said to be more harmonic and optimal than B. If the following constraints C1, C2 and C3 are given, where C1 dominates C2 and C3 represented as (C1>>C2>>C3), even when the first competitor, Candidate A, draws with the second competitor, Candidate B, on C1 but performs better on C2, then Candidate A is considered the winner even if it violates more constraints than candidate B on C3. This competition is often demonstrated in a tableau. A pointing finger shows the winning candidate; the columns of the tableau present an asterisk for each violation committed by the candidates, and includes an exclamation mark when a violation is fatal, that is when a candidate violates constraints that are highly placed. When the lower-ranked constraints cells in the tableau are shaded, it means such a candidate can never emerge optimal again even if it outperforms other candidates on the rest of the CON. An optimal candidate or output incurs violation on a limited number of highly ranked constraints in a particular grammar before becoming the winner. Their violations must be lowly ranked.

2.2.3.3 CONstraints

CONstraint is universal and the same in every language. Prince and Smolensky (1993) submit that all constraints are universal and universally present in the grammars of all languages, however, their rankings are based upon the grammar of a specific language. Constraints are hierarchically ordered and also violable. Some constraints are disobeyed only in order to obey higher ranked constraints. This means that constraints are ranked differently from one language to another and these constraints are used to test the well-formedness of each candidate, based on what is acceptable in the grammar of that language. These constraints compare each candidate to another in order to get the optimal candidate (that is, the candidate that incurs fewer violations).

Each constraint has absolute priority over all other constraints in a strict dominance hierarchy. It has its premise on the assumption that universal constraints can be violated and that these constraints are ranked differently in different languages (Kager, 2000). Constraints are set to restrict outputs generated by GEN to those which are likely to emerge optimal. These constraints are innate and violable. Candidates that violate highly ranked constraints are eliminated from being the optimal candidate. Constraints in Optimality Theory are grouped into two major types: FAITHFULLNESS and

MARKEDNESS constraints. Faithfulness constraints are structural constraints while Markedness constraints permit modifications of the input form.

1. **Faithfulness constraints**: this set of constraints requires outputs to be identical to input. They have underlying input and surface output representations and require a semblance between the underlying and surface representations (McCarthy, 2007; Esan, 2018). Faithfulness constraints require that all segments in the input to be represented and parsed in the output with all structures and features of the input being identical to the output.

Three main constraints that represent faithfulness are:

a. **MAX-IO** prohibits deletion. This means that each segment in the input is required to correspond with the segments in the output (Kager, 1999).
b. **DEP-IO** disallows epenthesis. The implication of this is that each segment in the output must have a corresponding segment in the input. That is, the output is dependent on the input and the constraint is violated by an insertion in the segment (Kager, 1999).
c. **IDENT (F)** proscribes any form of alteration to the value of any input segment. This means that every feature (F) of the input segment(s) is required to be identical or to correspond to every feature in the output segment(s) (McCarthy, 2007). The features could be place of articulation, manner of articulation or voicing.

2. **Markedness constraints:** this type of constraint is also known as the structural or well-formedness constraint. They are simplified output structures from input. The markedness constraint evaluates the well-formedness of output candidates. It is the constraint that “assigns violation-marks to a candidate based solely on its output structure, without regard to its similarity to the input” (McCarthy, 2002:14). Markedness constraint focuses primarily on whether the output form is similar to the surface structure constraints (McCarthy, 2007: 5) They are not in any way compared with the inputs (McCarthy, 2002; Sunday, 2008; Olarewaju, 2018). Markedness outputs are unmarked; unmarked structures are seen as very fundamental because they can be found in all grammars and occur cross-linguistically (Barlow and Gierut, 1999).

Markedness constraints are known to aid the simplified structure of language, which makes the unmarked structures more difficult to articulate. Instances of marked surface structures are those language features or segments that are difficult to articulate or acquire by children and are difficult to learn by many second language (L2) users. According to Bader (2010) and Esan (2018), fricatives, affricates, liquids and consonant clusters fall under the category of the marked properties of the universal language sound system, while vowels, glides, nasals, and stops are examples of the unmarked properties (Bader, 2010; Esan, 2018; Olarewaju, 2018).

Some constraints that represent Markedness include:

1. ***COMPLEX** prohibits consonant clusters.
2. **NOCODA** prohibits syllable-final consonant.
3. ***FRICATIVES** do not permit fricatives.
4. ***LIQUIDS:** No liquids are allowed.

Markedness requires simplicity to the output structure for faithfulness to be satisfied.

2.2.4 Conflicts between markedness and faithfulness constraints

Markedness and faithfulness constraints are in constant opposition. This is because a set of constraints is violated by a candidate in order to obey another. Faithfulness constraints disallow any unfaithfulness to the input, while the opposite is the main idea behind markedness constraints. This is referred to as "constraint conflict" McCarthy (2007: 5) and Kager (1999) posits that these conflicts between constraints can be resolved by constraint ranking on a tableau.

According to McCarthy (2002: 67), "a mapping may be faithful or unfaithful". This concept is embodied in the following instance: / xyz /→ [xyz] is faithful because every element present in the input is replicated in the output. /xyz/→ [wyz] is unfaithful because there is a modification of one of the elements and so the output is not an exact version of the input. Markedness constraints motivate change from the input underlying form, that is, between the input and output so that the output is markedly different from the input in some ways (McCarthy & Prince 1995; Archangeli, 1997).

2.2.5 Faithful and unfaithful mappings

The interactions between faithfulness and markedness constraints are the main tenets of Optimality Theory. Faithfulness is expected to dominate since output needs to be faithful to the input to aid comprehension. Violations of markedness are tolerated; however, if markedness dominates faithfulness, it means that some outputs are not faithful to the inputs and some inputs will be unfaithfully mapped, using markedness-obeying output rather than markedness-violating ones (McCarthy, 2002; Sunday, 2008; Esan, 2018; Sunday, 2021).

Kager (1999) posits that OT grammar is an input-output mechanism that pairs an output form to an input form. Optimality Theory models grammar as a system that provides mappings from inputs to outputs through the use of constraints. Optimality Theory achieves these mappings through the operations of Generator (GEN) and Evaluator (EVAL). These are considered the core of OT. Gen generates as many candidates as possible, based on the linguistic input, while EVAL determines the most harmonic candidate based on the constraint hierarchy that is operational in the language under investigation. EVALuator produces the optimal candidate by considering a set of violable universal constraints. Constraints are ranked differently in different languages of the world; this allows variations in the types of grammars. Some constraints are more important than others and so are highly placed in language, while others are lowly placed and therefore, lowly ranked in such languages. Some highly ranked constraints in one language can be lowly placed in another language.

2.2.6 Richness of the base

Richness of the base (ROTB) is a term used to present the single pool from which all language users draw their language inventories from. The base is the lexicon from which plausible input forms in human language are drawn. Richness of the base does not lay claim to the fact that all languages have the same vocabulary, rather, it stresses that the lexicon is not the source of linguistically significant regularities (McCarthy, 2002: 70).

There is an assumption that a lexicon serves as repertoire of every word in every language. Richness of the base is reported by Esan (2018) to be the speech repertoire of every language without limitation to the input. There are no limitations to the contributions to the pool of inventories and they do not have a language-specific restriction (McCarthy, 2007); this justifies its richness. The core argument of ROTB is that the lexicon is not limited to any language-specific requirements. Additionally, details for linguistic subjects cannot involve cautiously planned restrictions on the inputs of the grammar (McCarthy, 2007). Under ROTB, the concept of well-formedness is embedded in the control and operation of EVAL and constraint hierarchy. Consequently, constraint ranking determines the systematic differences between languages. However, in pre-OT grammar (where lexicon is advocated for), inviolability of constraints and 'crashing derivations' are bases for ungrammaticality and ill-formedness of structures (McCarthy 2007; Sunday, 2008).

2.2.7 Presentation of tableau

Constraints are presented at the topmost columns, left to right; the highest constraints are at the left-hand side and the lowest ones are at the right. The forms to be evaluated are exhibited in rows. A constraint violation is marked with an asterisk (*), while that of a winning or optimal candidate with lesser violations is represented with a pointing finger (☞). The violation that eliminates a candidate completely is a fatal violation and such a candidate gets the asterisk and an exclamation mark (*!). Then the cells in that column are shaded to indicate that all other violations are not relevant as a result of the violation of a higher ranked constraint (Fox, 2002:198; Sunday, 2008).

Two types of tableaux have been identified: the comparative tableau format proposed by Prince (2002), and the violation tableau format of Prince and Smolensky (2002).

1. **Comparative tableau:** In a comparative tableau, the number of violations of a candidate is recorded in its cell. Every cell in a loser row has the symbols W (winner) and L (loser), showing whether each constraint favours the winner or loser and shows no symbol if constraints do not favour either. The W and L symbols indicate the function of the constraint in the system. This tableau helps when the aim is to display rankings between constraints (Prince & Smolensky, 2002).
2. **Violation tableau:** The violation tableau displays candidates and their interactions, showing those that incur the fewest and lowest violations with the pointing finger and the candidate which incurs a violation is indicated with an asterisk, while the one with a fatal violation has both an asterisk and an

exclamation mark. A candidate with a fatal violation can never emerge as optimal because it has violated the highest ranked constraints in that language and gets eliminated from the competition completely. The other cells of such a candidate are shaded showing that no other operation that occurs in such cells matter. This type of tableau shows the members of a given set who are possible winners under different rankings of a given set of constraints (McCarthy, 2007).

A violation tableau is adopted for this study. An example of a violation tableau is given below:

Tableau 2.1: Illustration of an OT tableau

Input	Constraint 1	Constraint 2	Constraint 3
Candidate 1	*!	*	
Candidate 2		*	
☞ Candidate 3			*

Adapted from Esan (2018:59)

2.2.8 Optimality Theory and prosody

Prosody is the study that supersedes segmental phonology, which is otherwise known as the study of individual sounds or phonemes. Prosody is concerned with those elements of speech that are above individual vowel and consonant sounds. According to Akinjobi (2004), prosody constitutes the phonological units above the segments. It is concerned with such aspects as syllables, stress, intonation, rhyme and so on, which are parts of the intuitive knowledge of a speaker. These segments are organised to form some larger phonological units which refer to prosody (Hammond, 1997). Prosody also covers syllables (combination of sounds) and feet (combination of syllables). Wrong words may not be as a result of segments only but that of larger units like a syllable. Syllables and stress are core properties of the prosody of a language (Hammond, 1997).

Prosody or supra-segmental phonology comprises features larger than the segment. Although prosodic features are found in all languages, they are not all the same. These prosodic features include stress, tone, intonation, rhythm, and syllable, among others. Optimality Theory also covers suprasegmental phonology and other levels of language.

2.2.9 Optimality Theory and syllable

The relationship between syllable and OT is intertwined because the latter has contributed to the understanding of the role of the syllable. Syllable is defined in OT with respect to its constituents. A syllable, according to Sunday (2008), is defined as consonant(s) and vowel(s) grouped into peaks of sonority and loudness. Similarly, Hammond (1997: 86) states that "syllables are consonants and vowels grouped into peaks of sonority or intrinsic loudness". Since consonants and vowels which are segmental units of words are part of a syllable, this means that a word comprises at least a syllable. The most obligatory element of a syllable is the vowel which is the PEAK. Other elements, which are not obligatory, are ONSET and CODA.

Syllable licensing refers to the fact that a word must contain at least a syllable. Therefore, both PEAK and LICENSING restrict the structure of a word and a syllable. Hammond (1997) submits a formula for syllable licensing thus:

Syl – cons and vowels
Word – cons and vowels, then

If S (c &v) and W (c & v), then, W= S or W(s).

Furthermore, Hammond (197) reveals three constraints that are important in the analysis of the syllable.

1. **ONSET:** This constraint was suggested by Prince and Smolensky (1993) and it stipulates that every syllable must have an onset. A syllable must begin with a consonant. This constraint captures the universal preference of language for CV syllables.
2. **NO CODA:** This constraint was also proposed by Prince and Smolensky (1993) and it prohibits closed syllables, but encourages open syllables. A syllable must not end with a consonant sound. It stipulates that syllables should not have codas.
3. **FAITHFULNESS:** Output must be faithful to the input, hence, every segment and feature must be pronounced as they are.

Other syllable-related constraints as identified by Kager (1999: 101-102) are

4. **MAX-IO:** Input segments must appear in the output. Deletion of segments is prohibited.
5. **DEP-IO:** The output must not contain a vowel or consonant that is not present in the input. It forbids insertion.

Below are some other constraints which are identified by Prince and Smolensky (2004: 106-109)

6. **NUC:** Syllables must have nuclei.
7. ***COMPLEX:** No more than one C or V may associate to a syllable position node.
8. ***M/V:** V(owel) may not associate to margin nodes (ONS and NOCODA).
9. ***P/C:** C(onsonant) may not associate to peak (NUC) nodes.
10. **FAITH C:** All input consonants must be represented in the output .

There is a fundamental formal division among constraints: ONSET and NOCODA are Markedness constraints, while the others (MAX-IO and DEP-IO) are faithfulness constraints.

2.2.10 Optimality Theory and phonotactics

This present study focuses on phonotactics; therefore, it is necessary to understand the interactions of OT with the phonotactics of a language. Phonotactics is the knowledge about the acceptable sequence that sounds must follow in a particular language, and it is part of the intuition or knowledge of a speaker of that language (Sunday, 2008). The main crux of phonotactics is the innate understanding about how sounds work in a language to form words, accidental gaps, non-words or novel words in that language. For example, 'rik' is in conformation with the rules of English but is not a word in English - it is an accidental gap. However, 'rki' does not conform to the phonotactics of English and is instantly identified as an error. This unconscious knowledge of language helps the speaker to know what constitutes a syllable in their language (Sunday, 2008:83).

There are two concepts that come to fore in the interactions of OT and phonotactics. They are the principle of gradualness and re-ranking of constraints.

Principle of gradualness: this model was described by Magri (2011) as a model where all learners entertain a current hypothesis of a target phonotactics that gets updated over time, based on exposure to phonotactical licit adult forms. As time passes by, constraints are re-ranked to either make a winner or a loser of the optimal candidate, based on the study.

> If the study is looking for faithfulness dominating markedness in the output, then, a winner faithful to the output is ranked optimal, while if the study focuses on how a particular production is marked, then the losing output is ranked optimal (Magri, 2011: 2013)

Regarding child phonology in comparison to adult phonology, a similar output to the adult's will emerge winner, but to mark the way a child's phonology differs from that of an adult, the loser becomes the winner. This technique is what will be employed in this present research as it is expected that autistics' phonology should deviate from the target (adult) phonology and may be more similar to that of a child's. Gradually, tracking the changes in children's (autistic) phonology over a period of time is made possible through re-ranking of constraints. Thus, the principle of gradualness is illustrated below using 'clock' as an input.

Table 2.2 The principle of gradualness table

Group 1

Age	2:3	2:5	2:6	2:8
OUTPUT	tʌk	lʌk	Dk	flʌk
	tʌk	flʌkƟ	dʌk	Ɵlʌk
			klʌkƟ	

Group 2

Age	2:8	2:10	2:11	3:1
OUTPUT	klʌuk	kəlʌk	klʌk	klʌk
	kʌk	kʌk	klʌks	klʌk
			kʌk	

Adapted from McLeod, Doorn and Reed (2001), modified by the researcher

From the Table 2.2, it can be observed how the principle of gradualness is employed. Children between the ages of 2 years and 3 months, and 2 years and 8 months were observed in one group and the other group contained information about slightly older children (2 years and 8 months – 3 years and 1 month). There is a reduction in the target consonant cluster (/kl/ to [k]) and the substitution of /k/ with [t] among the youngest participants. It is easy to identify the winner that is faithful to the target language or the optimal output based on the features identified, which are tied to markedness.

Typorial factorial or factorial typology is the term given to possible re-ranking of constraints to suit the difference in language acquisition through the ages of participants. This principle was considered during the course of the study. The possible rankings predicted for languages are called factorial typology, which is the claim that "every permutation of CON is a possible grammar of a human language, and every actual human language has a grammar that is a permutation of CON" (McCarthy, 2007: 105). The various ways of ranking constraints define the permitted range of language variations. Magri (2011) expresses this concept thus:

a. {t d t^h d^h}

b.

F_1 = Ident [voice]	F_2 = Ident [Asp]
M_1 = *[+voice]	M_2 = *[Asp]
$M_{1,2}$ = *[+voice, + Asp]	

a. {ps bs pzbz}

b.

F_1 = Ident [fric-voi]	F_2 = Ident [Asp]
M_1 = *[+fric-voi]	M_2 = *[+stp-voi]
$M_{1,2}$ = Agree [stop-voi, fric-voi]	

(Magri, 2011:2014)

The first set contains obstruents which are represented by voice and aspiration features in segmental phonology. The second set entails clusters described by stop voicing and fricative voicing features. The (a)s are the input, while the (b) part of the sets show identical faithfulness constraints (F_1F_2), while M_1 and M_2 show markedness constraints in the output.

2.2.11 Optimality Theory and language disorder

People with language disorder may find it difficult to articulate word-final consonants (Sunday, 2008; Ojo, 2012). Blevins (1996) submits that a coda is a marked structure in many languages. For instance, Yoruba is a no-coda language and children in the process of language acquisition delete coda (Bader, 2010). However, while they acquire it after maturity, those with disorder struggle with it for a longer period, while and only a few acquire proficiency in it.

Sunday (2008) and Esan (2018) aver that people with some cases of language disorders may find it difficult to articulate word-final consonants. Judging from the study conducted by Ojo (2012), where it was reported that the speech of the people with autism has 52% of elision which occurs at syllable-final position. This information is important to the present study because the insights got from OT helps to instruct the NOCODA ranking and other Markedness constraints higher than Faithfulness constraints, like MAX and DEP in an autistic person's speech.

Also, Blevins (1996) submits that coda is considered a marked structure because many languages do not allow it. A host of other languages apart from Yoruba, such as Japanese, Igala, and so on, do not permit coda. Ojo (2012) concludes that owing to the influence of the mother tongue of autistic people, their spoken language reflects their first language, and irrespective of their age and features, their utterances still resemble that of children who are still in the stage of language acquisition. This tends to strengthen the argument that people with autism have delayed language development; while this might be the case, Lord et al. (2006) state that this is not particular to autistics only. Therefore, OT can be useful for the analysis of autistic children's utterances whose ranking of constraints cannot be the same with typically developing children. It is expected that in an autistics' utterances, markedness constraints should rank above faithfulness constraints.

2.2.12 Constraints relevant to this study

For this study, a set of constraints have been generated and they are listed below:

1. COMPLEX-ONSET allows consonant clusters at the beginning of a syllable (McCarthy, 2008)
2. *COMPLEX-CODA forbids consonant clusters at coda (Prince & Smolensky, 1993)
3. ONSET syllables must have onsets (Prince & Smolensky, 1993)
4. NO CODA syllables must not end with consonants (Wheeler, 2007)
5. MAX-V forbids deletion of segments; it infers that input vowels must have output correspondents (Wheeler, 2007)
6. DEP-IO output segments must correspond with the input segment. It forbids insertion (Kager, 1999)
7. *SCHWA-V allows the deletion of input vowels in the output vowels (Wheeler, 2007)
8. NO DIPH disallows diphthongs. It assigns one violation for every output that contains a diphthong (Krause, 2013)
9. VOICEDV# short vowels are banned word finally (Umbal, 2014)
10. *HIATUS forbids the occurrence of two adjacent vowels. Two adjacent vowels cannot be linked to two sets or features (Sande, Ondondo & Rew, 2019)
11. *COMPLEX NUCLEUS does not permit complex nucleus (Alotaibi, 2017)
12. *MAX - segments in the input must not correspond with segments in the output.
13. *L-ONS - approximants are not allowed in specific positions in the onsets.

The fundamental division among constraints: ONSET and NOCODA are Markedness constraints; the others (MAX-IO and DEP-IO) are faithfulness constraints.

2.3 Summary

This chapter presented the review of conceptual and empirical literature which are relevant to the study. The theoretical framework and constraints relevant to this study were also discussed in the chapter. The next chapter presents the methodology adopted in the study.

CHAPTER THREE

METHODOLOGY

3.0 Preamble

The methodology employed in this study is discussed in this chapter. The research design, sampling procedures, the sample population, the research instrument, ethical considerations, the technique for collecting data and the method of data analysis are also described.

3.1 Research design

This study employed a descriptive design. The phonemes, clusters and syllabic structures that the children produced were perceived and described theoretically and acoustically. Descriptive statistics was also employed.

3.2 Study area

The study was carried out in four (4) special school facilities in Lagos State, Nigeria. They were Patrick Speech and Language Centre at Ikeja Local Government Area of Lagos; Ire-pearl Centre of Hope at Badagry Local Government Area of Lagos; Helping Hands School and King Pearls Court both at FESTAC, Amuwo-Odofin Local Government Area of Lagos State. Data could not be collected from eight (8) other special needs facilities which had been contacted and visited earlier. These are Patsilver Educational Support and Therapy Centre, and the Zeebah Foundation, both under the Abuja Municipal Local Government Area of the Federal Capital Territory, FCT, Abuja; Quest Learning Centre and Behavioural Health Autistic Centre, both at Port Harcourt Local Government Area in Rivers State; Ladoke Akintola University of Technology Teaching Hospital (LAUTECHTH), and Charflow Special School, both at Oshogbo Local Government Area of Osun State; Oasis Special School at Amuwo-Odofin Local Government of Lagos State and Adeyanju Taiwo Centre for Children with special needs, under Ibadan North West Local Government Area in Oyo State. No data were got from these places because some of the respondents were mainly non-verbal. Also, some of the children were unresponsive and uncooperative, and in some cases, the processes of ethical consideration were not completed.

3.3 Study population

This study used a total of twenty-four autistics between 7 and 17 years of age. Sixteen (16) males and eight (8) females diagnosed with autism spectrum disorder by psychologists according to the Diagnostic and Statistical Manual (DSM-5) participated in the research. These included 10 severely affected autistics, 8 moderately affected autistics and 6 mildly affected autistics. The level of their severity was determined based on their performance and the years of intervention they had enjoyed from early, late or intermediate speech therapy intervention. All participants were enrolled in special schools in Lagos (Patrick Speech and Language Centre at Ikeja Local Government Area; Ire-pearl Centre of Hope at Badagry Local Government Area; Helping Hands School and King Pearls Court both at FESTAC, Amuwo-Odofin Local Government Area). Thirteen (13) subjects were from the south-east regions of Nigeria, three (3) were from North-central states, another four (4) were from south-south regions and four (4) were from south-west, Nigeria. Twelve (12) participants understood their first language but could not express themselves in it, four (4) others could both understand and express themselves in their first language minimally, and the other eight (8) were able to receive and express only in English. Another three (3) were also able to receive minimally in a third language. The schools from which the ASD populations for this study were got were visited on Mondays and Thursdays, though the children attended the school every week day.

3.4 Sampling procedure

The quota sampling technique was adopted for this study to select the suitable participants for the research because most of the children that were encountered within the ASD population were non-verbal. This debarred them from participating in the study, since being verbal was one of the criteria for selection of participants. Thus, only verbal autistics whose articulations were audible enough were sampled in the study. Before interaction with the participants commenced, it was ascertained that the participants were severely impaired, moderately impaired or mildly impaired by ASD; this was evidenced in their speech, social and behavioural uncertainties. The participants' speech and interactions with the researcher were recorded with an audio recording application on a mobile device. The interview method was mainly unstructured for the severely impaired and some of the moderately impaired autistics with attention deficits, while the mildly affected autistics and other moderately impaired ones easily followed a structured interview method.

All consenting participants were included. Those who did not give their consent were excluded. Only verbal autistics that were audible were included, while non-verbal and inaudible ones were excluded. Only a few autistics were audible despite the fact that they were verbal and this adversely affected the course of data collection as the twenty-four (24) participants got for this study were got after interacting with about fifty-nine autistics from different metropolitan states in Nigeria (Lagos, Abuja and Port Harcourt).

3.5 Research instrument

Instrumental and survey designs were used in the study. The research instrument was a prepared wordlist containing forty (40) words with different phonemes and syllabic structures. Some of the prepared words were not unfamiliar to the participants as they were got from the display charts and flash cards in some of the facilities visited. In some cases, the interview was unstructured and the researcher employed other techniques to get data from subjects, such as songs, conversations and observation. Fifty-eight (58) content words were gathered in such cases. The prepared wordlist instrument contained twenty-one (21) monosyllabic words, seventeen (17) di-syllabic words and two (2) polysyllabic words. These words had twenty-two (22) short and nine (9) long monophthongs; ten (10) diphthongs; and five (11) triphthongs incorporated into them. Also, twenty-three (23) and eighteen (18) consonant phonemes were at the onset and coda, respectively. Furthermore, eleven (11) complex onsets; ten (10) complex codas; four (4) minimum syllables; ten (10) open syllables and twenty-nine (29) closed syllables were incorporated into the wordlist. Eleven of such words considered as disyllables are triphthongs, realised as monosyllables in Received Pronunciation (RP). They are however categorised under disyllables because the target pronunciation for Nigerian autistic children is not RP but NE, which realises triphthongs in double breath.

3.6 Methods of data collection

Data were gathered for a period of two years. The researcher worked with speech therapists and special educators who, before each data collection session, were called to be reminded of a pre-planned schedule on Mondays and Thursdays. This went on for about a year until a new bi-weekly arrangement was made in the second year. This was due to the COVID-19 preventive measures put in place by the schools to allow a two-week break after each weekly visitation. About 4 hours was spent at a school on each day, interactions with each child lasted an average of 30 minutes depending on their level of concentration. A wordlist with various syllabic structures were carefully and randomly selected from texts, and these were either read or repeated by the participants twice or thrice and in other cases, many times. Songs and random conversations ensued between the researcher or a therapist and the participants. Questions and answers were used to elicit data, and the special educators or speech therapists helped to ensure active participation. Children who did not seem to be enthralled about the process or cooperate during the data collection were not forced into participation.

Responses were recorded with an audio-recording device. The researcher endeavoured to minimise distractions and interference in the classroom setting, in order to create an environment that is conducive to data collection. In some schools, an office was allocated to the researcher – this was more conducive as the researcher had time alone with the participant and the speech therapist or the special educator.

Unstructured method of interview was also employed to elicit data in cases where participants spoke randomly and did not follow all the other methods employed by the researcher. The words they uttered during these spontaneous renditions were also used for analysis. This unstructured method was also used to elicit demographic information from the participants and their minders. Their biographical data and such information about their diagnosis and how long they had been enjoying intervention were got from the school coordinators and caregivers and were recorded.

3.7 Methods of data analysis

The study adopted a descriptive design – it described the phonotactic features of the ASD population studied. The terminologies adopted to classify the ASD population in the study were Mild, Moderate and Severe according to the DSM-5 classification of autism as it relates to Wing's triad of language and communication. Recorded data were transcribed and analysed according to the level of audibility and intervention enjoyed. Results were discussed in the fourth chapter of this study.

Data were subjected to statistical and phonological analysis, using Optimality Theory. The statistical analysis was done to decide how each phoneme of the words tested was rendered. The different types of syllabic structures in mono-, di- and polysyllabic words were studied and their characteristics were noted. Tested words were categorised into nucleus, onsets, codas and varieties of structures.

Constraints, based on Optimality Theory principles, were employed in the analysis. What each constraint stood for was defined after each of the OT tableaux analyses. Inputs used were culled from the Nigerian English because the participants have not acquired Standard British English. The OT analyses were accompanied by phonological processes responsible for each outcome.

The results of the most prominent patterns were subjected to acoustical analysis, using Weenink and Boersma's PRAAT software which clearly captured the details of the discussion on perceptual and phonological analyses. The acoustic analysis focused on recurring patterns in the nucleus and consonant clusters at onsets and codas. Participants' utterances were analysed with PRAAT software. The acoustic cues of fundamental frequency (Hz), intensity and duration measured in milliseconds were identified for each segment.

Frequency counts and simple percentages were also employed in examining the various types of structures of each tested word, this helped to determine the prominent patterns. The spectrograms of all observable patterns were presented.

3.8 Ethical consideration

At the inception of data collection, a letter of introduction from the Department of English, University of Ibadan was taken to proprietors and coordinators of the special schools and facilities. This helped to formalise the process and also gain the assistance of staff where necessary. These members of staff rendered their assistance after the aim and objectives of the study had been explained to them. Furthermore, the schools got parents' and guardians' consent after assuring them of the confidentiality of their children's and wards' identity. Copies of the letters are included in the appendix of this study. The participants too were assured of the confidentiality of their identities; hence, they were referred to as 'Candidate 1, 2, 3' and so on in the study. They were also informed of their right to withdraw from participating whenever they wished to.

3.9 Summary

This chapter examined the methodology adopted in this study; it brought together the method of data collection and the method of data analysis. The analysis for this study is presented in the next chapter.

CHAPTER FOUR

ANALYSIS AND DISCUSSION

4.0 Preamble

This chapter presents the analysis of data for this research, using the research objectives as a guide. The aspects of the phonotactics analysed concerned phonemes, consonant clusters and syllable structures. The participants' productions were tested using thirty-eight words. The analysis is presented in four main sections: peaks, consonants, consonant clusters, syllables and intervention. These sections were presented and analysed, using simple descriptive statistical tables, Optimality Theory and PRAAT software. Phonological processes were used to discuss constraints and acoustic analysis using PRAAT under each segment. The Table below presents demographic information about the participants.

4.1 Demographic characteristics of research participants

Below is a tabular representation of the demography of the respondents that participated in this study. The table shows the distribution of the participants according to age, sex, diagnosis and the geographical zones they represented.

Table 4.1 Demographic characteristics of research participants

Candidates	Sex	Age	Diagnostic type	GPZ	L1	L2	School
C1	M	10	Severe	SE	-	English	KPC
C2	F	10	Severe	SW	Yoruba	English	KPC
C3	F	17	Severe	SE	Igbo	English	HHS
C4	M	10	Severe	SE	Igbo	English	HHS
C5	M	9	Severe	SE	Igbo	English	KPC
C6	F	13	Severe	SE	Igbo	English	HHS
C7	F	12	Severe	SW	Yoruba	English	HHS
C8	F	15	Severe	SE	-	English	HHS
C9	M	14	Severe	SW	Yoruba	English	PSLC
C10	M	8	Moderate	SS	-	English	IPCH
C11	M	13	Moderate	SS	Urhobo/Yoruba	English	HHS
C12	F	8	Moderate	SE	-	English	HHS
C13	F	9	Moderate	NC	Igede/Yoruba	English	HHS
C14	M	12	Moderate	SS	-	English	PSLC
C15	M	10	Moderate	SE	Igbo	English	PSLC
C16	M	12	Moderate	SS	Edo	English	HHS
C17	F	14	Moderate	SE	Igbo	English	PSLC
C18	M	17	Moderate	NC	Berom/Hausa	English	HHS
C19	M	12	Mild	SE	Igbo	English	HHS
C20	F	11	Mild	SW	Yoruba	English	IPCH
C21	M	10	Mild	SE	-	English	PSLC
C22	M	7	Mild	NC	-	English	HHS
C23	M	7	Mild	SE	Igbo	English	HHS
C24	M	8	Mild	SE	-	English	HHS

Key

Diagnostic type= severely affected, moderately affected and mildly affected

SW= south-west; SS= south-south; SE= south-east; NC= north-central

KPC=King's pearls court;

HHS=Helping hands school

PSLC= Patrick Speech and Language Centre;

IPCH= Ire-Pearl centre of hope

As presented in Table 4.1, there are sixteen males and eight females who range from seven to seventeen years in the sample population. They all speak English and have been diagnosed with varying degrees of the autistic spectrum disorder.

4.2 Phoneme sequencing by the autistic children

The sequence of phonemes, both vowels and consonants, which were produced by the participants, was tested. The English vowels are mainly divided into twelve (12) pure vowels (monophthongs) and eight (8) diphthongs. Triphthongs remain a controversial concept in scholarship but there are five (5) of them in the English language, and analysis of vowel phoneme sequencing was aligned with these three classifications of English vowels. The monophthongs were analysed based on the part of the tongue where articulation occurred, that is, front, back and central vowels.

4.2.1 Sequence of front vowels

The following words were purposively used to test the front vowels: *impediment, navigate, fountain* and *sprint* /ɪ/; colleague /iː/; *impediment* /e/; and *pat, navigate* /æ/. Some other words which contain front vowels and were spontaneously produced by the participants were also used for analysis. These words are *drink, cookie, mister, little, children, with, teddy, tickle, tummy, break, bread, teddy, step, head, neck, correction, please, thank* and *bag.* The front vowels featured multiple times in these words.

Table 4.2: Variants of front vowels produced by the participants

Variants		Mild	Moderate	Severe	Sub-total (%)	Grand total (100 %)
/iː/	[ɪ]	1	2	6	9 (36.0)	
	[iː]	5	5	4	14 (56.0)	25
	[e]	-	2	-	2 (8.0)	
/ɪ/	[iː]	15	31	30	76 (58.5)	
	[ʊ]	-	1	6	7 (5.4)	
	[ɪ]	14	10	8	32 (24.6)	
	[m]	1	2	3	6 (4.6)	130
	[e]	-	2	3	5 (3.8)	
	-	-	1	3	4 (3.1)	
/e/	[e]	6	11	12	29 (85.3)	
	[ɪ]	-	-	2	2 (5.9)	34
	[iː]	-	-	3	3 (8.8)	
/æ/	[æ]	12	15	4	31 (60.8)	
	[ɑː]	-	4	9	13 (25.5)	
	[bɑ]	-	-	2	2 (3.9)	
	[rɑ]	-	-	1	1 (2)	51
	[e]	-	-	1	1 (2)	
	-	-	-	3	3 (5.9)	

Of all the front vowels, the mid front unrounded vowel, /e/, was the monophthong with the least variants. In other words, this vowel phoneme was the easiest to produce for the participants. The phoneme had a percentage of 85.3% occurrence. The ease of production was found across the three levels of autism severity. The total number of expected tokens was 34, and 29 tokens were produced. The other two variants were [ɪ] and [i:] which were produced by the severe autistics only, and the low percentage of 5.9% and 8.8%, respectively, were negligible.

Similarly, the close front unrounded vowel, /i:/, was produced 56% of the time. In other words, of the 25 expected tokens, all mild, moderate and severe autistic participants produced the sound 14 times in total. Other times, the long vowel /i:/ was shortened and this happened 9 times. The phoneme was shortened most by the severe autistics. The last variant of the front close front unrounded vowel, /i:/, was the mid front unrounded vowel, [e], and only the moderate autistics produced it this way – it occurred twice.

In the case of the half close front unrounded vowel, /ɪ/, there were a total of 5 variants, the most recurrent of them was the close front unrounded vowel, [i:], (58.5%) – the lengthened form of the phoneme. This shows that the front close unrounded vowel is much easier for autistics to produce than the shorter vowel which occurred 24.6% of the time. The other variants were half close back rounded vowel, [ʊ], (5.4%), voiced bilabial nasal, [m], (4.6%) and half open front unrounded vowel, [e], (3.8%). Sometimes, the participants did not produce the sound at all and this occurred 3.1% times.

The final open front unrounded vowel was /æ/ and there were five variants of this phoneme, many of which were generated by the severe autistic children. However, the mild and moderate autistic children were able to produce the phoneme well because the phoneme was lengthened at four instances only by the moderate autistic children. Thus, it can be generalised that autistics thrive in front vowel phonemes, as retention of all the front vowel phonemes was above average. Furthermore, the close front unrounded vowel, /i:/, was produced appropriately by mild autistics and most of the moderately impaired autistics, while the severely impaired autistics preferred its short variant, [ɪ], to the actual input. The mildly affected autistics retained actual front vowel sequences 70% of the time, while the moderately affected retained it 51.25% of the time. The severely affected autistics performed poorly and only retained actual front vowel phonemes 26.3% of the time. One instance has been theoretically analysed in a tableau.

Tableau 4.1: The emergence of [spi:nt]

Input: sprint /sprınt/ →[spi:nt]

Sprint /sprınt/	***MAX**	***L-ONS**	**CODA**	**DEP-V**
(i) /sprınt/	*!	*		
(ii) [spi]			*	
(iii) [spri:]		*		
☞ (iv) [spi:nt]				*

Constraint ranking: *MAX>>*L-ONS>>CODA>>DEP-V

Optimal Candidate: [spi:nt]

The half close front vowel /ɪ/ is mostly realised as its variant, the close front vowel, [i:], in Nigerian English, and while this long variant of the input pervades the outputs, as seen in the tableau, the optimal variant had more frequency in the data. Candidate (i), having disobeyed the highest ranked constraint *MAX, incurs a fatal violation. This constraint forbids an output from being faithful to the input; hence, candidate (i) is eliminated for being identical to the input. Candidate (iii) is also eliminated from the tableau because it incurs a violation of the next highly ranked constraint, *L-ONS. This constraint disallows the realisation of laterals and approximants at the onset position of an output. The next ranked constraint, CODA, is violated by Candidate (ii). This constraint requires that all outputs must have a coda; since Candidate (ii) has violated this constraint, it can not be further analysed in the tableau. With all other candidates eliminated, Candidate (iv) emerges as the winner, being the only candidate with the least violation of the highly ranked constraints. Instead, it violates a lowly constraint, DEP-V, which forbids the insertion of any vowel that is not represented in the input, in this case, the vowel is close front unrounded [i:].

Tableau 4.2: The emergence of [kɔ:ji:n]

Input: /kəli:g/ → [kɔ:ji:n]

Colleague /kəli:g/		*NOCODA	V:#	DEP-V
(i)	[kəlıg]		*	*
(ii)	[kəlı]	*!		
☞ (iii)	[kɔ:ji:n]			**

**Constraint ranking: ***NOCODA>>V:#>>DEP-V

Optimal Candidate: [kɔ:ji:n**]**

Tableau 4.2 contains three constraints and three candidates. The first constraint, *NOCODA is the highest ranked constraint which allows codas in a word. This important constraint is fatally violated by Candidate (ii) which does not have a coda in its two syllables. Thus, it incurs a violation against the first constraint and this violation is a fatal one. Candidate (i) also incurs a violation against constraint 2, V:#, which requires that long vowels should be at word final positions. This candidate has a short vowel in the final position before the coda, as a result of this, it incurs a violation against this second constraint, thus, it is unable to emerge as the optimal candidate. The elimination of Candidates (i) and (ii) means that Candidate (iii) becomes the optimal output because it has satisfied both of the highly ranked constraints and has only violated the least ranked constraint in the tableau, DEP-V. This lowly ranked constraint requires faithfulness to the imputed vowels; the winner disobeys this least constraint by inserting long vowels in place of short ones in the output. Thus, the autistic children prefer the long vowels to the short ones; in other words, like other typically developing children, there is seldom a distinction between the articulation of tense and lax vowels.

Tableau 4.3: the emergence of [pu:]

Input: put /pʊt/ → [pu:]

Put /pʊt/	**NOCODA**	***V: #**
☞ (i) [pu:]		*
(ii) [pʊt]	*!	

Constraint ranking: NOCODA>>*V:#

Optimal Candidate: [pu:**]**

Two candidates interact with two constraints in Tableau 4.3. Candidate (ii) is unable to emerge as the optimal candidate because it disobeys the most important constraint, NOCODA, which forbids output renditions from ending with a consonant. By retaining the voiceless stop, /t/, in its output, the candidate incurs a fatal violation as indicated by the exclamation and asterisk signs; hence, it does not emerge as a harmonic candidate. Candidate (i) emerges as the optimal candidate despite violating the lower ranked constraint, *V:#, which forbids an output from ending with a long vowel. Candidate (i) ends with a long close back rounded vowel, [u:], thus, it violates constraint 2. The violation of constraint 2 by Candidate (i) is not a fatal one and so it still emerges as the winner. Therefore, autistic children prefer the long vowel to the short one, and this is significantly similar to what obtains among even typically developing children as well as adults in Nigeria. This further illustrates that the acquisition of language even by autistic children is greatly influenced by the language in their environment, even though they may experience certain impediments in their speech production.

Tableau 4.4: The emergence of [skʊ]

Input /skru:/ (screw) → Output [skʊ]

Screw /skru:/	**COMPLEX ONSET**	***L-ONS**	**MAX V**	**DEP**
(i) [skru:]		*!		
(ii) [du]	*!			*
(iii) [skwɔ:]		*!		*
☞ (iv) [skʊ]			*	*

Constraint ranking: COMPLEX ONSET >>*L-ONS >>MAX V >> DEP

Optimal Candidate: [skʊ]

Tableau 4.4 contains four constraints and four candidates. The first constraint, COMPLEX ONSET, is the highest ranked constraint. It encourages outputs to begin with multiple consonants. Candidates (i), (iii) and (iv) comply with this constraint by retaining clusters in their onsets. However, Candidate (ii) violates this constraint by having only one consonant in its onset. This violation is a fatal one because COMPLEX ONSET is the highest ranked constraint in the tableau.

For constraint 2, *L-ONS prohibits sonority liquid sounds in onset positions of an output. Candidates (i) and (iii) violate this important constraint and neither is able to emerge as an optimal candidate as a result. Thus, having violated only lowly ranked constraints, MAX V and DEP, Candidate (iv) emerges as the optimal candidate. MAX V requires faithfulness to underlying vowels, therefore, by changing its peak from close back rounded vowel, /u:/, to its variant, half close back rounded vowel, [ʊ], Candidate (iv) has violated this constraint. The least constraint, DEP, forbids the importation of foreign sounds which are not originally featured in the input. Candidates (ii), (iii) and (iv) do not obey DEP, disregarding the rule, but Candidate (iv) still remains the optimal candidate in the tableau because the constraints it violates are not highly ranked ones. This shows that although autistic children can manage to produce consonant clusters at the onset of syllables, they can hardly manage more than C^2 onsets. Furthermore, the presence of a complex onset seems to reduce the energy needed for producing a longer vowel phoneme, thus, the complex onset is followed by a short vowel which does not require as much acoustic energy as would be found in a long one.

Tableau 4.5: The emergence of [kɔlɪ]

Input: /kɔli:g/ → [kɔlɪ]

Colleague /kɔli:g/	NOCODA	*V:#	DEP-V
(i) [kɔli:g]	*!		
☞ (ii) [kɔlɪ]			*
(iii) [kɔli:]		*!	

Constraint ranking: NOCODA>>*V:#>>DEP-V

Optimal Candidate: [kɔlɪ**]**

Tableau 4.5 contains three constraints and three candidates. The first constraint, NOCODA, is the highest ranked constraint. It disallows codas in an utterance. This important constraint is fatally violated by Candidate (i) which retains a coda in its presentation. Candidate (iii) also incurs a fatal violation of the next highly ranked constraint, *V:#, which forbids long vowels at word final positions; this candidate retains a long vowel in its output and is eliminated as a result. The elimination of Candidates (i) and (iii) enables Candidate (ii) to become the optimal output because it has satisfied all the highly ranked constraints and has failed at only the least ranking constraint, DEP-V. This constraint forbids the insertion of a different vowel from the imputed vowel; thus, the optimal candidate's substitution of the long close front unrounded /i:/ vowel with a short one, incurs a non-fatal violation. Below is an acoustic representation of *colleague*.

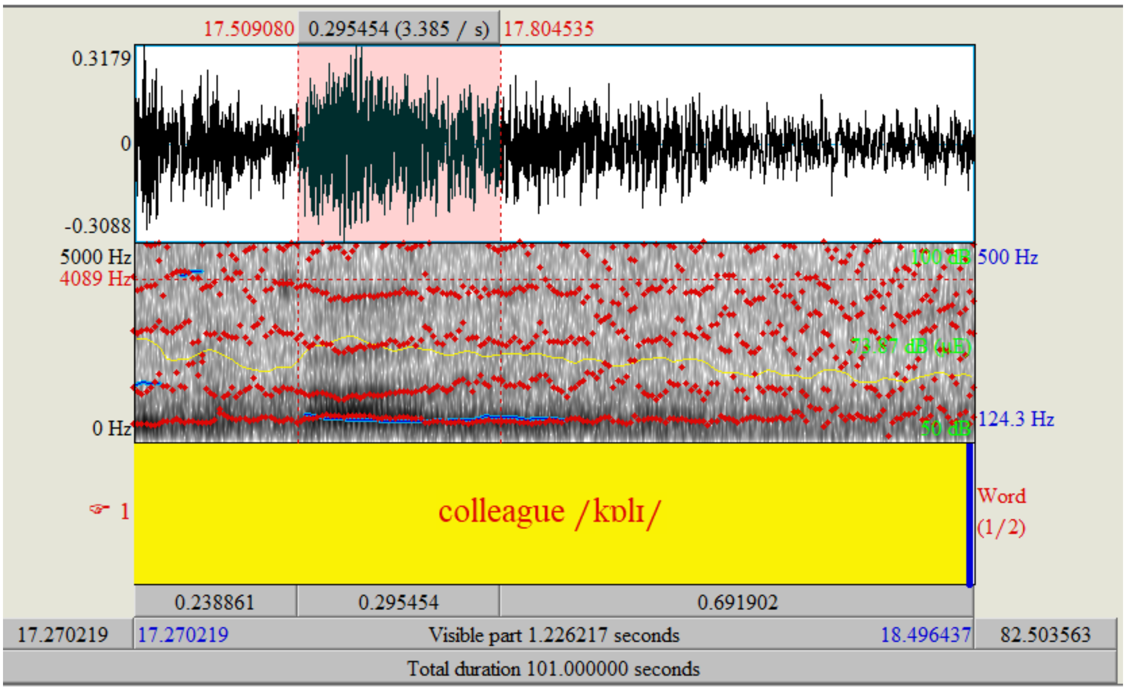

Figure 4.1: Acoustic representation of *colleague*

The acoustic representation of *colleague* in Figure 4.1 highlights the peak of the second syllable. It reveals the reduction of the vowel quality from long /i:/ to short [ɪ] and a deleted coda. The intensity and pitch values of the first syllable are at 71.32 dB and 124.6 Hz, respectively, while the first and second formant values are set as 525.4 and 1047, respectively. The first and second formants are quite close together, showing that articulation of the vowel phoneme is close to the front of the mouth and that the lips were not very far apart during articulation.

4.2.2 Sequence of back vowels

The following words were purposively used to test the back vowels: *colleague* /ɔ/; *court* /ɔ:/; *screw* /u:/; *put, /*ʊ/, and *car* /ɑ:/. Some other words which contain back vowels and were spontaneously produced by the participants were also used for analysis. These words are *want, water; cookie, you*, *shoes; aunty, banana, asking,* and *garden.* The back vowel phonemes featured once in these words.

Table 4.3: Variants of back vowels produced by the participants

Variants		Mild	Moderate	Severe	Sub-total (%)	Grand total (100%)
/ʊ/	/ʊ/	6	8	9	23 (88.5)	
	/u:/	-	2	1	3 (11.5)	26
	/ɔ/	1	1	-	2 (7.4)	
	/u:/	4	4	4	12 (44.4)	
	/ʊ/	1	4	5	10 (37.0)	27
/u:/	/o/	-	-	1	1 (3.7)	
	/i:/	-	1	-	1 (3.7)	
	/uɔ/	-	-	1	1 (3.7)	
/ɔ/	/ɔ/	6	11	7	24 (92.2)	
	/o/	-	-	1	1 (3.9)	26
	/e/	-	-	1	1 (3.9)	
/ɔ:/	/ɔ/	5	9	7	21 (87.5)	
	/ɔ:/	1	-	1	2 (8.3)	24
	/o/	-	-	1	1 (4.2)	
/ɑ:/	/æ/	1	2	2	5 (12.2)	
	/ɑ:/	5	9	10	24 (82.8)	29

As seen in Table 4.3, autistics generally performed above average in the articulation of back vowel phonemes. Mildly affected autistics retained the back vowel sequence to the tune of 73.3%, while moderately affected ones retained the back vowel sequence to the tune of 62.7%. Even severely impaired autistics performed better at back vowel sequence than the front vowels.

The half close back rounded (short) vowel /ʊ/ had one variant apart from the expected vowel phoneme. Both utterances differ only in terms of laxity. However, all three categories of autistics articulated the half close back rounded (short) vowel very well. The moderate and severe autistics were the only ones who had longer variants, while the mild autistics produced only the expected short vowel phoneme. There was a total of 88.5% articulation of the half close back rounded /ʊ/ among the participants.

The close back rounded long vowel, /u:/, however, had six variants, 44.4% of which were actually a correct rendition of the input, while the shorter form was rendered 37.0% times within the total tokens. This shows that a greater variation lies in the laxity of the close back rounded vowel, although even among the mild autistic children, there was still one instance of a rendition of a half open back rounded vowel, [ɔ]. Generally, however, the greater variation lies between the short and long forms of the close back rounded vowel.

In the articulation of the half open back rounded vowel, /ɔ/, there were three variants from the severe autistics, while the mild and moderate autistic children all produced the sound appropriately. Thus, there was a 92.2% success rate in the participants' articulation of the back vowel phoneme. The severe autistic children's variants were close back rounded, [o], and half open front unrounded, [e]; these occurred only once each. In the case of the open back rounded vowel, /ɔ:/, there was a production rate of 87.5% for half open version, [ɔ] - the shorter version of the input vowel phoneme - while only 8.3% produced the expected open back rounded (long) vowel. There was another variant close back rounded [o], however, this occurred only once. Finally, open back neutral vowel, /ɑ:/, was well articulated by a large percentage of the participants (82.8%), while 12.2% of them articulated it as half open front neutral version, [æ].

Tableau 4.6: the emergence of [kɔ]

Input: court /kɔ:t/ → [kɔ]

Court /kɔ:t/	**NOCODA**	**DEP-V**
☞ (i) [kɔ]		*
(ii) [kɔ]	*!	*
(iii) [kɔs]	*!	*

Constraint ranking: NOCODA>>DEP-V

Optimal Candidate: [kɔ]

Tableau 4.6 features three candidates interacting with two constraints. Candidates (ii) and (iii) incur fatal violations for disobeying the higher ranked constraint, NOCODA. This constraint forbids outputs from ending with a consonant phoneme. Therefore, Candidates (ii) and (iii) have fatally violated NOCODA because they end with a coda. Candidate (i) emerges as the optimal candidate because it obeys the highly ranked constraint, although it also disobeys the lowly ranked constraint, DEP-V. DEP-V forbids the insertion of new vowel phonemes that are not originally featured in the input. The substitution of the long /ɔ:/ with the short variant, [ɔ], shows how the harmonic candidate flouts the least ranked constraint in the hierarchy. Although deletion has also occurred in this tableau, emphasis is on the replacement of the long vowel phoneme with a shorter one as found among the autistic participants.

4.2.3 Sequence of central vowels

The central vowels were also tested among the participants and the following words were used for this purpose: *early, /ɜ:/; sculpts/sculpt and plunge/plunged /ʌ/;* and *impediment, arrive, about /ə/.* In the course of data collection, some of the participants produced some words outside the wordlist, and these were also used in the analysis. The words are *girl; sun, come* and *tummy; hello, water, banana, mister, little, children, golden*, *table*, *tickle* and *correction.* The following table presents the variants of the central vowels as they were produced by the participants.

Table 4.4: Variants of central vowels produced by the participants

Variants		Mild	Moderate	Severe	Sub-total (%)	Grand total (100%)
/ ɜ:/	[e]	5	7	6	18 (72)	
	[ɑ:]	-	1	-	1 (4)	
	[ɜ:]	1	-	-	1 (4)	25
	[ɔ]	-	1	3	4 (16)	
	[i:]	-	-	1	1 (4)	
/ʌ/	[ʌ]	1	3	-	4 (7.8)	
	[ɔ]	10	10	13	33 (64.7)	
	[ɑ:]	1	2	1	4 (7.8)	
	[ʊ]	-	-	3	3 (5.9)	51
	[o]	-	1	-	1 (2)	
	[ɔ:]	-	2	2	4 (7.8)	
	[æ]	-	1	1	2 (4)	
/ə/	[e]	6	6	5	17 (21.8)	
	[æ]	8	7	4	19 (24.4)	
	[ɑ:]	2	7	8	17 (21.8)	
	[ə]	2	2	2	6 (7.7)	
	[bɑ]	-	-	2	2 (2.6)	
	[rɑ]	-	-	1	1 (1.3)	78
	[ɪ]	-	1	2	3 (3.8)	
	[ʊ]	-	1	3	4 (5.1)	
	[i:]	-	-	2	2 (2.6)	
	[ɔ]	-	-	2	2 (2.6)	
	-	-	3	7	10 (12.8)	

Autistics interactions with central vowel sequences were the most dynamic of all the three sub-groups of the English pure vowels. As seen in Table 4.4, there were more diversified choices from the participants. Out of 164 tokens received for the central sounds, only 11 outputs were retained as the input (6.7%) – this is a negligible amount. It is not far-fetched from what is achievable in the Nigerian English. The half open front unrounded vowel, [e], the open back rounded vowel, [ɔ], and the open front unrounded vowel, [æ], were the variants mostly used to substitute the half close central neutral vowel, /ɜ:/, the open central neutral vowel, /ʌ/, and the half open central neutral vowel, /ə/, respectively. The half open front unrounded, [e], and the open back neutral, [ɑ:] vowels, were also used to substitute the schwa, /ə/, depending on the environment they occurred in. Whenever the schwa, /ə/, was found at word initial or final positions, it was realised as the open front unrounded vowel, [æ], for example, in words like, *arrive*, *about*, *water* and *banana*. The preferred phoneme for the same sound was [e], whenever the sound was situated in the medial position: *impediment* and *hello*.

The severe autistics had the most variants for each of the tested sounds because they have not mastered the skill of coordinating their speech organs to produce target sounds. The mildly impaired had the least variants for each tested sound, mostly because they have mastered the coordination of their tongue to produce the target vowel phoneme. This motor skill is clearly missing in the articulation of severely impaired autistics, while it is not so mastered in the articulation of the moderately impaired. The latter group tends to be distracted when uttering words though they have the ability to utter these target sounds if they are able to put their minds to it.

Also, short vowels were retained 42.9% of the time and substituted 57.1% of the time. The long vowels were mostly retained up to 60% of the time and the 40% of the time they were not retained, their short variants were used in place of the actual input. Autistics tend to prefer long vowels to their shorter counterparts.

For the open central neutral vowel, /ʌ/, presented in the table, five (5) words represented the sound; two (2) from the prepared wordlist with twenty-four (24) realisations each and three (3) other unprepared words. The variant sounds in the output were [ɔ], [ʊ], [o], [ɔ:] and [ʌ]. Among these, open back rounded vowel, [ɔ], was the optimal sound having occurred thirty-three (33) times, that is a total of 64.7%, while all the other variants had less than five (5) frequent occurrences.

The Optimality theoretical analyses for the most frequent variants identified in the central vowel sequences presented in Table 4.4 above are analysed in the subsequent tableaux.

Tableau 4.7: The emergence of [plɔnʤ]

Input: plunge /plʌnʤ/ → [plɔnʤ]

Plunge /plʌnʤ/	***SCHWA**	**MAX-V**	**DEP-IO**
(i) [plʌnʤ]	*!		
☞ (ii) [plɔnʤ]		*	*

Constraint ranking: *SCHWA>>MAX-V>>DEP-IO

Optimal Candidate: [plɔnʤ]

Tableau 4.7 shows the constraints responsible for the emergence of [plɔnʤ] as the optimal candidate. The constraints in Tableau 4.7 are *SCHWA, MAX-V, and DEP-IO. The input and the emergent optimal output are similar, except for the vowel that occupies the peak. However, Candidate (i) incurs a fatal violation against *SCHWA which prohibits the realisation of a central vowel in an output. Therefore, the presence of open central neutral, /ʌ/, in Candidate (i)'s peak violates this constraint. This violation is also a fatal one because *SCHWA is the highest ranked constraint in the tableau; this explains the use of the exclamation mark beside the asterisk. Candidate (i)'s violation of this constraint leads to the emergence of Candidate (ii) as the optimal candidate because in order to obey this highly ranked constraint, Candidate (ii) has substituted its central vowel /ʌ/ with a open back rounded vowel, [ɔ]. Thus, it emerges as the harmonic output.

Candidate (ii)'s emergence as optimal candidate is not deterred by its violation of MAX-V and DEP-IO which require faithfulness to the underlying vowels and a correspondence between output and input segments, respectively. These violations are not fatal because the constraints are not as highly ranked as the first.

The emergence of [plɔnʤ] in place of /plʌnʤ/ is very similar to what is found among typically developing Nigerian children as well as adults, who constantly replace central vowels with back vowels however the departure occurred at other variant realisations by the autistics such as [ploʤ], [plɔːʤ], and [plɑːnʤ] are realisations typical Nigerian English speakers would not utter. Figure 4.2 shows the acoustic representation of *plunge*.

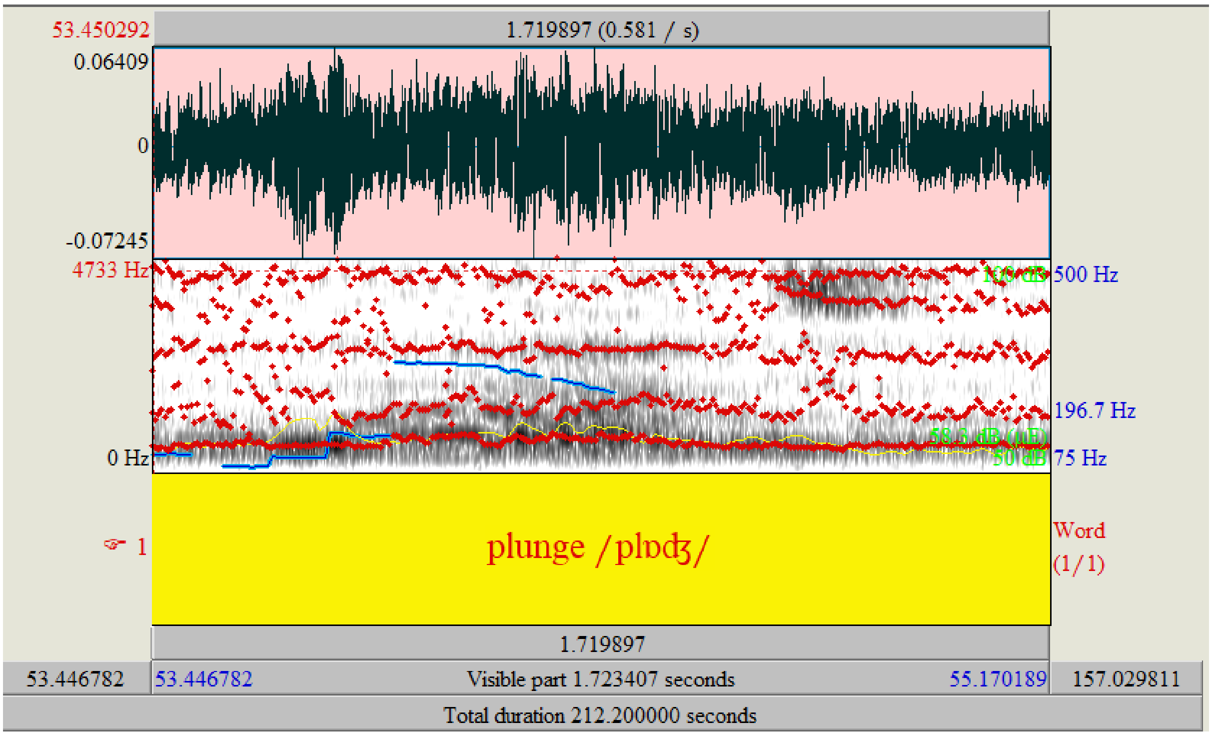

Figure 4.2: Acoustic representation of *plunge*

Figure 4.2 shows the word *plunge* as having a single peak, this is indicated by the blue line which shows pitch. The descension of the blue line shows the presence of a pitch which is a representation of a nucleus. The blue line highlights the peak of the word, disclosing the substitution of the open central neutral vowel, /ʌ/, for the open back rounded vowel, [ɔ], with the following formant values: 418 for F1 and 734.2 for F2. The complex clusters at word initial and final position C^2VC^2 have not been interfered with, and the substitution of the vowel did not affect the structure either.

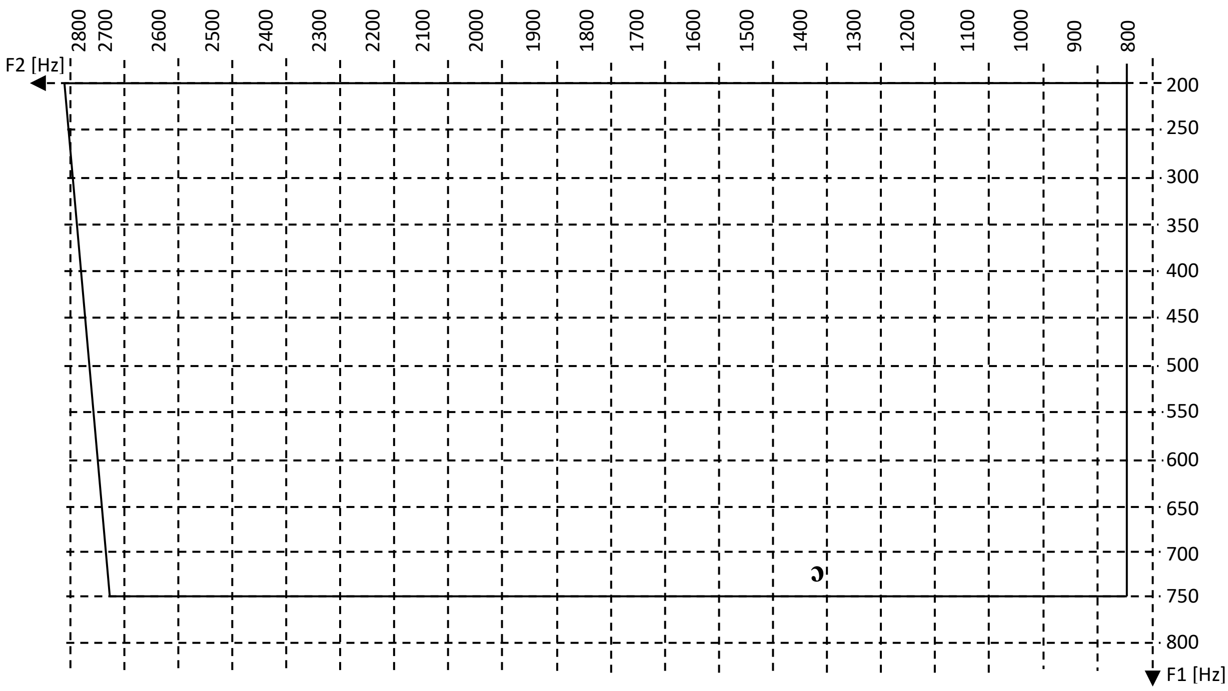

Figure 4.3 Representation of /ɔ/ on acoustic vowel chart

Figure 4.3 shows the position of the open back rounded vowel, /ɔ/, on the acoustic vowel chart. This chart was plotted using the first and second formant values from the spectrogram. It is evident that the rendition of the sound by the participant is quite similar to what obtains in the English language spoken by a typically growing child. The F1 values are within the range of 700 and 750Hz, while the F2 values are within the range of 1400 and 1300Hz.

Tableau 4.8: The emergence of [im.pe.di.men]

Input: impediment /ɪm.pe.dɪ.mənt/→[im.pe.di.men]

Impediment **/ɪm.pe.dɪ.mənt/**	***COMPLEX CODA**	**MAX-V**	**FAITHC**
(i) [ɪm.pe.dɪ.mənt]	*!		
(ii) [im.pe.di.ment]	*!		
(iii) [m.pe.ri.men]		*	**
☞(iv) [im.pe.di.men]			*

Constraint ranking: *COMPLEXCODA>>*ONSET>>FAITHC

Optimal Candidate: [im.pe.di.men]

The schwa sound, /ə/, is one of the most challenging vowels in Nigerian English (NE). It mostly assumes other short vowels depending on the environment it finds itself. In Tableau 4.8, the schwa assumes the half-open front spread vowel, [e]. Candidates (ii), (iii) and (iv) realise the sound as [e], representing typical Nigerian speakers while Candidate (i), representing a standard speaker, was faithful to the input. Candidates (i) and (ii) fatally violate the highest ranked constraint, *COMPLEX CODA. This constraint forbids the coda of the output from occurring in multiple forms; these Candidates, (i) and (ii), retain the complex coda in their outputs and are eliminated. Candidate (iii) is also evicted as a result of its violation of the next highly ranked constraint, *MAX-V. *MAX-V forbids the deletion of any imputed vowel at the output. Candidate (iii) violates this constraint by deleting the initial vowel in its output. Candidate (iv), having satisfied all highly ranked constraints but fails at the least ranking constraint – FAITHC, which insists that all imputed consonants must be represented in the output, emerges the winner.

The next variant of schwa takes the form of the open back neutral vowel, [a], as seen in the following samples presented in Tableaux 4.9 and 4.10.

Tableau 4.9: The emergence of [ɑ.bɑ]

Input: about /ə.baʊt/ → [ɑ.bɑ]

About /ə.baʊt/	***ONSET**	***SCHWA**	**NOCODA**	**MAX**
(i) [ə.baʊt]		*!	*	
(ii) [ɑ.baot]			*	
☞ (iii) [ɑ.bɑ]				*
(iv) [bout]	*!		*	

Constraint ranking: *ONSET>>*SCHWA>>NOCODA>>MAX

Optimal Candidate: [ɑ.bɑ]

The fourth candidate is unable to emerge as an optimal candidate because it violates the highest-ranking constraint, *ONSET, which insists that no output must begin with a consonant. Candidate (iv) violates this constraint by beginning with a consonant. Also, Candidate (i) disobeys the next highly ranked constraint, *SCHWA, which forbids the occurrence of central vowels in the output. This violation occurs because of Candidate (i)'s retention of this vowel in its first syllable. Thus, it is unable to emerge as a harmonic candidate. Candidate (ii) also exits the competition for violating the NOCODA constraint which forbids any segment of the output from ending with a consonant; this candidate, as well as the previously eliminated ones, retained the coda consonant in their outputs and are marked with an asterisk each, leaving Candidate (iv) to emerge as the optimal candidate because it has obeyed the highly placed constraints and violated the least ranking constraint, MAX, instead. MAX forbids any form of deletion in the output. The emergence of [ɑ.bɑ] in the output shows the candidates' preference for back vowels over central vowels, as well as their preference for monophthongs over diphthongs. The preference for back vowels is not unique to autistic children, rather, it is also found among typically developing children as well as adults. However, the choice of pure vowels over diphthongs can be said to be found more with autistic children than typically developing children who are of the same age range with them.

Tableau 4.10: The emergence of [ɑ.rɑ]

Input: arrive /ə.raɪv/→[ɑ.rɑ]

Arrive /ə.raɪv/	*CODA	NO DIPH	MAX
(i) [ə.raɪv]	*!		
☞ (ii) [ɑ.rɑ]			*
(iii) [ɑ.rɑi]		*	
(iv) [ɑ.rɑv]	*!		

Constraint ranking: *CODA>>NO DIPH>>MAX

Optimal Candidate: [ɑ.rɑ]

From the tableau above, Candidates (i) and (iv) incurred a fatal violation for disobeying the highest ranked constraint, *CODA, which forbids an output from ending with a consonant. The retention of voiced labio-dental fricative, /v/, in Candidates (i) and (iv) is responsible for their violation of this constraint. Candidate (iii) also violated NO DIPH constraint, which forbids diphthongs from occurring in an output. The retention of the closing diphthong, /ɑɪ/, in the output leads to Candidate (iii)'s violation of this constraint. This leaves Candidate (ii) to emerge as the optimal candidate because it only incurs a violation against the least ranked constraint, MAX, which disallows any form of deletion in the output. This candidate has some deleted segments in its output and therefore violates this consonant; however, the violation is not a fatal one. Therefore, Candidate (ii) emerges as the optimal candidate.

Tableau 4.11: The emergence of [pɑ:]

Input: pat /pæt/ → [pɑ:]

Pat /pæt/	NOCODA	MAX-V
☞ (i) [pɑ:]		*
(ii) [pæt]	*!	

Constraint ranking: NOCODA>>MAX-V

Optimal Candidate: [Pɑ:]

Two (2) candidates interact with two constraints in Tableau 4.11, Candidate (ii) flouts the highest-ranking constraint, NOCODA, which forbids an output from ending with a consonant. By retaining the voiceless alveolar stop, /t/, in its output, Candidate (ii) has incurred a fatal violation that prevents it from emerging as a harmonic candidate. Candidate (ii)'s elimination allows for Candidate (i) to emerge as the winner for violating the least ranked constraint, MAX-V, which forbids deletion of any vowel sound in the output. Candidate (i) deletes the consonant representing the coda, /t/, and incurs a violation, but not a fatal one, enabling it to still emerge as the optimal candidate.

Tableau 4.12: The emergence of [im.pi.di.ment]

Input: impediment /ɪm.pe.dɪ.mənt/→[im.pi.di.ment]

Impediment /ɪm.pe.dɪ.mənt/	**COMPLEX CODA**	***SCHWA**	***ONSET**	**FAITHV**
(i) [ɪm.pe.dɪ.mənt]		*!		
(ii) [m.pe.di.ment]			*	***
☞ (iii) [im.pi.di.ment]				****
(iv) [im.pe.di.men]	*!			***

Constraint ranking: COMPLEXCODA>>*SCHWA>>*ONSET>>FAITHV

Optimal Candidate: [im.pi.di.ment]

In Tableau 4.12, the fourth candidate is eliminated for incurring a fatal violation against the highest ranked constraint, COMPLEX CODA, which, as the name implies, insists that an output must have multiple consonants at the final segment. Candidate (iv) has ignored this constraint by ending its output with a simple coda. Candidate (i) is next in line to be eliminated for violating the next highly ranked constraint, *SCHWA, which forbids imputing a central vowel in the output. The candidate retains the schwa in its rendition and got eliminated. Following that, Candidate (ii) gets eliminated for disobeying the *ONSET rule, which forbids an output from beginning with a consonant; this candidate deletes the vowel sound at the initial segment, hence, beginning the output with a consonant. Despite the fact that Candidate (iii) incurs more violations than the other candidates in the least ranking constraint on the tableau, it did not violate any of the highly ranked constarints like the other candidates and so, it did not matter how many its violations of the least ranking constraint are, it still emerged as the winner. FAITHV demands that output vowel should be faithful to the input vowel, however, none of Candidate (iii)'s output vowels are faithful to the input, yet, it emerges as the harmonic candidate.

Tableau 4.13: the emergence of [kæ]

Input: car /kɑ:/ → [kæ]

Car /kɑ:/	***V:#**	**DEP –V**
(i) **[kɑ:]**	***!**	
☞ (ii) **[kæ]**		*****

Constraint ranking: *V:#>>DEP-V

Optimal Candidate: [kæ**]**

There are two candidates and two constraints in Tableau 4.13. Candidate (i) is the first to be eliminated for violating the higher ranked constraint, *V:#. This constraint forbids long vowels from occurring at the final position of an output. Candidate (i) retains a long vowel, /ɑ:/, as its final phoneme and is eliminated. Candidate (ii) is able to emerge as the winner because it has violated the lower ranked constraint instead of the higher ranked one. In other words, Candidate (ii) violates DEP-V, which insists that all underlying vowels must be faithful to the input vowels. This violation occurs because Candidate (ii) substitutes its long vowel with a short version, [æ], this way, it does not incur any violation against the higher ranked constraint.

Tableau 4.14 the emergence of [eji:] and [eri:]

Input: early /ɜ:lɪ/ → [eji:] and [eri:]

Early /ɜ:lɪ/	***MAX**	**V: #**	**DEP**
(i) [eli]		*!	
☞ (ii) eji:]			***
☞ (iii) [eri:]			
(iv) [ɜ:lɪ]	*!		

Constraint ranking: *MAX>>V:#>>DEP

Optimal Candidates: [eji:] and [eri:]

For Tableau 4.14, four candidates interact with three constraints. This tableau is a slightly different one as there are two optimal candidates. Candidate (iv) incurs a fatal violation by flouting the *MAX rule, which states that output should not be faithful to the input, thus, the candidate exits from the race for being faithful to the input. Candidate (i) is also eliminated after incurring a fatal violation against V:# which directs that all outputs must end with a long vowel. By ending with a short vowel, this candidate violates this constraint and exits the competition. Finally, Candidates (ii) and (iii), having obeyed the highly ranked constraints, emerged as the optimal candidates. Both candidates incurred similar violations in the least ranked constraint, DEP, which forbids the insertion of sounds not featured in the input. By introducing the voiced palatal semi vowel/glide, [j] and the voiced alveolar approximant, [r], into their outputs, respectively, both Candidates (ii) and (iii) disobeyed this rule. However, these are not fatal violations, therefore, both candidates are still able to emerge as winners together.

4.2.4 Sequence of diphthongs

The English vowels do not accommodate front diphthongs. There are therefore only centring and closing diphthongs in the English vowels and they are considered in this section. The words used to test the centring diphthongs were: *peered; bears, air;* and *pure;* for closing diphthongs: *navigate; sprite, arrive; boys, boy; go; proud* and *about*. Other words spontaneously spoken by participants which were also used in the analysis were: *year, ear, bear, chair, eight, play, way, fine, shine, eye, hello, old, golden, down, round* and *mouth.*

Table 4.5: Variants of centring diphthongs produced by the participants

Variants		Mild	Moderate	Severe	Sub-total (%)	Grand total (100%)
/ɪə/	[e]	-	2	3	5 (19.2)	
	[ie]	6	7	6	19 (73.1)	26
	[i]	-	-	2	2 (7.7)	
/eə/	[e]	3	9	11	23 (46.0)	
	[ie]	6	7	4	17 (34.0)	
	[i]	-	-	4	4 (8.0)	50
	[eɑ]	3	2	1	6 (12.0)	
/uə/	[ɔː]	-	1	-	1 (4.2)	
	[ɔ]	4	6	2	12 (50)	
	[o]	-	2	6	8 (33.3)	24
	[uə]	2	-	1	3 (12.5)	

The issues that permeate the English central vowels overflow to the English centring diphthongs in that the participants favoured monophthongised variants to the actual input, except for the tested centring diphthong /ɪə/ which was replaced with another diphthong [ie], with a frequency of 19, that is (73.1%) out of 26 renditions of the sound. All the mild autistics realised it as [ie], and so did most of the moderately and severely affected autistics. Only 2 moderate and 3 severe autistics reduced the vowel quality to the half open unrounded vowel, [e], (19.2%), while another 2 severe ones realised the diphthong as the half close front unrounded vowel, [i], (7.7%). None of the participants realised the actual input sound.

For the second centring diphthong, /eə/, only 6 (12.0%) out of 50 tokens retained the input sound which is negligible compared to the variant diphthong output [ie] that was produced 17 (34%) times in the words, *bear*, *bears*, *chair* and *air*. The implication of this is that autistics are unable to differentiate between /ɪə/ and /eə/ and as a result, they replace those sounds with the variant [ie]. The tendency for autistics to realise ‘air’ and ‘peer’ with the same variant sound exists. This is a situation that also borders on Nigerian English, however, a typical educated Nigerian English user to an extent would be able to differentiate between the two diphthongs, /ɪə/ and /eə/ even if they may end up interchanging one for the other, they do not always log both sounds together as the autistics did. The popular choice output however, was the monophthongised half open front unrounded/e/ with an output of 23 (46%). These various outputs cut across all autistic types. The only variant peculiar to the severe autistics was the monophthongised close front unrounded vowel, /i/ sound and only 4 (8%) of them realised it as such, while two Milds were able to retain the actual input, one severe also did.

The final centring diphthong, /uə/ generated only 3 (12.5%) actual input out of 24 tokens received for the sound. The most prominent sound was the open back rounded vowel, [ɔ] with an output of 50% by half of the participants. This cuts across all the autistics, regardless of their severity. However, most of the severe autistics, 6 of them and 2 other moderate ones (33.3%) preferred [o] to the close back vowel; but no mild autistics patronised the second popular sound.

In all, centring diphthongs were only retained 9 (9%) times out of the 100 tokens received for centring diphthongs in the data. The popular variant for /ɪə/ and /eə/

remained its uneducated Nigerian version of the sounds, [ie], while the variant for the last sound was [ɔ].

Tableau 4.15: the emergence of [pie]

Input /pɪəd/ (peered) → [pie]

Peered /pɪəd/	***SCHWA**	**NOCODA**	**MAX**
(i) [pɪəd]	*!		
(ii) [ped]		*	*
☞ (iii) [pie]			**

Constraint ranking: *SCHWA>>NOCODA>>MAX

Optimal candidate: [pie]

Tableau 4.15 consists of the interactions of three candidates with three constraints in the process of selecting the optimal output. Candidate (i) incurs a fatal violation for disobeying the highest ranked constraint, *SCHWA, which forbids central vowels from being in the output. Thus, Candidate (i) is eliminated from the competition for retaining a schwa in the output. Candidate (ii) flouts the NOCODA rule, which is the next in the hierarchy of constraints; the rule insists that an output must not end with a consonant. Candidate (ii) ends its output with a coda and is thereby, knocked out of the competition. Finally, Candidate (iii), having obeyed the higher-ranking constraints, fails at the final constraint, MAX, which requires that all outputs must correspond with the input, no deletion is tolerated. Despite failing to satisfy this constraint which ranks least in the tableau by not remaining faithful to the input, Candidate (iii) emerges as the most harmonic candidate of the three candidates.

Tableau 4.16: The emergence of [bes]

Input /beɑz/ (bears) → [bes]

Bears /beɑz/	NODIPH	MAX
(i) [beɑ]	*!	*
(ii) [beɑz]	*!	
☞ (iii) [bes]		**
(iv) [bie]	*!	

Constraint ranking: NO-DIPHTHONG>>MAX

Optimal candidate: [bes]

In Tableau 4.16, Candidates (i), (ii), and (iv) all bow out at the first interaction with the highest ranking constraint, NODIPH, which forbids an output from having a diphthong; these eliminated candidates all retained varying diphthongs in their outputs: Candidates (i) and (ii) have [eə] in their renditions while candidate (iv) had [ie] in its production and as a result, they all got eliminated, leaving Candidate (iii) to emerge winner even after disobeying the least ranking constraint in the hierarchy, MAX, which forbids the deletion of any segment in the output; by deleting the diphthong and replacing it with a monophthong, half open front unrounded vowel, [e], this candidate has violated this rule but still emerges the winner because the constraint was the least in hierarchy.

Tableau 4.17: the emergence of [pjo]

Input /pjʊə/ (pure) → [pjo]

Pure /pjʊə/	NODIPH	*V:#	DEP
☞ (i) [pjo]			*
(ii) [pjɔ:]		*!	
(iii) [pjʊə]	*!		

Constraint ranking: NO-DIPHTHONG>>*V:#>>DEP

Optimal candidate: [pjo]

Tableau 4.17 reveals Candidate (i), having satisfied the highly ranked constraints, as the most harmonic of the three candidates. Although Candidate (i) fails at the least ranked constraint, DEP, which forbids the insertion of any segment not present in the input, it still emerges as the winning candidate. It substitutes the vowel in the output but the violation is not a fatal one. Candidates (ii) and (iii) were knocked out of the competition for incurring a fatal violation for disobeying the higher and the highest-ranking constraints, respectively. By harbouring a long vowel at the final segment of the output, Candidate (ii) violates the higher constraint, *V:#, which forbids a long vowel at the end of an output. Candidate (iii) retains a diphthong in its output, thereby violating the highest-ranking constraint, NODIPHTHONG, which forbids an output from having a diphthong.

Table 4.6: Variants of closing diphthongs produced by the participants

Variants		Mild	Moderate	Severe	Sub-total (%)	Grand total (100%)
/eɪ/	[e]	3	6	8	17 (63)	
	[eɪ]	3	3	2	8 (29.6)	27
	[i]	-	-	2	2 (7.4)	
/ɑɪ/	[ɑ:]	-	3	11	14 (26.9)	
	[ɑɪ]	12	14	5	31 (59.6)	
	[æ]	-	1	3	4 (7.7)	52
	[i:]	-	1	2	3 (5.7)	
/ɔɪ/	[ɔ]	-	3	5	8 (32)	
	[ɔɪ/	6	7	3	16 (64)	25
	[o]	-	-	1	1 (4)	
/əʊ/	[əʊ]	-	-	-	-	
	[o]	6	10	11	27 (100)	27
/ɑʊ/	[ɑ:]	-	7	11	18 (35.3)	
	[ɑʊ]	10	7	6	23 (45.1)	51
	[ɑo]	2	4	4	10 (19.6)	

For the first closing diphthong featured on the table, /eɪ/ was retained 8 (29.6%) times out of the 27 times it was uttered and this choice was made by three mild and moderate and two severe autistics. The prominent variant for this diphthong was the monophthongised half open front unrounded vowel phoneme, [e]; it was produced by most of the participants, 17 (63%) out of the 27 tokens. While 3 of the mildly affected autistics retained the actual input, the other half, 3, opted for the monophthongised popular option, [e]. Three moderate ones were also able to retain the actual input – diphthong, but most of them, 6, followed the popular choice. The half open front rounded vowel, [e] was also the prominent choice of the severe autistics as 8 of them uttered the sound as such while two others retained the actual input, another two chose the close front unrounded vowel, [i], as their choice variant.

The second closing diphthong on the table, /ɑɪ/, was well realised by all the mild autistics both times the sound was featured in the data; it had a frequency of 31 (59.6%) out of 52 tokens. It was also a popular choice among the moderate autistics as 14 of them realised the sound, while three other moderately affected autistics substituted the sound with open back neutral sound, [ɑ:], and each one used either the close front unrounded vowel, [i] or the open front vowel, [æ] in place of the input sound. While the input sound was popular among the mild and severe autistics, it was not so popular among the severe autistics, instead, they opted for open back neutral, [ɑ:] as their preferred variant. Five others retained the input sound; 3 others still used [ɑ:] and 2 more, [i] for their choice variants.

The closing diphthong, /ɔɪ/, just like /ɑɪ/, was the preferred variant among the mild and moderate autistics. All Milds produced the sound as it was and so did the majority of the Moderates. The sound had a frequency of 19 (64%) out of 25 total occurrences. However, this variant was not the choice of the severe autistics as they preferred the open back rounded vowel, [ɔ] to the input sound. Three moderate autistics also shared this option, bringing the total occurrence to 8 (32%), one severe autistic did not stop there but still explored [o] as a possible variant, although its occurrence is quite negligible.

This closing diphthong, /əʊ/, happens to be the most challenging sound for the autistics, not necessarily because it is a difficult sound to produce, but because all the participants assumed the sound was referring to the letter ‘o’ and as a result, every single participant in all the three categories of autism did not produce the diphthong, rather, the monophthongised the sound, [o]. Therefore, the lone variant of the input produced had a 100% occurrence and the actual input had 0% occurrence in the table.

The final closing diphthong on the table is /ɑʊ/, which was well retained by 10 mild autistics out of the 12 tokens for the sound received from them. Only 7 moderately impaired autistics were able to retain the sound and 5 other severe autistics as well, making the total occurrence of 23 (45.1%) out of 51 occurrences of the sound. The open back neutral vowel, [ɑ:], was the other popular choice for the moderate autistics and the popular choice for the severe autistics. The total occurrence for this sound was 18 (35.3%). The third option for the sound, /ɑo/ made a worthy competition as two mildly affected autistics realised the input diphthong as such. Four moderate and severe autistics each produced it as such.

Mild autistics easily retained the closing diphthongs to the tune of 73.8%, that is, 31 times in the 42 occurrences of the diphthong they were substituted 11 times (11.9%) which is totally negligible. This indicates that mildly affected autistics are able to produce closing diphthongs. The moderately affected were able to retain actual diphthongs 31 (47%) times out of 66 tokens received for the sounds and substituted 35 times, that is, 53%. This suggests that moderately impaired autistics are able to produce target closing diphthongs but are slightly more prone to substituting phonemes. Lastly, the severe autistics were hardly able to retain the closing diphthongs. They retained it 16 (21.6%) times out of 74 times the closing diphthongs occurred in the data – they mostly preferred monophthongised variants and this occurred 58 times (78.4%). The reason is not far-fetched, the diphthong is a more complex form of vowels and if they found it difficult to coordinate their tongue to hit the target monophthongs, the diphthong is two vowel sounds put together. It is expected that they will experience more difficulties in producing the sounds.

There are some theoretical analyses of some of the dominant patterns discussed in the table of this section.

Tableau 4.18: The emergence of [nɑvige]

Input: /nɑvigeɪt/ (navigate) → [nɑvige]

Navigate /nɑvigeɪt/	NODIPH	NOCODA	MAX
(i) [nɑvigeɪt]	*!		
(ii) [nɑviget]		*	
☞ (iii) [nɑvige]			*

Constraint ranking: NO-DIPHTHONG>>NOCODA>>MAX

Optimal candidate: [nɑvige]

In Tableau 4.18, the highest-ranking constraint is the NO DIPHTHONG constraint which forbids an output from having a diphthong. This important constraint is violated by Candidate (i), which retains a diphthong in its output for which it receives a fatal violation and is eliminated from the competition. Candidate (ii) also follows suit having violated the next highly ranked constraint in the hierarchy, NOCODA. This constraint disallows an output from retaining a coda consonant; this candidate ends its output with a coda and is excused from the competition. Candidate (iii) having obeyed the highest ranking constraint and violating the least constraint emerges as the winner because this constraint has the least rankings in the hierarchy. Following this section is the acoustic representation of *navigate.*

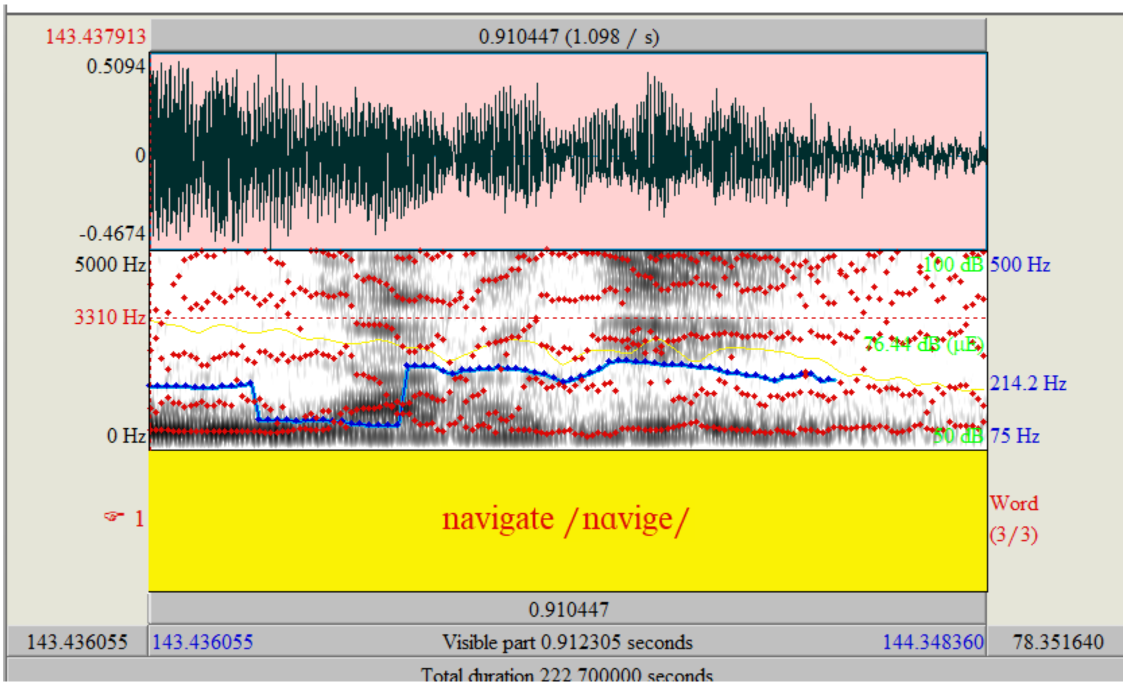

Figure 4.4: Acoustic representation of *navigate*

The final syllable of the word is the focus of the acoustic analysis in Figure 4.4. From the spectrogram in Fig. 4.4, it can be viewed from the way the formants detectors run freely towards the end of the utterance that the segment was rendered open with no coda. The pitch of the syllable is as high as 214.2 Hz and the intensity is at 76.44 dB.

For the next closing diphthong presented, /aɪ/, the highest differing variant, [ɑ:], after the actual input which was the optimal output, had a total of 14 (26.92%) productions, ‘sprite’ will represent the emergence of [ɑ:] in place of /ɑɪ/.

Tableau 4:19: The emergence of [sprɑːt]

Input: /spraɪt/ (sprite) → [sprɑːt]

Sprite /spraɪt/	***NOCODA**	**NODIPH**	**FAITH-V**
☞ (i) [sprɑːt]			*
(ii) [spɑː]	*!		
(iii) [spraɪt]		*	

Constraint ranking: *NOCODA>>NO-DIPHTHONG>>FAITH-V

Optimal candidate: [sprɑːt]

Tableau 4.19 shows the constraints interaction which made the optimal candidate emerge winner. The highest-ranking constraint in the tableau is the *NOCODA constraint which insists that all outputs must have a coda; Candidate (ii) flouts this constraint and incurs a fatal violation for having an output without a coda; thus, it is eliminated from the competition. The next highly ranked constraint is NO-DIPHTHONG, which forbids diphthongs in the output. Candidate (iii) disobeys the rule by retaining the closing diphthong, /ɑɪ/ in its output and it is issued a violation mark; the shaded boxes show that they are barred from the competition. Hence, there is an opportunity for Candidate (i) to emerge as the winner despite violating the least ranked constraint, FAITH-V, which requires faithfulness to the input vowel; by monophthongising the diphthongs in the output, the winning candidate violated the least ranked constraint but this violation is not fatal.

Tableau 4.20: the emergence of [bɔs]

Input /bɔɪz/ (boys) → [bɔs]

Boys /bɔɪz/	NODIPH	DEP	MAX
(i) [bo]		*	**
(ii) [bɔɪz]	*!		
☞ (iii) [bɔ]			*

Constraint ranking: NO-DIPHTHONG>>DEP>>MAX

Optimal candidate: [bɔs]

In Tableau 4.21 above, three candidates interact with three constraints to vie for the most harmonic candidate. Candidate (ii) is the first to exit for incurring a fatal violation against the highest constraint, NODIPH, which forbids an output from having a diphthong; this candidate is guilty of violating this rule by possessing a diphthong in its output. Candidate (i) also got eliminated from the competition for disobeying the next highly ranked constraint in the hierarchy, DEP, which states that output must correspond to the input therefore, output must not harbour any epenthetic segment [o], in this case which was exactly what this candidate did. The emergence of Candidate (iii) is not without the violation of the least ranked constraint, MAX, which forbids the deletion of any segment in the output; however, the winning candidate was obviously missing a segment in its output but because the constraint is not a serious one, it is still able to emerge as the winner.

Tableau 4.22: the emergence of [go]

Input /gəʊ/ (go) → [go]

Go /gəʊ/	**NODIPH**	**DEP**
☞ (i) [go]		*
(ii) [gəʊ]	*!	

Constraint ranking: NO-DIPHTHONG>>DEP

Optimal candidate: [go]

Tableau 4.22 reveals how Candidate (i) emerges as the more harmonic of the two candidates. This candidate obeyed the higher constraint, NODIPH, which forbids an output from bearing a diphthong. This constraint is violated by Candidate (ii) because of its possession of a diphthong in its output, thereby, eliminating it from the competition. Thus, this paves the way for Candidate (i) to emerge winner because it has obeyed the higher ranked constraint and disobeyed the least ranked constraint, DEP, which states that output must correspond to the input, therefore, output must not harbour any epenthetic segment. By substituting the diphthong sound /əʊ/ and replacing it with /o/, this candidate flouts this constraint but still emerges the winner because the constraint is the least in the tableau.

Tableau 4.23: The emergence of [prɑ:d]

Input: /praʊd/ (proud) → [prɑ:d]

Proud /praʊd/	**NO-DIPH**	**FAITH-V**
☞ (i) [prɑ:d]		*
(ii) [praʊd]	*!	
(iii) [paʊd]	*!	

Constraint ranking: NO-DIPHTHONG>>FAITH-V

Optimal candidate: [prɑ:d]

Tableau 4.23 shows the constraints interaction which made the optimal candidate to emerge as winner. The highest ranked constraint in the tableau is NO-DIPHTHONG which forbids diphthongs in its output. Both Candidates (ii) and (iii) disobey the rule by having diphthongs in their output and are issued the fatal violation mark; the shaded boxes show that they are barred from the competition. Hence, there is an opportunity for Candidate (i), to emerge as winner despite violating the lower constraint, FAITH-V, which requires faithfulness to the input vowel. The winning candidate is not faithful to the input vowel because it substitutes the diphthong with a monophthong in the output but this violation is not strong enough to hinder it from emerging as the optimal candidate in this competition.

4.2.5 Sequence of triphthongs

All the triphthongs in English are closing triphthongs because they are generated from all the closing diphthongs and the schwa. The words used to test triphthongs were: *loyal, lawyer, royal, flour, flower, our, hour, fire, choir, quiet, mower, sower, player,* and *prayer*. Below are the closing triphthongs as realised by the participants.

Table 4.7: Variation of the triphthongs produced by the participants

Variants		Mild	Moderate	Severe	Sub-total (%)	Grand total (100%)
/ɔɪə/	[ojæ]	**7**	**9**	**10**	**26 (36.1)**	72
	[ɔɪə]	4	2	-	6 (8.3)	
	[ɔjæ]	3	13	11	31 (43.1)	
	[ɔɪ]	-	3	6	9(12.5)	
/ɑʊə/	[ɑ:]	8	7	5	20 (20.8)	96
	[ɑʊæ]	7	10	6	23 (24)	
	[ɔ:]	-	7	4	11 (11.5)	
	[ɑʊə]	4	-	1	5 (5.2)	
	[æwæ]	5	9	12	26 (27.1)	
	[ɑʊ]	-	3	2	5 (5.2)	
	[ɑɪ]	-	-	2	2 (2.1)	
	[æjæ]	-	-	2	2 (2.1)	
	[iɑ]	-	-	2	2 (2.1)	
/eɪə/	[eijæ]	6	4	-	10 (20.8)	48
	[eɪə]	2	2	-	4 (8.3)	
	[ejæ]	4	12	14	30 (62.5)	
	[eɑ]	-	-	2	2 (4.2)	
	[e]	-	-	2	2 (4.2)	
/ɑɪə/	[æjæ]	10	12	11	33(67.4)	49
	[ɑ:]	-	2	5	7 (14.3)	
	[ɑɪə]	2	4	2	8 (16.3)	
	[æje]	-	-	1	1 (2.0)	
/əʊə/	[oɑ]	-	-	2	2 (4.1)	48
	[owæ]	8	10	12	30 (62.5)	
	[o]	-	5	2	7 (14.6)	
	[əʊə]	4	3	2	9 (18.8)	

The triphthongs posed a different level of challenge to all the participants as they found it problematic to say all three individual monophthongs within a single utterance or breath effort. Production of triphthongs by all categories of autistics was 32 (8.9%) times out of 361 tokens expected for all the triphthongs in the data. Looking at the performances of each autistic category, the trend preceding the last two sections persisted, with the mild attempting the target sounds with most success 14 (18.9%), than the other subgroups, and the moderately impaired ones 11 (9.4%) following after. The severely impaired ones were only able to produce the input 5 (4.2%) of the time.

The most preferred variant for the first triphthong, /ɔɪə/, was [ɔjæ] which was produced 31 (43.1%) times. This outcome was most common with the moderate and severe autistics whose next choice variant was the most preferred for the mild autistics, [ojæ], with an output of 26 (36.1%). The actual input was the least favoured variant as both the moderate and the severe autistics opted for the diphthonged version of the input [ɔɪ], three more times than the target triphthong, making an occurrence of 9 (12.5%), thus, performing better than the input which had only 6 (8.3%) occurrences in the table.

The next triphthong, /ɑʊə/, in Table 4.7 generated the most variant in the table; there were 9 variants compared to the average of 4 or 5 generated by the others. The most dominant variants as seen in the table are not too far apart in frequency: 26 (27.1%), 23 (24.0%) and 20 (20.8%) for [æwæ], [ɑʊæ] and [ɑː], respectively. The strength of numbers came to fore again as the predominant variant was decided by moderate and severe autistics, whereas this choice was the mild autistics' third choice, while their second-choice variant was also the second-choice variant for the mild autistics. The mild autistics' popular choice, [ɑː], was the third choice of the moderate and severe autistics with an output of 20 (20.8%). The fourth-choice variant of the sound was another monophthongised variant, [ɔː], produced by 7 moderate and 4 severe autistics, giving it an output of 11 (11.5%). All the other variants, including the target input /ɑʊə/ and its diphthongised variant, [əʊ], had 5 (5.2%) outputs each and are thus, negligible. The remaining three variants, [ɑɪ], [æjæ] and [iɑ] were all uttered by severe autistics and had an output of 2 (2.1%) each.

The third target triphthong, /eɪə/, had the lowest output as itself as attempted by only 2 mild and moderate autistics, each giving it a total of 4 (8.3%) out of the 48 times it was rendered. The mild autistics' popular variant, [eijæ], was only rendered 4 times by moderate autistics and was not rendered at all by the severe autistics. Thus, the frequency of the variant amounted to 10 (20.8%). The popular variant option for the sound as determined by moderate and severe autistics was [ejæ] with a frequency of 30 (62.5%) which only 4 mild autistics produced. The other options [eɑ] and its monophthongised version [e], were both produced by 2 severe autistics each with a frequency of 2 (4.2%) each.

The last two triphthongs in Table 4.7, /ɑɪə/ and /əʊə/, were the unifying triphthongs in the sense that all the autistics seemed to agree on an optimal output in both cases, while for the other first three triphthongs tested, the mild autistics stood alone while the moderates and the severe ones decided the prominent variants. This was not the case for the fourth and fifth triphthongs in the table. The prominent variant for /ɑɪə/ was [æjæ], with an output of 33 (67.4%) as decided by all the categories of autistics. While 10 of the mildly impaired autistics opted for this option, 2 others were able to retain the actual input. Four moderate and 2 severe ones were also able to achieve production of the target input, making a total of 8 (16.3%) for the actual sound. The monophthongised variant, [ɑ:], was the next choice of 2 moderate and 5 severe participants, with an output of 7 (14.3%). The lone variant by a severe autistic was [æje], with an output of 1 (2.0%).

For the final triphthong in Table 4.7, /əʊə/ was realised in two ways by the mild autistics, it was realised in three ways by the moderate ones and in 4 ways by the severe ones. In all, the emergent option was [owæ] by all the categories with an output of 30 (62.5%) out of 48 tokens received for the sound. It had the highest retention of the input sound which came next to the popular variant. The closing triphthong, /əʊə/, had a frequency of 9 (18.8%). Next to it was [o] with a frequency of 7 (14.6%) as rendered by 5 moderate and 2 severe autistics. Again, there is a lone sound, [oɑ], uttered by 2 severe autistics - 2 (4.1%) - making it a negligible figure.

Because of the complexity of the triphthongs, there was an expected poor performance by all the participants in the retention of the sounds. Even at that, the last sound featured in the table seemed to be the easier triphthong of the lot because it had the highest retention frequency by all the categories of autistics. Subsequently, Optimality theoretical analyses for the most frequent variants identified in Table 4.7 are presented.

Tableau 4.24: The emergence of [rojæ]

Input: /rɔɪəl/ → [rojæ]

Royal /rɔɪəl/	***HIATUS**	***COMP NUC**	**FAITH-V**
☞ (i) [rojæ]			**
(ii) [rɔɪəl]	*!	*!	

Constraint ranking: *HIATUS>>*COMPLEX NUCLEUS>>FAITH-V

Optimal Candidate: [rojæ]

Tableau 4.24 presents the constraints possible for the emergence of the optimal candidate: [rojæ]. The highest ranking constraint, *HIATUS, forbids the occurrence of two adjacent vowels, that is, two adjacent vowels cannot be linked to two sets or features. The second in the rank of highly placed constraints, *COMPLEX NUCLEUS, also disallows the coexistence of complex nucleus in the output. These two highly placed constraints were fatally violated by Candidate (ii), the presence of a triphthong in the output of Candidate (ii) disqualifies it from the competition; making Candidate (i) emerge as the optimal candidate, despite its violation of the lowly ranked one, FAITH-V and an obedience of the highly ranked one. FAITH-V requires faithfulness to the underlying vowels. By introducing epenthesis /j/ and substituting other vowels in the output, the winning candidate violates the constraint but this violation is not a fatal one.

Tableau 4.25: the emergence of [fævæ]

Input /flɑʊə/ (flower)→[fæwæ]

Flower /flɑʊə/	*HIATUS	*L-ONS	MAX
(i) [flæwæ]		*	
(ii) [flɑʊə]	*!		
☞ (iii) [fæwæ]			*

Constraint ranking: *HIATUS>>*L-ONS>>MAX

Optimal Candidate: [fæwæ]

Tableau 4.25 reveals the constraints responsible for the emergence of the optimal candidate: [fæwæ]. The highest-ranked constraint, *HIATUS, forbids the occurrence of two adjacent vowels, that is, two adjacent vowels cannot be linked to two sets or features, this very important constraint was fatally violated by Candidate (ii) by retaining a diphthong in its output; therefore, it is eliminated from the competition, leaving Candidates (i) and (iii). The second in the rank of highly placed constraints is *L-ONS, which permits the avoidance of liquids in certain positions in the output, this constraint was violated by Candidate (i) for retaining the lateral sound, /l/, in its output; and is also eliminated from the competition, making Candidate (ii) to emerge as the optimal candidate, despite violating the last constraint that is lowly placed, that is, MAX, which insists that every segment in the output must correspond to the input. The output of the winning candidate does not correspond to the input but this violation is not a fatal one, hence, the emergence of this candidate as the harmonic candidate.

Tableau 4.26: The emergence of [pejæ]

Input /preɪə/ (prayer)→ [pejæ]

Prayer /preɪə/	*HIATUS	*L-ONS	MAX
☞ (i) [pejæ]			*
(ii) [preɪə]	*!		
(iii) [preɪjæ]		*	

Constraint ranking: *HIATUS>>*L-ONS>>MAX

Optimal Candidate: [pejæ]

Tableau 4.26 presents the constraints for the emergence of the harmonic candidate: [pejæ]. The highest ranked constraint, *HIATUS, forbids the occurrence of two adjacent vowels, that is, two adjacent vowels cannot be linked to two sets or features, this constraint is violated by Candidate (ii) for retaining adjacent vowels in its output; therefore, this candidate got eliminated from the competition. Candidate (iii) is also evicted from the tableau for flouting the second highly placed constraint in the hierarchy, *L-ONS, which permits the avoidance of liquids in certain positions in the output. This candidate retains an approximant, /r/, in its output. This leaves Candidate (i) to emerge as the optimal candidate even after violating the least constraint, MAX, which insists that every segment in the output must correspond to the input; the winning candidate's output does not correspond to the input but this does not deter it from emerging as the optimal candidate.

Tableau 4.27: The emergence of [pæjæ]

Input /fɑɪə/ (fire) → [pæjæ]

Fire /fɑɪə/	***FRICATIVES**	**DEP**
(i) [faɪjæ]	*!	**
☞ (ii) [pæjæ]		****
(iii) [fɑɪə]	*!	

Constraint ranking: *FRICATIVES>>DEP

Optimal Candidate: [pæjæ]

In Tableau 4.27 above, *FRICATIVES prevents fricatives from surfacing in the output and it is ranked the highest in the tableau. Both Candidates (i) and (iii) disobey this rule by having the voiceless fricative /f/ in their outputs and both incur fatal violations for which they both exit the competition, giving way for Candidate (ii) to emerge as winner for obeying the highly placed constraint and violating the least constraint, DEP, which forbids epenthetic sounds of any segment in the output. In this case, the actual segments of the input have entirely been deleted and replaced with epenthetic sounds in the output by the winning candidate but this offence is not a fatal one. A figure of the acoustic representation of *fire* is provided on the next page.

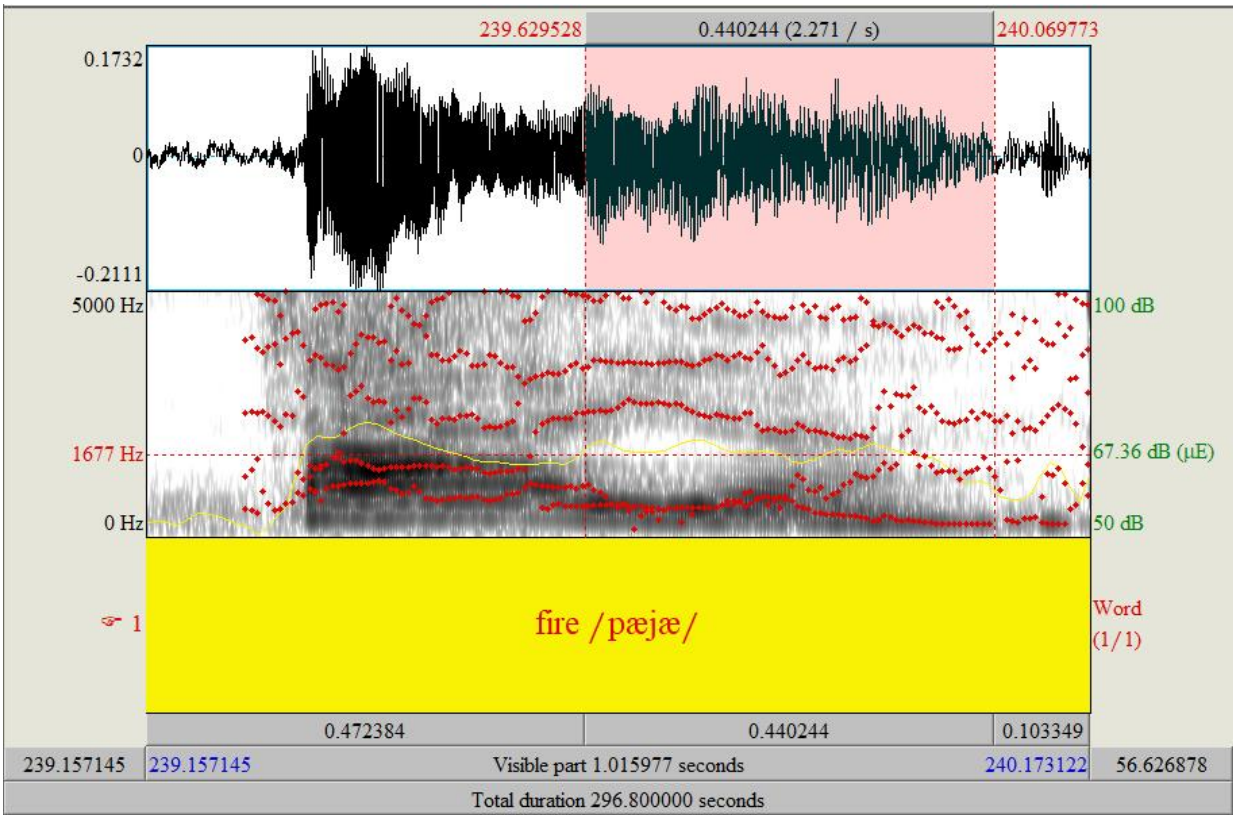

Figure 4.5: Acoustic representation of *fire*

The acoustic analysis in Fig. 4.5 presents the spectrogram for the word, *fire*. The CV^3 structured word has been converted to a CVCV-structured word in the output with a high pitch value of 264.4Hz and an intensity of 67.52dB. The figure shows a slight build up of acoustic energy for the articulation of the voiceless bilabial plosive /p/ together with the short vowel /æ/. The break in the spectrogram indicates the insertion of the epenthetic /j/ which terminates at the repetition of the short vowel, /æ/.

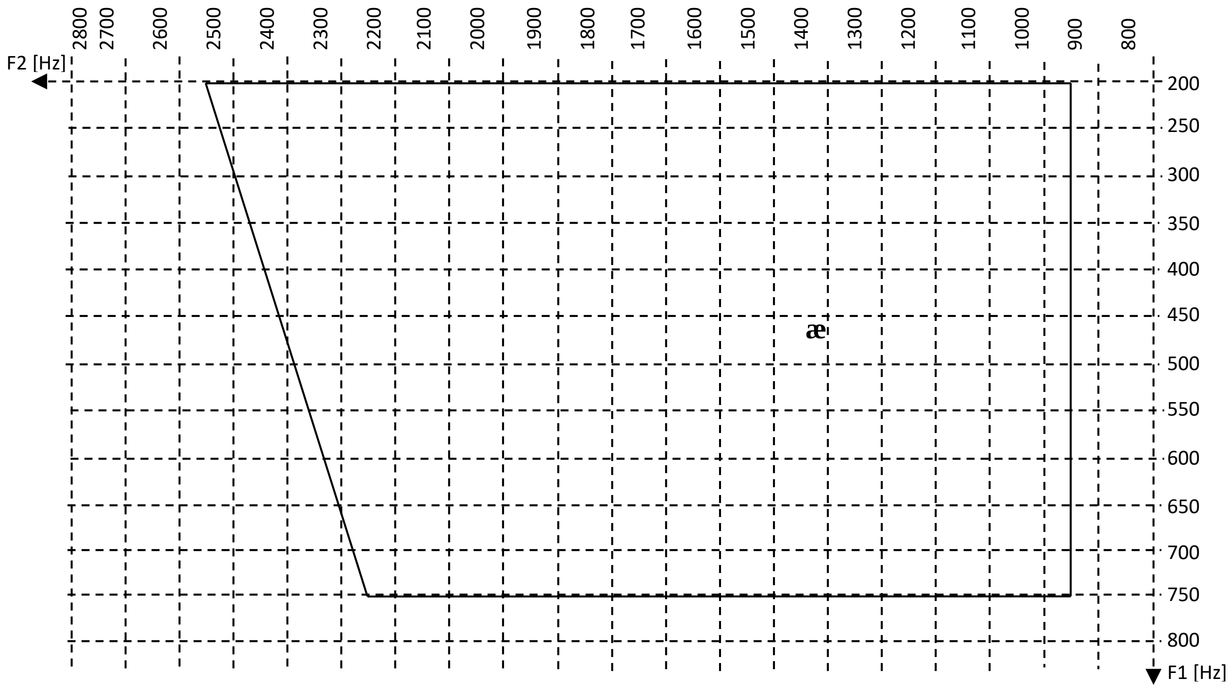

Figure 4.6 Representation of /æ/ on acoustic vowel chart

Using the F1 and F2 values from the spectrogram, the acoustic vowel chart was plotted for /æ/ as uttered by the participants. It is evident that the vowel is more mid and central than what is found on the Englis vowel chart. This shows that these participants rendition of this vowel is quite subtle and weak, almost like a central vowel. It takes mastery to differentiate and produce accordingly and this is yet to be attained by the participants.

Tableau 4.28: The emergence of [owæ]

Input /səʊə/ (sower) → [owæ]

Sower /səʊə/	***FRICATIVES**	**DEP**
☞ (i) [owæ]		****
(ii) [sowæ]	*!	**
(iii) [səʊə]	*!	

Constraint ranking: *FRICATIVES>>DEP
Optimal Candidate: [owæ]

Tableau 4.28 above presents *FRICATIVES as the highest ranked constraint, this constraint prevents fricatives from surfacing in the output. Candidates (ii) and (iii) both incur fatal violations for disobeying this constraint, and having the voiceless fricative /s/ in their outputs, therefore, they do not emerge as optimal candidates. Instead, Candidate (i) emerges as the winner for obeying the highly placed constraints and violating the least constraint, DEP, which forbids epenthetic sounds in outputs. Just like in Tableau 4.27, the actual input sounds have been deleted and replaced with epenthetic sounds in the output as seen in the optimal candidate's output but this violation is not a serious one; hence, the emergence of the candidate as the optima candidate is on course. The acoustic representation of *sower* is presented on the next page.

4.2.6 Consonant phoneme sequence in autistic children's onsets

The following words were purposively used to test the sequencing of consonant phonemes – *lawyer, loyal, royal, navigate, fountain, fire, court, car, put, pat, peered, pure, bears, boys, bottle, go, sower, mower* and *colleague.* In addition to these words, the severely affected autistic children also spontaneously produced some words which were also used for analysis. These were *little, round, fine, correction, cup, cookie, come, neck, boy, banana, bear, bag, golden, garden, girl, sun, mister* and *mouth.* In consonance with the first objective of this study, individual consonant phonemes are discussed in relation to how they are patterned. This discussion has been patterned and analysed according to manner of articulation.

Table 4.8: Variants of the participants' stops

Variants		Mild	Moderate	Severe	Sub-total (%)	Grand total (100%)
/b/	[b]	18	29	25	72 (93.5)	77
	-	-	-	5	5 (6.5)	
	[b]	3	-	3	6 (6.3)	
	[p]	21	29	30	80 (83.3)	
	[dp]	-	2	-	2 (2.1)	
/p/	[pp]	-	2	-	2 (2.1)	96
	[f]	-	-	1	1 (1.0)	
	[kj]	-	-	1	1 (1.0)	
	-	-	3	1	4 (4.2)	
/m/	[m]	6	9	8	23 (88.5)	26
	-	-	-	3	3 (11.5)	
/n/	[n]	6	7	8	21 (84)	25
	[d]	-	-	1	1 (4)	
	-	-	2	1	3 (12)	
/k/	[k]	18	27	26	71 (92.2)	77
	[dk]	-	1	2	3 (3.9)	
	[t]	-	-	-	1 (1.3)	
	-	-	-	2	2 (2.6)	
/g/	[g]	6	9	9	24 (88.9)	27
	-	-	-	3	3 (11.1)	

Table 4.8 shows how the participants produced stops in their utterances. Their articulation of the plosive sounds was generally very well done as well as their nasal and velar stops as the least percentage of success was 83.3%. Although the severe autistic children had more variants than the moderate and mild autistics, these variants were not as many or varied as those found under the vowel phonemes.

Table 4.9: Variants of the participants' fricatives

Variants		Mild	Moderate	Severe	Sub-total (%)	Grand total (100%)
/f/	[f]	12	15	13	40 (80)	50
	[p]	-	1	1	2 (4)	
	[k]	-	-	1	1 (2)	
	[b]	-	1	-	1 (2)	
	-	-	2	4	6 (12)	
/s/	[s]	6	8	7	21 (84)	25
	[d]	-	1	-	1 (4)	
	[r]	-	-	2	2 (8)	
	-	-	-	1	1 (4)	

In Table 4.9, there are four and three variants for the voiceless labiodental fricative /f/ as well as the voiceless alveolar fricative /s/, respectively. As found in the previous table, the most variants are also found in the severe autistic children's utterances, while the mild autistics did not have any variant, however, the moderate autistics produced a few variants. This shows that, when it comes to communication and language skills, the autistics are mild, although this does not automatically mean that they are also mild where social and behavioural skills are concerned.

Table 4.10: Variants of the participants' laterals

Variants		Mild	Moderate	Severe	Sub-total (%)	Grand total (100%)
/l/	[r]	-	-	2	2 (4.1)	49
	[j]	-	1	4	5 (10.2)	
	[l]	12	17	13	42 (85.7)	
/r/	[j]	-	-	2	2 (8)	25
	[l]	-	2	2	4 (16)	
	[r]	6	7	6	19 (76)	

Table 4.10 shows the distribution of the variants for the articulation of /l/ and /r/ among the autistic children. Similar to the other consonant phonemes, the highest number of variations is present among the severe autistic children, while the mild autistics were able to produce the sounds as they were required of them. The moderate autistic children, however, had one other variant apart from the expected phoneme. It is important to note however, that the same set of variants was found in /l/ and /r/.

4.2.7 Consonant phoneme sequence in autistic children's coda

The patterns of the simple coda produced by the autistic children were examined in this section of the work. The instrument used to test these structures were *sprite, navigate, put, pat, court, eight, quiet, loyal, royal, bottle, little, tickle, table, girl, arrive, proud, peered, bread, head, boys, bears, please, fountain, fine, sun, golden, shine, down, children, garden, correction, bag* and *colleague.* Analysis of these simple codas has been done using the manner of articulation for the classification of the phonemes concerned.

Table 4.11: Variants of participants' stops in simple codas

Variants		Mild	Moderate	Severe	Sub-total (%)	Grand total (100%)
	[t]	30	34	6	70 (57.4)	
/t/	[s]	-	12	38	50 (41.0)	122
	-	-	-	2	2 (1.6)	
	[d]	8	11	3	22 (44.0)	
/d/	[wd]	-	-	1	1 (2.0)	50
	-	4	7	16	27 (54)	
	[g/	5	5	3	13 (52.0)	
/g/	[n]	-	-	3	3 (12.0)	25
	-	1	4	4	9 (36.0)	
	[n]	6	8	12	26 (78.8)	
/n/	-	-	2	5	7 (21.1)	33

In Table 4.11, the participants performed fairly well in their articulation of simple codas. However, the few variants that they produced also had quite high percentages. For instance, in their articulation of voiceless alveolar stop, /t/, the moderate and severe autistic children produced a variant, voiceless alveolar fricative, [s] for the sound which occurred only twice but deleted the simple coda, 41.0% of the time. However, the mild autistics were able to produce the sound correctly all the times they were required to. In the case of voiced alveolar stop, /d/ however, there was only a 44% success rate among the participants, while they were unable to produce the sound at all 54% of the time. During these times, they were silent, not even substituting the sound with any other producing such words as [prɑː] for /prɑʊd/ *proud*; [pie] for /piəd/ *peered* and [bre] for /bred/ *bread*. In the cases of the voiced velar plosive, /g/ and voiced alveolar nasal, /n/, however, there were 52% and 78.8% success rates, respectively, and these were found across all the participants. They did not produce the sounds in these coda positions 36% and 21% of the time, respectively. It is very conspicuous that consonant phonemes occupying the coda are deleted or unarticulated more of the times than onsets. This is a distinguishing feature that cuts across all the autistic children, whether mild, moderate or severe.

The next most realised simple coda following the voiceless alveolar stop, /t/, was another voiceless alveolar but nasal sound, /n/. It was produced 26 times out of 33 tokens received for the sound, taking up 78.8%, while 7 (21.2%) deletions were witnessed by the sound. It is a decisive sound in the sense that it also did not generate any variants, it was either realised or deleted and from the table above, indicating that autistics are able to produce the sound mostly and a few others could not; similarly, in the case of the onset as well, majority were able to produce the nasal sound at the onset position and a few were unable to do so.

The voiced velar plosive, /ɡ/, was produced 13 (52%) out of 25 total outputs. Nine, 9 (36%) others deleted the sound at the coda position; three (12%) others substituted the sound with the alveolar nasal, /n/. This sound was one of the easily produced sound at the onset position as 88.9% were able to produce the sound without difficulties at the onset position. The sound only witnessed three instances of deletions at the onset position and no substitution. What this tends to reveal is that the sound is mostly preferred at the onset position than at the coda position by autistics.

Table 4.12: Variants of participants' fricatives in simple coda

Variants		Mild	Moderate	Severe	Sub-total (%)	Grand total (100%)
	[f]	-	1	1	2 (8.3)	
	[v]	6	6	4	16 (66.7)	
/v/	[s]	-	2	3	5 (20.8)	24
	-	-	-	1	1 (4.2)	
	[s]	6	11	3	20 (40.8)	
/z/	[z]	6	2	1	9 (18.4)	49
	-	-	5	15	20 (40.8)	

Table 4.12 contains the participants' realisations of some fricatives, and although there are variants for these phonemes, all of them are fricatives, they only differ in terms of voice or place of articulation. Also, in the case of voiced labiodental fricative /v/, there was a 66.7% success rate, and at other times, the participants produced the voiceless labiodental fricative, [f] on two occasions [ɑrɑf] in place of /ərɑɪv/ *arrive* and voiceless alveolar fricative, [s], [ɑrɑs] on one instance. The remaining 5 participants did not produce it at all, hence, deleting the coda. In the realisation of the voiced alveolar fricative, /z/ however, the participants were only able to produce the voiced alveolar fricative 18.4 percent of the time, instead, the voiceless counterpart [s] of this phoneme was produced 40.8% and so, in the place of *boys* /bɔɪz/ and *bears* /beɑz/, [bɔs] and [bes] were preferred. At other times, they were not produced at all, particularly among the moderate and severe autistics.

The voiced labio-dental fricative, /v/, is another sound that autistics found easy to articulate at the coda position as 16 (66.7%) out of 24 autistics were able to produce the sound. Two of them (8.3%) substituted the sound with its voiceless counterpart, [f] while one (4.2%) other substituted the sound with another fricative, but the voiceless alveolar, [s]. The sound witnessed 5 (20%) deletions from autistics that were unable to utter any sound at the coda position. Another sound that was averagely articulated by autistics at the coda position is the voiced alveolar plosive, /d/, it was rightly realised by 22 (44%) out of 50 tokens generated. Twenty-seven (54%) others deleted the sound producing [prɑ:] in place of *proud* /prɑʊd/ while a lone epenthetic [w] –[prɑwd] surfaced before the coda making it a rare occurrence of complex coda in place of simple coda.

With the voiced alveolar fricative, /z/, there was an expected total of 49 tokens. The sound was only realised 9 times (18.4%) and deleted 20 times (40.8%). It also happened to be the most substituted coda as 20 (40.8%) others substituted the sound in place of deletion and the voiceless fricative [s] was preferred above the actual input of the voiced counterpart /z/. The most realised coda was the voiceless alveolar stop, /t/, which was produced 70 times out of 122 tokens received for the simple coda taking up 57.4 percentages. The sound was also deleted 50 times, that is to the tune of 41% leaving a negligible room of 1.6%, for 2 instances of substitutions. Two autistics opted for the voiceless fricative [s] in place of the voiceless alveolar input /t/.

Table 4.13: Variants of participants' lateral in simple coda

Variants		Mild	Moderate	Severe	Sub-total (%)	Grand total (100%)
	[l]	6	2	-	8 (10.6)	
/l/	-	12	12	31	68 (89.5)	76

For the simple coda, deletion was the dominant process that pervaded the participants' production, for instance, in Table 4.15, deletion happened 89.5% of the times, while the lateral sound was produced only in 10.6% of the total renditions. Also, these deletions are not unique to one group of autistics, rather, it is found across all the levels of severity.

So far, the most neglected coda is /l/, out of a total of 76 tokens received for that sound, only 8 autistics were able to produce the sound; it did not generate any variant but was deleted 68 times, that is 89.5% of the time. Autistics were able to realise the sound to the tune of 85.7% at the onset position but found it much more difficult to produce the sound at the coda position and therefore resulted into deleted coda. The theoretical analyses of the significant coda phonemes have been discussed previously.

4.3 Patterns of consonant clusters in autistic children

The patterns of consonant clusters used by the participants were investigated in this section of the study. There are a maximum three consonants within a cluster at the onset of an English syllable, and a maximum of four consonants within a cluster at the coda of an English syllable. Thus, the investigation of consonant clusters was patterned likewise. The complex onsets were tested using a prepared wordlist as well as spontaneously produced words. The words were *sculpts*, *sprint*, *impediment,* and *plunge*; these were engaged for the analysis of complex onsets. Likewise, the clusters in the codas were examined using the following words: *scupts/sculpt, plunged/plunge, sprint* and *impediment.* Other words spontaneously spoken that were also analysed in this section were: *please, play, quiet* and *want.*

4.3.1 Patterns of complex onsets in autistic children

For the patterns of complex onsets, analysis was done according to the number of phonemes in the consonant clusters which are either C^2 or C^3.

Table 4.14: Variants of participants' sequence in C^2 onset

Variants		Mild	Moderate	Sere	Sub-total (%)	Grand total (100%)
/sk/	[sk]	6	6	5	17 (70.8)	24
	[st]	-	1	-	1 (4.2)	
	[tw]	-	1	-	1 (4.2)	
	[t]	-	-	2	2 (8.3)	
	[k]	-	-	1	1 (4.2)	
	[sdk]	-	1	-	1 (4.2)	
	[h]	-	-	1	1 (4.2)	
/pl/	[pl]	10	16	12	38 (76)	50
	[pr]	2	2	2	6 (12)	
	[p]	-	-	6	6 (12)	
/pr/	[pr]	12	14	9	35 (72.9)	48
	[pl]	-	-	4	4 (8.3)	
	[p]	-	2	5	7 (14.6)	
	[pj]	-	1	-	1 (2.0)	
	[ppr]	-	1	-	1 (2.0)	
/fl/	[f]	-	-	6	6 (12.5)	48
	[pl]	-	1	-	1 (2.1)	
	[w]	-	1	1	2 (4.2)	
	[fl]	12	16	10	38 (79.2)	
	[l]	-	-	1	1 (2.1)	
/kw/	[k]	-	-	2	2 (8)	25
	[w]	-	-	1	1 (4)	
	[r]	-	-	1	1 (4)	
	[kw]	6	8	4	18 (72)	
	[j]	-	1	-	1 (4)	
	-	-	-	2	2 (8)	

In Table 4.14, the words were used to test complex onsets which have two consonant phonemes. The tested complex onsets were /sk, pl, pr, fl, kw/ and the words that were used are *plunge, screw, sculpts, sprite, sprint, player, prayer, flower, flour, choir* as well as *play*, *please* and *quiet.* The participants were able to adequately articulate the complex onsets, although a few of them, especially the severely impaired autistic children produced these onsets in ways that were different from the perceived sounds for instance, while two others totally deleted the C^2 complex onset structure.

The mild autistics also produced a few variants, but they were predominantly able to articulate the structures that were read out to them. In the case of /sk/, there was a 70.8% success rate, and all the mild autistics produced the sounds appropriately, while there were some variants from the moderate and severe autistics. In /pl/, there was a 76% success rate, the severe autistics produced two other variants apart from the expected structures, and these other variants constituted 8 of the expected tokens. In /pr/ and /fl/, there were also success rates of 72.9% and 79.2%, respectively. /kw/ was successfully rendered 72% of the time.

Tableau 4.29: The emergence of [pejæ]

Input /pleɪə/ (player) → [pejæ]

Player /pleɪə/	*HIATUS	*L-ONS	MAX
☞ (i) [pejæ]			*
(ii) [pleɪə]	*!		
(iii) [pleɪjæ]		*	

Constraint ranking: *HIATUS>>*L-ONS>>MAX

Optimal Candidate: [pejæ]

In Tableau 4.29, the constraints responsible for the emergence of the harmonic candidate, [pejæ], are presented. Candidate (ii) incurs a fatal violation of the highest ranked constraint, *HIATUS, which forbids the occurrence of two adjacent vowels, that is, two adjacent vowels cannot be linked to two sets or features. Thus, by retaining a triphthong in its rendition, Candidate (ii) disobeys this important rule and is eliminated. The second highly placed constraint in the hierarchy, *L-ONS, mandates the avoidance of liquids in certain positions in the output. This constraint is violated by Candidate (iii) which retains a lateral sound /l/ in its output and exits the competition. This leaves Candidate (i) to emerge as the winner despite violating the least constraint, MAX, which insists that every segment in the output must correspond to the input; the output of the winner is not faithful to the input but this violation is not a serious one and that is the reason it emerges as the optimal candidate. It is not unexpected that Candidate (ii), which contains a triphthong and Candidate (iii) which contains a diphthong are not the harmonic candidates. Especially with triphthongs, correct articulation is usually challenging, even among typically developing children and adults in Nigeria. Therefore, it is no surprise at all that triphthongs are not the candidates' first option. Although diphthongs are not as complex as triphthongs, it is still not a first option for the participants.

Tableau 4.30: The emergence of [fæwæ]

Input /flɑʊə/ (flour) → [fæwæ]

Flower /flɑʊə/	***HIATUS**	***L-ONS**	**MAX**
(i) [flæ]		*	*
(ii) [flɑʊə]	*!		
☞ (iii) [fæwæ]			*

Constraint ranking: *HIATUS>>*L-ONS>>MAX

Optimal Candidate: [fæwæ]

The highest ranked constraint for Tableau 4.30, *HIATUS, forbids the occurrence of two adjacent vowels, that is, two adjacent vowels cannot be linked to two sets or features, this very important constraint is fatally violated by Candidate (ii) and is eliminated from the competition for retaining adjacent vowels in its output. Candidate (i) also defaults in the second highly placed constraints, *L-ONS. This constraint permits the avoidance of liquids in certain positions in the output. Thus, Candidate (i)'s violation of this constraint leads to its elimination from the competition, in other words, Candidate (i)'s retention of a liquid sound /l/ in its production is responsible for its non-emergence as an optimal candidate. Candidate (iii) emerges as the most harmonic candidate of the three, although not without incurring a violation of its own in the least constraint, MAX, which insists that every segment in the output must correspond to the input. The output of the winning candidate does not correspond to the imputed segments but this violation is not a serious one and so it still emerges as the optimal candidate.

Table 4.15: Variants of the participants' sequence in C³ onset

Variants		Mild	Moderate	Severe	Sub-total (%)	Grand total (100%)
/skr/	[skr]	2	3	-	5 (20.8)	24
	[sk]	3	4	2	9 (37.5)	
	[skw]	1	-	-	1 (4.2)	
	[dr]	-	-	1	1 (4.2)	
	[k]	-	1	3	4 (16.7)	
	[kr]	-	1	-	1 (4.2)	
	[h]	-	-	1	1 (4.2)	
	-	-	-	2	2 (8.2)	
/spr/	[spr]	7	8	2	17 (35.4)	48
	[spl]	-	4	-	4 (8.3)	
	[sp/	5	6	8	19 (39.6)	
	[p]	-	-	6	6 (12.5)	
	-	-	-	2	2 (4.2)	

Table 4.15 shows the complex onsets that were used to test the participants' consonant clusters. The specific combination of phonemes that were used are /skr/ and /spr/ and these are present in the following words, *sprint, sprite*, and *screw*, The participants had some difficulty with producing these complex onsets because only 20.8% of them were able to produce /skr/, and these outputs came from the mild and the moderate autistics only, while the severe autistic children were unable to produce this complex onset. As evident in the table, the variants that the severe autistics produced had only two consonant phonemes, two produced [sku:] and one produced [dru:], another as [du:] in them, in place of /skru:/ *screw,* showing that a complex onset with three consonants is an extreme difficulty for the severe autistics.

In the case of /spr/ also, there was only a success rate of 35.4% and majority of these came from mild and moderate autistics, while only two tokens came from the severe autistic children. Generally, also, the participants performed better with C^2 complex onsets than C^3, especially the severe autistic children. The following are the Optimality representations of the dominant onsets from the previous tables.

Tableau 4.31: The emergence of [du:]

Input /skru:/ (screw) → Output [du:]

Screw /skru:/	***COMPLEX ONSET**	***V:#**	**MAX**
(i) [sku:]	*!	*	*
☞ (ii) [du:]		*	**
(iii) [skru:]	*!	*	

Constraint ranking: *COMPLEX ONSET >>*V:#>>MAX

Optimal Candidate:[du:]

Tableau 4.31 contains three constraints and three candidates. The first constraint, *COMPLEX ONSET is the highest ranked constraint. It discourages syllables from having complex onsets. Candidates (i) and (iii) fail to comply with this important constraint by retaining the clusters in their onsets; therefore, they incur fatal violations as a result. However, Candidate (ii) obeys this constraint by having only one consonant in its onset. Candidate (ii) emerges as the winner despite violating the second and third constraints, *V:# and MAX. The first, *V:#, prohibits an output from ending with a long vowel, while the second, MAX, requires faithfulness to input, that is, no deletion of any segment is allowed. However, the winning candidate failed at these constraints by retaining a long vowel in its output as well as not being faithful to the underlying segments of the input. Despite these violations, Candidate (ii) still emerges as the optimal candidate because it violates lesser constraints so as to obey the highest ranked constraint in the tableau. The emergence of [du:] over /skru:/ is a total replacement of the C^3 complex onset with a simple onset – a clear preference for a structure that involves less acoustic energy and articulatory effort. The acoustic analysis of *screw* is presented next.

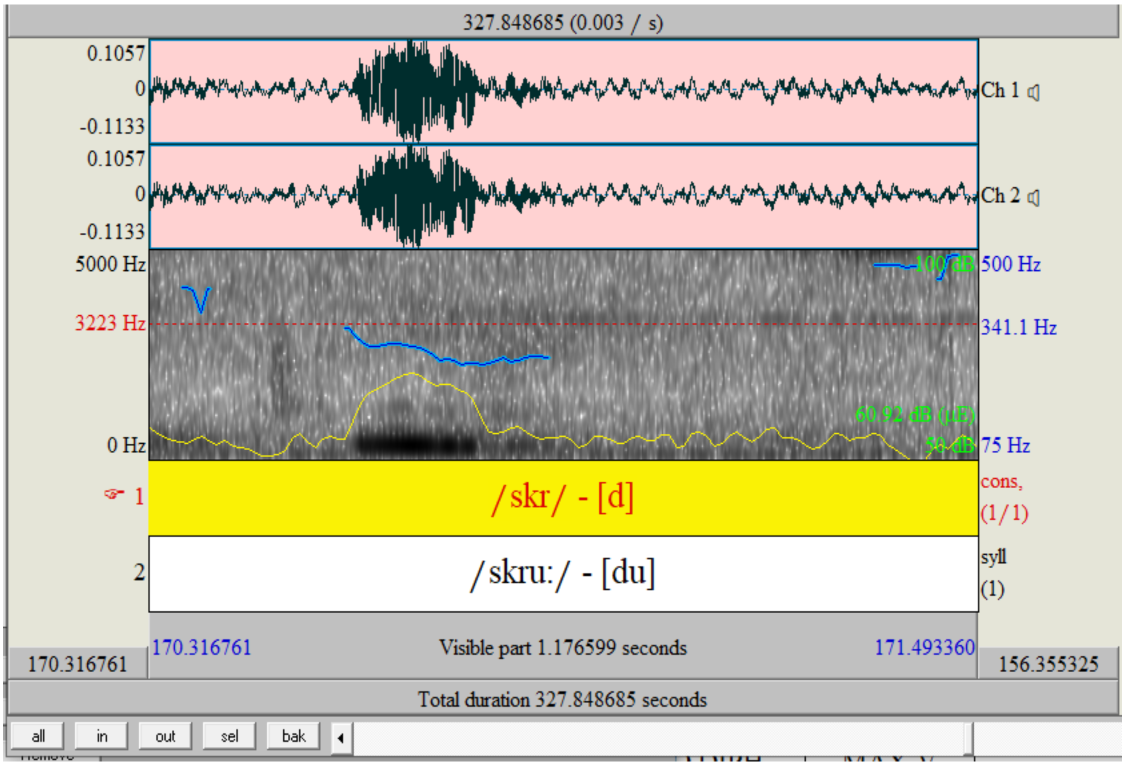

Figure 4.7: Acoustic representation of *screw*

The acoustic representation of *screw* is presented in Figure 4.7. From the faint occupied spectrogram, the faint force in realising the voiced alveolar plosive [d] and the rounded back vowel [u:] clearly shows that the uttered word does not entail complex onsets /skr/. A fricative such as /s/ should have been represented by spectrogram waves that line the better part of the image because fricatives entail a consistent release of air, however, this is absent from the spectrogram – an indication that the complex onset which ought to have been initiated by the voiceless alveolar fricative /s/ is absent. Thus, the structure of the utterance changes from a C^3 structure to a C^1 structure. The structure has a high pitch value of 341.1 Hz and an intensity of 60.92 dB realised in 1.17 seconds.

4.3.2 Patterns of complex codas in autistic children

The English language permits up to four (0-4) consonants in the cluster at the coda position of a syllable. Therefore, in this aspect of the analysis, the complex codas were grouped into C^2, C^3 and C^4, based on the number of consonants in the cluster. The following words were used to test these complex codas – *sculpts/sculpt, plunge/plunged, sprint, want,* and *impediment*.

Table 4.16: Variants of participants' C^2 coda clusters

Variants		Mild	Moderate	Severe	Sub-total (%)	Grand total (100%)
/nʤ/	[w]	-	-	1	1 (4.2)	24
	[n]	-	1	-	1 (4.2)	
	[ng]	-	-	1	1 (4.2)	
	[ʤ]	2	4	-	6 (25.0)	
	[nʤ]	4	3	-	7 (29.7)	
	[nts]	-	1	-	1(4.2)	
	-	-	-	7	7 (29.7)	
/nt/	-	1	3	10	14 (28.6)	49
	[n]	-	4	6	10 (20.4)	
	[nt]	10	10	1	21 (42.9)	
	[t]	1	1	1	3 (6.1)	
	[s]	-	-	1	1 (2.6)	

Two combinations of consonant clusters were used to test C^2 coda clusters and these combinations were /nʤ/ and /nt/. The success rate was 29.7% and this was found among the mild and moderate autistic children only. These sets of autistics were also able to produce the affricate in the cluster only, the children that fell within this category constituted 25%. The severe autistics deleted the clusters totally – they were unable to articulate the sound at all. In the next instance, 42.9% of the participants were able to produce /nt/, and the mild and moderate autistics constituted the majority of this group.

/-nʤ/ was rendered in 6 variants: /w, ng, n, ʤ, nʤ, nʧ/. In the data, 7 (29.2%) were able to accurately produce the sounds representing the coda, retaining the segments. Another 7 (29.2%) others completely deleted the sounds representing the complex coda segments producing [plɔ:] in plce of /plʌnʤ/ *plunge*. Eight (33.3%) each realised the other 5 varying sounds representing the coda segments. The pattern displayed in the rendition of the variant outputs shows that in the most (25%) rendered variant, the voiced alveolar affricate, /ʤ/ -[plɔʤ], while the nasal /n/, was mostly deleted. In other words, C_1 was mostly deleted and C_2 was retained. On only one occasion was C_2 /ʤ/ deleted and C_1 /n/ retained in [plɔn]. All the other options were rendered once (4.2%). Three instances of substitution were noted, first, the voiced velar stop /g/ was used in place of the affricate and the voiceless affricate substituted the voiced counterpart in the second instance. In both cases, C_2 was deleted and replaced. The third instance witnessed the deletion of both C_1 and C_2 and replaced it with a semi-vowel glide.

The last complex coda structure tested was /-nt/ which occurred thrice and generated 49 tokens. Autistics thrived better on this combination of consonants at the coda position as a total of 21 (42.9%) rightly produced the sounds representing the segment; 14 (28.6%) others completely deleted the sounds –[spi:] instead of /sprɪnt/ for *sprint*; though 10 (20.4%) reduced the structure from a CC to a C, deleting the alveolar stop, /t/-[im.pe.di.men] for /ɪm.pe.dɪ.mənt/ *impediment*, that is C_2 while retaining C_1 /n/; and only 3 (3.2%) preferred the alveolar stop /t/ to the alveolar nasal, /n/ and so they deleted C_1 and retained C_2 –[im.pe.di.met]. There is another lone case of substitution as one severely affected autistic deleted both C_1 and C_2 and replaced it with voiceless fricative, [s] in *want* /wɔnt/ to [wɔs].

In Table 4.16 above, the consonants of the complex coda were presented. These codas were found in 5 words among which, /-nt/ occurred thrice, therefore, a total of 49 representations are expected for it; the other two complex coda representations occur only once each. A sum of 32% entirely deleted the coda segments from the tested words; another 28.9% were able to correctly maintain the structure while the remaining 39.2% was left to be divided among all the other variants. A total number of 31 deletions occurred out of 97 instances leaving 66 instances of coda renditions. Among the number that rendered coda in varying degrees (38), 97.8% deleted one or more segments of the coda; 13.2% inserted new segments or substituted some sounds in the segment.

Tableau 4.32: The emergence of [plɔʤ]

Input: plunge /plʌnʤ/ → [plɔʤ]

Plunge /plʌnʤ/	***SCHWA**	***COMP CODA**	**MAX**
(i) [plʌnʤ]	*!		
(ii) [plɔnʤ]		*!	
☞ (iii) [plɔʤ]			*

Constraint ranking: *SCHWA>>*COMPCODA >>MAX

Optimal Candidate: [plɔʤ]

Tableau 4.32 shows the constraints responsible for the emergence of [plɔʤ] as the optimal output. The constraints in the analysis above are *SCHWA, *COMPLEXCODA, and MAX. Three candidates interact with the constraints to vie for the most harmonic output. Candidate (i) incurs a fatal violation of the highest placed constraint, *SCHWA, which prohibits the realisation of a central vowel in an output. Therefore, the presence of the central vowel, /ʌ/, in candidate (i)'s peak violates this constraint. Candidate (ii) also exits the competition for disobeying the second highly placed constraint namely, *COMPLEX CODA, this constraint forbids an output from retaining multiple consonants at the coda position of a word which this candidate disobeys by having more than one consonant in its output. Candidate (iii) emerges as the optimal candidate after violating MAX which forbids the deletion of any segment represented in the input from the output. The violation is not fatal because the constraint is not highly ranked as the others and despite the deletion of one of the coda representations, this candidate still emerges the most harmonic of all.

Tableau 4.33: The emergence of [spi:]

Input: sprint /sprɪnt/ → [spi:]

Sprint /sprɪnt/	*COMPCODA	*L-ONS	*CODA	MAX
(i) [sprɪnt]	*!	*	*	
☞ (ii) [spi:]				***
(iii)[/spri:t]		*	*	*
(iv)[/spi:n]			*	**

Constraint ranking: *COMPCODA>>*L-ONS>>*CODA>>MAX

Optimal Candidate: [spi:]

In Tableau 4.33, Candidate (i) incurs a fatal violation having disobeyed the highest ranked constraint *COMPLEX CODA which forbids output from bearing more than one consonant at the final position of a word, hence, it is eliminated for having more than one coda representations in its rendition. Candidate (iii) gets dismissed next from the competition for incurring a violation of the second highly ranked constraint, *L-ONS, which forbids an onset segment from retaining liquids in the output, this candidate retains an approximant, /r/ in its production and is excused. The next ranked constraint, *CODA, was violated by Candidate (iv) and the previously eliminated contestants, the constraint disallows output from having a coda; this constraint was violated and causes the candidate involved to bow out of the competition. With all other candidates eliminated, Candidate (ii) emerges as the winner having been the only candidate with the violation of the least ranking constraint, MAX, which forbids the deletion of any segment, in the output. Below is the acoustic representation of the *sprint.*

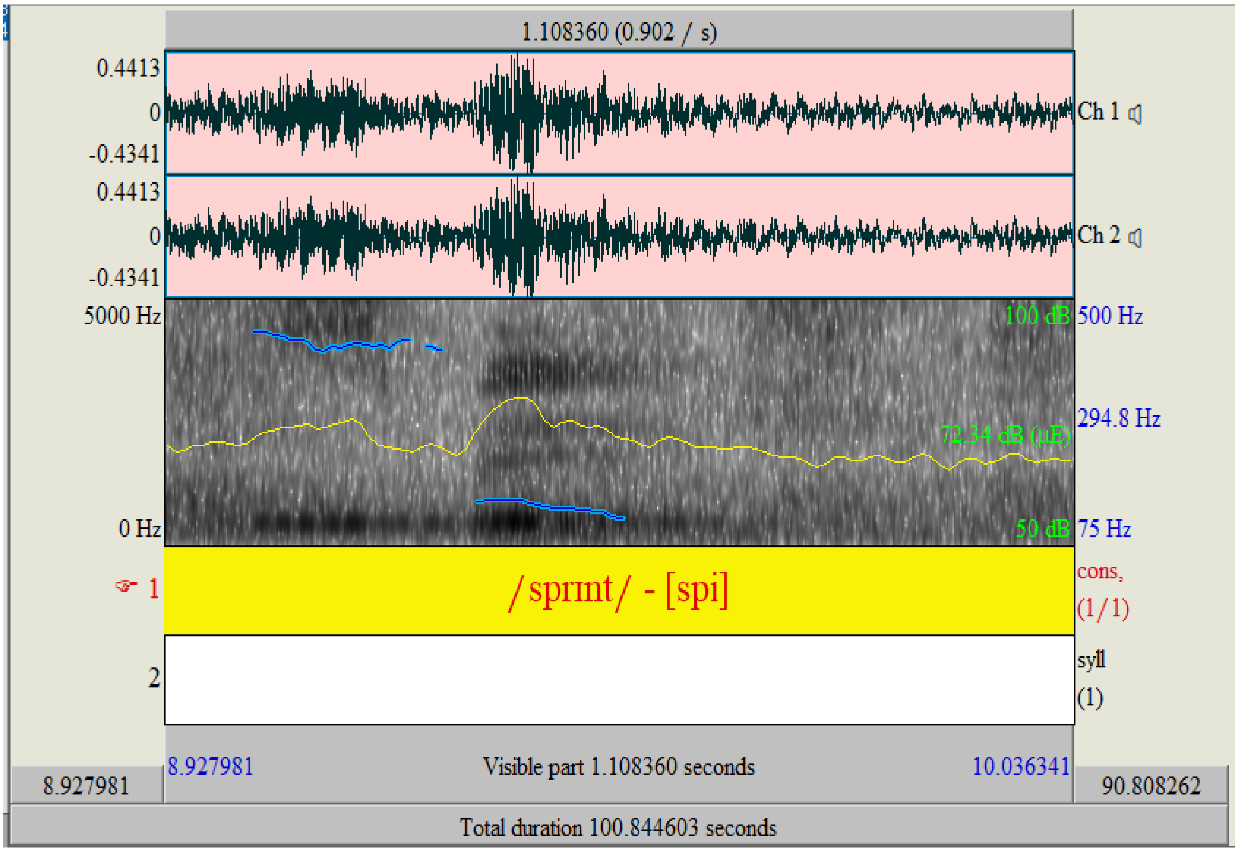

Figure 4.8: Acoustic representation of *sprint*

The figure presented above is that of *sprint*. It reveals how the word has been realised without its coda representations. Hence, the voiceless fricative, /s/, can be spotted then the brief closure before the voiceless stop, /p/. The conspicuous loss of the approximant /r/ and the long monophthong, /i:/, in place of the deleted codas. The intensity value runs at 72.34 dB while its pitch is at 294.8 Hz.

Table 4.17: Variants of the participants' C^3 coda clusters

Variants		Mild	Moderate	Severe	Sub-total (%)	Grand total (100%)
/ndʒd/	[n]	-	2	3	5 (20.8)	24
	[dʒ]	-	2	-	2 (8.3)	
	[ndʒ]	4	5	1	10 (41.7)	
	[ndʒd]	2	-	-	2 (8.3)	
	-	-	-	5	5 (20.8)	
/lpt/	-	-	-	5	5 (20.8)	24
	[p]	-	3	1	4 (16.7)	
	[t]	-	2	3	5 (20.8)	
	[pt]	4	4	-	8 (33.3)	
	[lpt]	2	-	-	2 (8.3)	

In Table 4.17, /nʤd/ was used to test a C3 coda cluster and of the expected 24 tokens, only 2 were produced successfully by mild autistics, while the moderate and severe autistics were unable to produce the cluster at all. In fact, rather than produce this cluster, they deleted all or at least one of the phonemes realising plunge /plʌnʤd/ as either [plɔn], [plɔʤ], or [plɔnʤ]. The severe autistics deleted all three phonemes the most. In the second instance of the consonant cluster /lpt/, only two tokens were produced out of 24 expected tokens; these two came from the mild autistic children. Also, the mild and moderate autistic children deleted the lateral sound, /l/, that is C^1 in the cluster and produced only [pt] -C^2 and C^3 rendering [skɔpt] for /skʌlpt/ *sculpt*.

The severe autistic children mainly deleted (20.8%) all the sounds –[skɔ], while others produced only one phoneme in place of the three; either [skɔt] or [skɔp]. Undoubtedly, the participants experienced much more difficulty with the C3 codas than other aspects of an English syllable. This is not a surprise because of the articulatory effort that clusters require and the varying levels of language impairment that the autistic children experience.

Table 4.18: Variants of the participants' C^4 coda clusters

Variants		Mild	Moderate	Severe	Sub-total (%)	Grand total (100%)
/lpts/	[ts]	1	-	-	1 (4.2)	24
	[t]	-	2	-	2 (8.3)	
	[pt]	3	3	-	6(25.0)	
	[ps]	-	1	-	1(4.2)	
	[p]	-	1	1	2 (8.3)	
	[pts]	1	-	-	1(4.2)	
	[n]	-	-	1	1 (4.2)	
	-	1	2	7	10 (41.2)	

For the first complex coda tested, /-lpts/ was rendered in 7 different forms and none of the variant outputs was exactly faithful to the input: [n, ts, t, ps, pt, pts, p] Most of these variants were produced by 1(4.8%) participant each; the most frequent variant was [pt] which occurred 6 (25%) times producing –[skɔpt] in place of /skʌlpts/ *sculpts*. The voiceless labial plosive, [p], and the voiceless alveolar plosive, [t], were other variants exceptions that occurred twice (8.3%) each. In all, 8 (33.3%) were able to produce some form of complex coda, all of which were made up of not more than two consonants at the coda position. All 10 (41.7%) remaining completely deleted the entire coda segments –[skɔ:]. A closer look at the pattern of the variant outputs reveals that the voiced alveolar lateral, /l/, representing the C_1 was the most deleted because it did not feature even once in the variant outputs; the voiceless bilabial plosive, /p/, and the voiceless alveolar plosive, /t/, that is, C_2 and C_3 were equally and mostly featured in the variant outputs however, $C_{4,}$ the voiceless alveolar fricative, /s/, was averagely featured in the variant output. There is however a lone case of substitution featuring /n/ in the variant output rendered –[skɔn].

The trend from the above seems to suggest that autistics had more difficulty producing codas than onsets and so deletion and substitution helped them in uttering the complex coda to an extent. Presented below is the optimality analysis of prominent sounds discussed.

Tableau 4.34: The emergence of [skɔ:]

Input: /skʌlpts/ (sculpts) → [skɔ:]

Sculpts /skʌlpts/	***COMPLEX^{CODA}**	**NO CODA**	**DEP-IO**
(i) [skɔt]		*!	*
(ii) [skɔlpts]	*!	*!	*
☞ (iii) [skɔ:]			*
(iv) [skʌlpts]	*!	*!	

Constraint ranking: *COMPLEX^{CODA}>>NO CODA>>DEP-IO

Optimal Candidate: [skɔ:]

Tableau 4.34 displays the constraints involved in the selection of the optimal candidate. The highest ranked constraint, $*COMPLEX^{CODA}$, which prohibits the presence of complex codas in a segment is fatally contravened by Candidates (ii) and (iv), hence, eliminating them from being the optimal as the two candidates possessed complex codas in their productions. NO CODA requires that coda in a segment is not allowed, this is the next highly ranked constraint; this constraint is violated by Candidate (i) by retaining a consonant at the coda segment of its output. Therefore, together with the previous candidates, Candidate (i) is also eliminated; having violated the first two highly ranked constraints. This allows Candidate (iii) to emerge the optimal candidate; having satisfied the highly ranked constraints but disobeyed the least ranked, DEP-IO, which disallows insertion of new segments. The substitution of the actual sound for **/ɔ:/** by the winning candidate assigns it a violation which is not fatal, hence, its emergence. On the next page is the acoustic representation of *sculpts*.

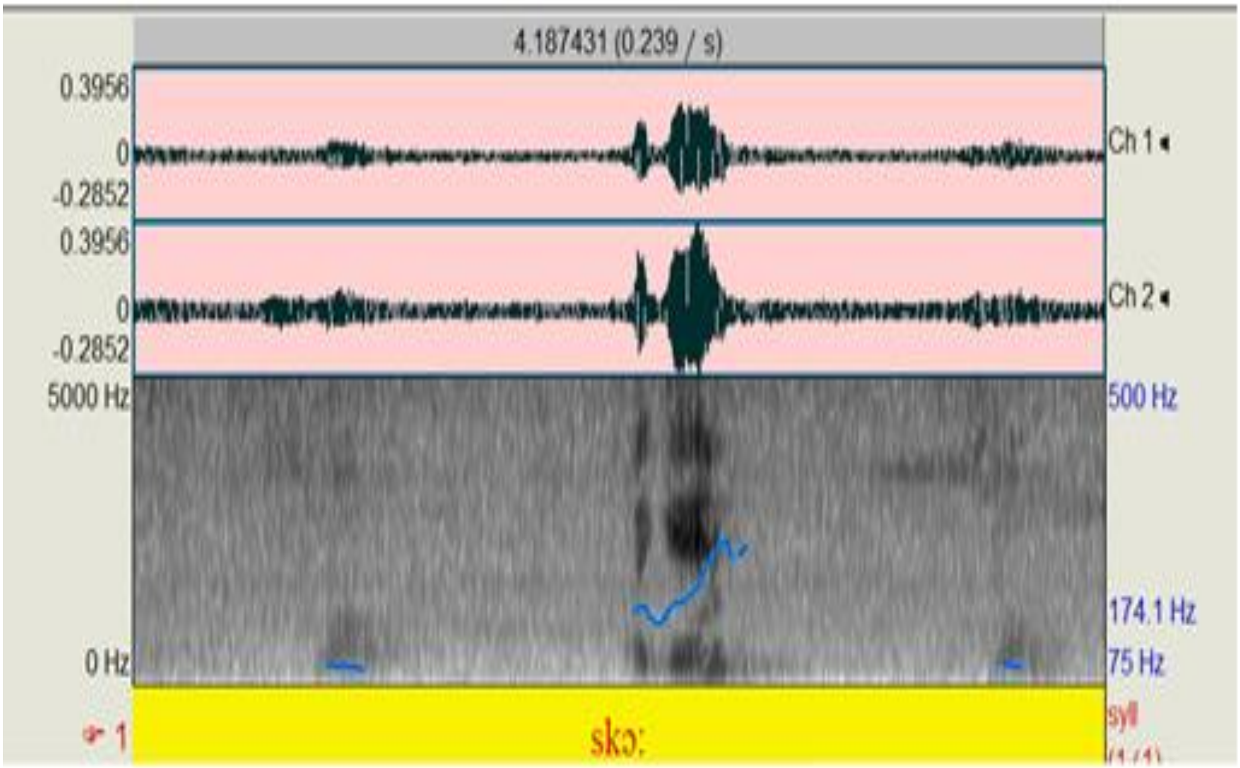

Figure 4.9: Acoustic representation of *sculpts*

The Praat image above shows the frequency and intensity values for the word *sculpts*. The word has a pitch value of 174.1 Hz and an intensity of 72.89 dB. From the figure, the voiceless fricative /s/ is seen, and this is indicated by the darker shades of spectrogram which appear in three portions before the larger parts. After this, there is a brief closure before the burst of acoustic energy that is peculiar with plosives. The voiceless velar stop /k/ is the sound produced and presented in the spectrogram waves. It is closely followed by the back vowel /ɔ/, after which no further dark shades are seen, indicating that no other sound is uttered afterwards. Thus, the deletion of the coda by the participants is conspicuous in this acoustic illustration. Thus, the structure of the word is changed from C^2VC^4 to C^2V.

4.4 Pattern of syllable structures by the participants

The English syllable structure allows vowel(s) only as the only obligatory element of a syllable structure which may adopt an onset or a coda or both. When the only obligatory element (vowel(s)) stands alone, representing a syllable structure, the structure is known as a minimum structure. When this obligatory element adopts an onset without a coda, the syllable structure is called an open structure and when the obligatory element adopts coda with or without an onset, the structure is regarded as a closed structure. The analysis of the third objective will follow this categorisation.

Table 4.19: Variants of participants' minimum syllable structures

Variants		Mild	Moderate	Severe	Sub-total (%)	Grand total (100%)
V	V	6	9	6	21 (87.5)	24
	V^2	-	-	3	3 (12.5)	
V^2	V	6	7	6	19 (73.1)	26
	V^2	-	2	3	5 (19.2)	
	CV	-	-	2	2 (7.7)	
V^3	V	4	5	4	13 (28.9)	45
	CV	-	3	2	5 (11.1)	
	VCV	6	6	5	17 (37.8)	
	CVCV	2	4	4	10 (22.2)	

The minimum syllable is made up of the only obligatory segment of the syllabic structure which can be represented by vowels: monophthongs – long (V:) or short (V); diphthongs- VV or V^2; triphthongs – VVV or V^3; or syllabic consonants- (m, n, l). The minimum syllable in Table 4.19 above is represented by monophthong, (V); diphthongs, (VV/V^2), and triphthongs, (VVV/V^3). The different rendition patterns cut across the various autistic types.

The first structure examined in Table 4.19 was the V minimum structure which was easily retained by autistics 21 (87.5%). All the mild, moderate and 6 severe autistics retained the structure. The single V minimum structure witnessed a few cases of diphthongisation, 3 (12.5%) by severe autistics. The next minimum structure tested was the V^2 diphthong structure which was monophthongised by 19 (73.1%) participants: all the mild and most of the moderate and severe autistics realised the structure as such. Only 2 moderates and 3 severe autistics retained the actual structure 5 (19.2%). Two (7.7%) severe autistics initiated a CV structure, to replace the input structure.

The final structure in Table 4.19 carried a V^3 minimum structure which was reduced to V: via monophthongisation which was the second popular choice among all the categories of autistics 13 (28.9%); the second output structure rendered by 5 (11.1%) autistics were produced by 3 moderate and 2 severe. The variant was the CV structure; they introduced an epenthetic onset and monophthongised the vowel from $V^3$to V. For the majority choice variant, VCV, 17 (37.8%) opted for structure most of all the participants chose. The V^3 was broken apart and experienced three major processes: first, there was deletion, the V^3 quality was reduced to V^2, between the first and the second V; next, an epenthetic sound, C –[w] showed up; and the ideal sounds were substituted. Those were the processes were responsible for our /ɑʊə/ becoming [æwæ] in the output.

The final variant output from the table produced another open disyllabic structure- CVCV. Ten (22.2%) autistics, 2 mild, 4 moderate and 4 severe, preferred the CVCV structure, they introduced an epenthetic C –[h] at the beginning of the structure and at the middle, taking away the V_2 and inserting an epenthetic C –[w] to break apart the V^3structure, while the initial and final Vs were then substituted from /ɑ:/ to [æ] and /ə/ to [æ] in hour /ɑʊə/ rendered as [hæwæ]. None of the participants were faithful to the V^3

input structure and to achieve the variant structures above, deletion was mainly engaged in all instances and so was epenthesis.

What Table 4.19 reveals is that autistics simplify complex minimum syllable structures by three main processes, many of which overlap – substitution 83%; deletion 50%; then epenthesis 33.3%. Only 26.5% of autistics from the presented data were able render the input with the correct syllabic structure and the variants thrived to the tune of 73.5%.

Below are relevant theoretical analyses of the prominent structures:

Tableau 4.35: The emergence of [e]

Input: air /eɑ/ → [e]

Air /eɑ/	**NO DIPH**	**MAX-V**
(i) [eɑ]	*!	
☞ (ii) [e]		*

Constraint ranking: NO DIPH>>MAX-V

Optimal candidate: [e]

Tableau 4.35 reveals the emergence of the half open front unrounded vowel, /e/, as the harmonic output, having interacted with the constraints presented. NO DIPH is the highest ranked constraint and it forbids an output from retaining diphthongs; this constraint is disobeyed by the first candidate and so incurs a fatal violation and is eliminated from the competition. Candidate (ii), having obeyed the highest ranked constraint and disobeyed the lesser one, MAX-V, emerges as the winner. MAX-V requires faithfulness to the underlying vowels in the output.

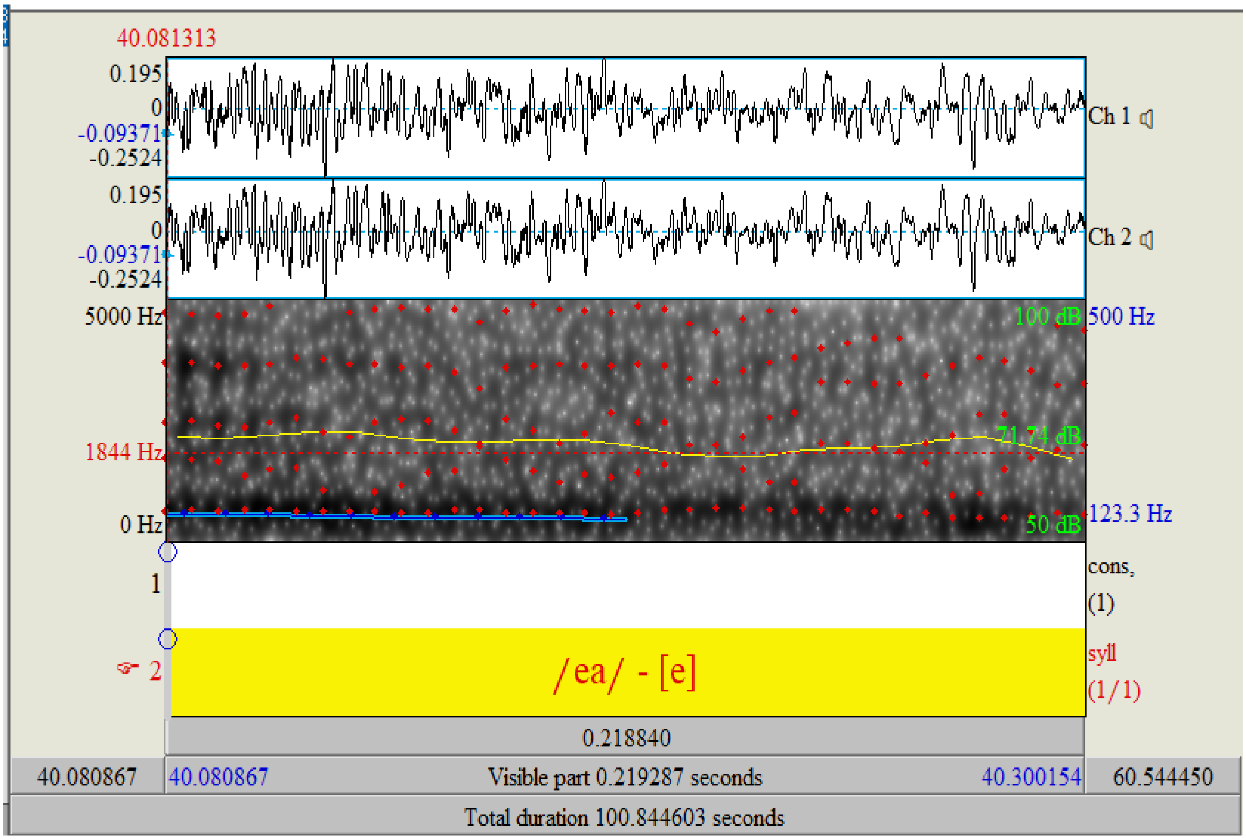

Figure 4.10: Acoustic representation of *air*

This minimum syllable is represented by a diphthong /eə/, which was further reduced via monophthongisation to [e]. For the formants, F1 value was placed at 620.33 and 1844.1 for F2. Its intensity value is at 71.71 dB and a pitch of 123.3 Hz.

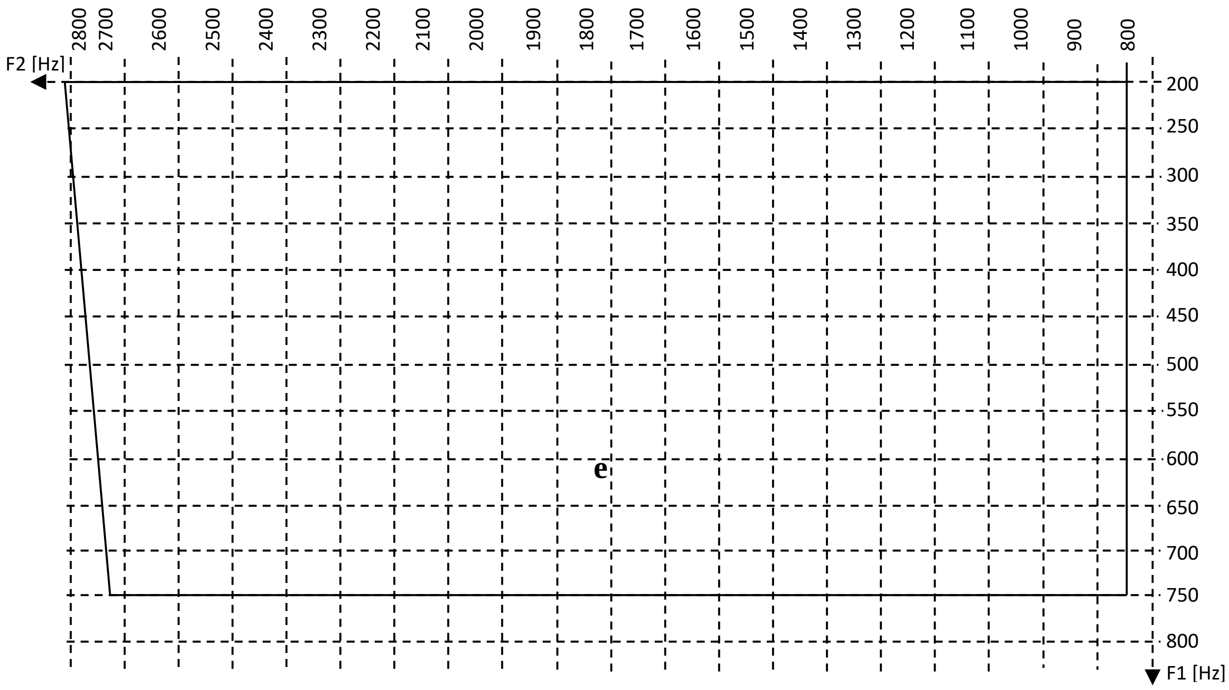

Figure 4.11: Representation of /e/ on an acoustic vowel chart

The vowel /e/, with first formant value of 644Hz and second formant value of 1844Hz is plotted into the acoustic vowel chart and it is conspicuous that the phoneme is more central than front as found in typical speech. The subtlety of central vowels can be associated with this vowel because the acoustic energy that should accompany a front vowel is not so strong in many of the autistic children. To achieve a front vowel, a higher first formant value is needed, but this is absent in this speaker's speech. This acoustic vowel chart is a representation of Figure 4.11.

Tableau 4.34: The emergence of [æwæ]

Input: our /ɑʊə/ → [æwæ]

Our /ɑʊə/	*HIATUS	MAX-V
☞ (i) [æwæ]		**
(ii) [ɑʊə]	*!	

Constraint ranking: *HIATUS>>MAX-V

Optimal candidate: [æwæ]

Tableau 4.34 shows the constraints responsible for the emergence of [æwæ] as the optimal output. The highest ranked constraint, *HIATUS, is violated by Candidate (ii). This violation happens because all the phonemes of the word are produced together in the minimum syllable, hence, *HIATUS which states that no two adjacent vowels should be linked to a set or feature, is violated. Thus, Candidate (ii) is eliminated from the competition and Candidate (i) emerges as the winner in the tableau, having satisfied the highest constraint over the lesser ranked constraint. The acoustic analysis of *our* is presented on the next page.

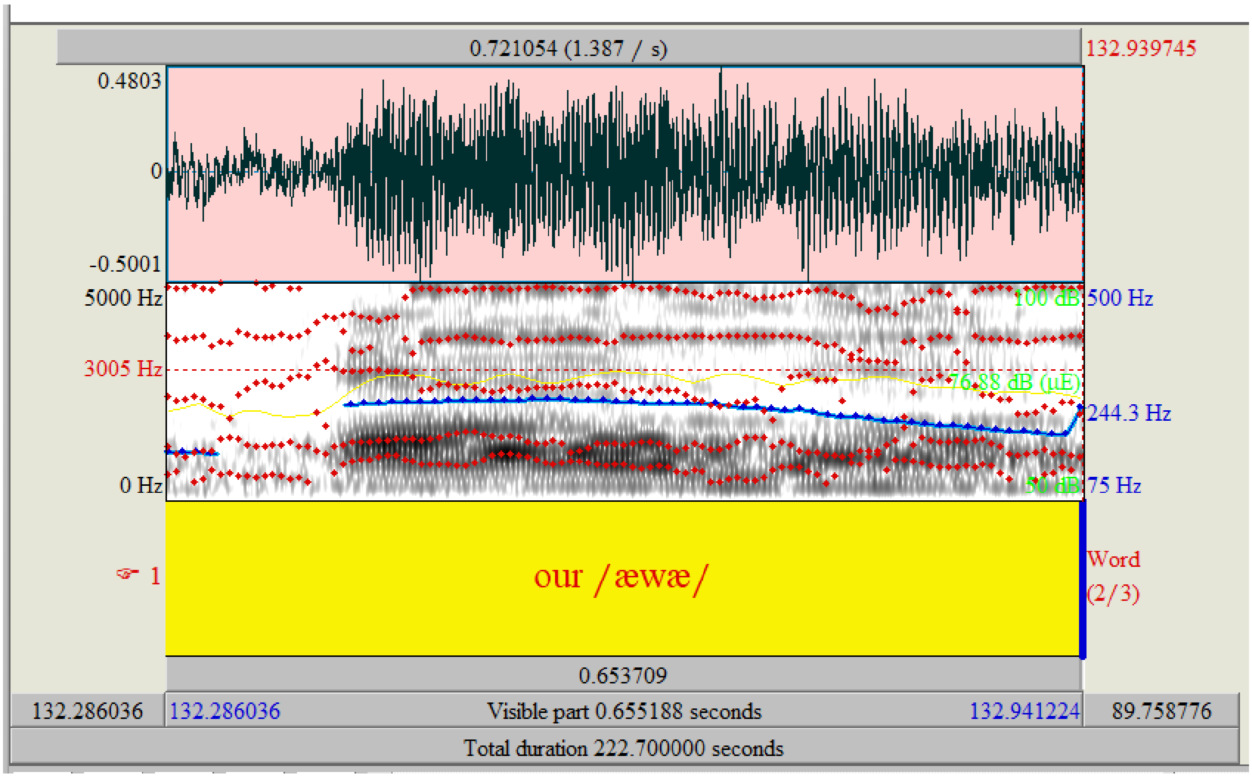

Figure 4.12: Acoustic representation of *our*

The image presented above is that of *our*. The formants for the vowels are at 680.1 for F1 and 1260.7 for F2. The intensity value is at 58.2 dB while the pitch is at 92.69 Hz. The first and second formats for both peaks in the two syllables are within the same range because both sounds are the same. The consistency is seen, not only in the values, but also in the horizontal line that the first and second formants present.

Table 4.20: Open syllables in the autistic children's utterances

Variants		Mild	Moderate	Severe	Sub-total (%)	Grand total (100%)
CV	V	-	-	2	2 (7.7)	26
	CV	6	9	8	23 (88.5)	
	C^2V	-	1	-	1 (3.9)	
CV^2	V	-	-	1	1 (3.6)	28
	CV^2	-	1	-	1 (3.6)	
	CV	6	10	10	26 (92.9)	
CV^3	CV	-	3	1	4 (4.2)	96
	CV^2	-	2	3	5 (5.2)	
	VCV	-	1	2	3 (3.1)	
	CVC	-	-	1	1 (1.0)	
	CVCV	24	29	29	82 (85.4)	
	C^2VCV	-	1	-	1 (1.0)	
C^2V^2	CV	-	3	5	8 (32)	25
	C^2V	6	6	5	17 (68)	
C^2V^3	CV	-	-	1	1 (1.0)	96
	CV^2	-	-	2	2 (2.1)	
	C^2V	1	1	2	4 (4.2)	
	C^2V^2	-	-	1	1 (1.0)	
	VCV	-	-	1	1 (1.0)	
	CVC	-	-	1	1 (1.0)	
	C^2VC	-	-	2	2 (2.1)	
	CVCV	1	2	5	8 (8.3)	
	CV^2CV	1	1	-	2 (2.1)	
	C^2V^3	1	-	-	1 (1.0)	
	C^2V^2CV	2	-	2	4 (4.2)	
	C^2VCV	18	30	19	67 (69.8)	
	C^3VCV	-	2	-	2 (2.1)	
C^3V	V	-	-	2	2 (8.3)	26
	CV	-	1	2	3 (12.5)	
	C^2V	3	5	5	13 (54.2)	
	C^3V	3	3	-	6 (25.0)	
VCV	V^2	-	-	1	1 (4.2)	24
	VCV	6	8	7	21 (87.5)	
	VCVC	-	-	1	1 (4.2)	
	CVCV	-	1	-	1 (4.2)	

Table 4.20 displays instances of the open syllable structures that were tested. The words used to test this aspect were *screw, player, prayer, prayer, flower, flour, lawyer, fire, sower, mower, car, you, shoe, early, pure, play, go, boy, year, bear,* and *chair*. Two open syllabic structures were noted to be easily realised by all the autistic categories, they were: CV and VCV; because 23 (88.5%) and 21 (87.5%) comfortably reproduced the structures, respectively. From the above table, only three severe autistics used variant structures (V = 2 (7.7%) and CV^2 = 1 (3.9%)) to replace the CV input structure as in [ɑ:] for /kɑ:/ car, deleting the onset and in the rare occasion, [dkɑ] was used to replace the structure –it was later found out that the participant also stutters – the figure of the deviant structures were negligible. Similarly, only two autistics, one moderate and one severe, rendered structures that were different from the input, that is, CVCV and VCVC, respectively.

The next three tested structures: CV^2, CV^3 and C^2V^2 were open structures which all the autistics could not render but generated various structures for. A total of 26 (92.9%) could only manage a CV structure in place of the CV^2 structure, as in [go], in place of /gəʊ/ go, while only one moderate autistic (3.6%) was able to retain the actual input structure, and one severe autistic (3.6%) reduced the structure to V –[o]. In the case of the CV^3 structure /lɔɪə, fɑɪə, səʊə, məʊə/, it was realised in six differing ways, CVCV –[lɔjæ, fæjæ, sowæ, mowæ]- was the most preferred structure (82: 85.4%) by all the categories of the participants. While all the mild and most of the moderate and severe autistics realised it as CVCV, it was realised as CV by 3 moderate and 1 severe autistics (4: 4.2%); it was also realised as CV^2 by 2 moderate and 3 severe autistics (5: 5.2%). It was realised as VCV by 1 moderate and 2 severe autistics (3: 3.1%). Finally, only one (1.0%) moderate and severe autistic each realised it as C^2VCV and CVC, respectively.

Seventeen (68%) opted for C^2V as the structure to replace C^2V^2 –/pjʊə, pleɪ/, deleting one of the vowels –[pjo, ple]; all the mild autistics, most of the moderate autistics and 50% of the severe autistics realised the structure this way. The other variant of the structure, CV –[pɔ], was produced by 3 autistics and the other half of the severe autistics bringing the frequency of the variant to 8 (32%). The emergent variant for the C^2V^3 –/pleɪə, preɪə, flɑʊə/- open structure was C^2VCV –[plejæ, prejæ, flɑwæ] , as produced by 18 mild autistics, 30 moderate autistics and 19 severe autistics, bringing the total frequency to 67 (69.8%). This structure generated the highest variant structures that were minor. CVCV –[pejæ, fɑwæ]- was the other noticeable variant with a frequency of 8

(8.3%) realised by 1 mild, 2 moderates and 5 severes. All the other output structures, CV, CV^2, C^2V, C^2V^2, VCV, CVC, C^2VC, CV^2CV, C^2V^3, C^2V^2CV and C^3VCV had various frequency ranges between 4 (4.2%), 2 (2.1%) and 1 (1.0%); which were all negligible. The processes involved in rendering the preferred variant structure in C^2VCV revealed that deletion of V_2 had occurred and an epenthetic C had also been employed to take the place of V_2 and break apart V_1 and V_3.

For the final structure, C^3V –/skru:/, there were four variant structures in the output, V, CV, C^2V and C^3V. Deletion was the process involved in changing C^3 to C^2 in the most preferred output structure. C^2V –[sku:], was produced by 13 participants (54.2%) from across all levels of severity. The actual C^3V structure was realised by 6 (25%) of the participants, which was the next to the predominant choice but was only rendered by 3 mild and 3 moderate autistics, no severe autistics retained the structure. The next variant was the CV structure as delivered by 3 (12.5%) participants – 1 moderate and 2 severe participants. Again, the dominant process engaged with was deletion as C^3 was drastically reduced to C^1. There was a drastic reduction in the last variant where all the C^3 were completely erased, leaving only V to represent the structure by 2 (8.3%) severely affected autistics.

What this suggests is that most autistics, irrespective of severity levels, are at best able to manage diphthongs for peak, but not triphthongs, as witnessed by the epenthetic features that alter the input structures. This indicates that among the internal processes at work in the variant output structures replacing the input as seen from Table 4.20, two main processes affected input structures – deletion and epenthesis. While deletion reduced output structures, epenthesis added to it. Mainly, the two processes worked together. As one structure was being altered, it was also being replaced and a third process responsible for that to happen was substitution. However, substitution in itself, did not affect the structure.

Generally, there is a 12% chance that autistics would retain the structure of an open syllable and there is an 84.0% chance that they would rely on deletion, substitution and epenthesis to guide them in making much simpler and manageable open syllabic structures instead of more complex ones. Here are some of the theoretical interpretations of the prominent structures discussed above.

Tableau 4.35: The emergence of /CVCV/

Input: CV^3 /CVVV/ → [CVCV]

CV^3 /CVVV/	***COMPLEX ONSET**	***HIATUS**	**NO DIPH**	**DEP**
☞ (i) CVCV				*
(ii) CVVV		*!		
(iii) CVV			*	
(iv) CCV	*!			

**Constraint ranking: ***COMPLEX ONSET>>*HIATUS>>NO DIPH>>DEP

Optimal candidate: [CVCV]

Tableau 4.35 displays the constraints responsible for the emergence of the optimal structure, CVCV. Candidate (iv) violates the highest constraint, *COMPLEX ONSET by retaining more than one consonant in its onset position. Candidate (ii) also bows out by violating *HIATUS. There are multiple vowels in one position within Candidate (ii), thus, it violated *HIATUS. In Candidate (iii), there is a diphthong in the output and this is forbidden by constraint 3. The exit of these three candidates paves the way for Candidate (i) to emerge as the winner despite inserting new segments into the input, thereby violating DEP. However, DEP is the least ranked of the constraints.

Tableau 4.36: The emergence of /CCV/

Input: C^3V /CCCV/ → [CCV]

C^3V/CCCV/	***MAX**	**COMPLEX ONSET**	**FAITHC**
☞ (i) CCV			*
(ii) CCCV	*!		
(iii) CV		*	
(iv) V		*	

Constraint ranking: *MAX>>COMPLEX ONSET>>FAITHC

Optimal candidate: [CCV]

Tableau 4.36 displays how the CCV becomes the emergent winner of the imputed structure. *MAX is the highest ranked constraint and it compels outputs to entertain one or more omissions. Candidate (ii) does not obey this constraint because all the segments in the input are represented in the output. This violation is a fatal one because the constraint is very highly ranked. Both Candidates (iii) and (iv) fail to comply with the next highly ranked constraint, COMPLEX ONSET, which allows outputs to retain multiple consonants at the onset position, and they are also eliminated from the competition. This leaves Candidate (i) to emerge as the optimal structure, despite failing at the least constraint, FAITHC, which requires faithfulness to the underlying consonants.

Tableau 4.37: The emergence of /CCVCV/

Input: C^2V^3 /CCVVV/ → [CCVCV]

C^2V^3/CCVVV/	**COMPLEX ONSET**	***HIATUS**	**DEP**
(i) CVCV	*!		*
(ii) CCVVV		*	
☞(iii) CCVCV			*
(iv) VCV	*!		*

Constraint ranking: COMPLEX ONSET>>*HIATUS>>DEP

Optimal candidate: [CCVCV]

Tableau 4.37 presents the winning structure as /CCVCV/ – Candidate (iii) because it has satisfied all highly ranked constraints. The first and most important constraint in the tableau is COMPLEX ONSET and it requires that all onsets in the output must have multiple consonants. *HIATUS is the next constraint and it forbids the existence of adjacent vowels in the output; Candidate (iii) obeys both of these highly ranked constraints; however, it fails at the least constraint, DEP, which disallows the insertion of any segment in the underlying input. Other Candidates (i) and (iv) fail at the highest constraint and Candidate (ii) also fails at the next highly placed constraint and they are all eliminated from the competition; thus, Candidate (iii) emerges as the winner.

Table 4.21: Closed syllables in the autistic children's utterances

Variants		Mild	Moderate	Severe	Sub-total (%)	Grand total (100%)
CVC	V	-	-	1	1 (1.3)	79
	CV	-	7	26	33 (41.8)	
	CVC	18	19	7	43 (54.4)	
	C^2V	-	2	-	2 (2.5)	
CV^2C	V	-	-	2	2 (2.6)	
	CV^2	4	10	12	26 (33.3)	
	CV	-	-	9	9 (11.5)	
	CVC	-	4	6	10 (12.8)	78
	CV^2C	14	13	2	29 (37.2)	
	CV^3C	-	-	1	1 (1.3)	
	VCV^2	-	1	-	1 (1.3)	
CVC^2	CVC	-	1	3	4 (13.8)	
	CVC^2	2	-	-	2 (6.9)	
	CVCV	5	8	9	22 (75.9)	29
	CVC^2V	-	1	-	1 (3.5)	
C^2V^2C	CV	-	-	2	2 (8.3)	
	C^2V	-	-	2	2 (8.3)	
	C^2VC	-	1	2	3 (12.5)	
	C^2V^2C	5	7	3	15 (62.5)	
	C^2VC^2	1	1	-	2 (8.3)	24
C^3V^2C	CV	-	-	2	2 (8.3)	
	C^2V	-	1	3	4 (16.7)	
	C^2V^2C	-	-	2	2 (8.3)	
	CVC	-	-	2	2 (8.3)	24
	C^3V	-	3	-	3 (12.5)	
	C^3VC	2	2	-	4 (16.7)	
	C^3V^2C	4	3	-	7 (29.2)	
C^2VC^2	CVC^2	1	2	1	4 (16)	
	CV	-	-	2	2 (8)	
	C^2V	-	1	3	4 (16)	26
	C^2VC	-	3	2	5 (20)	
	C^2VC^2	5	4	1	10 (40)	
C^3V^2C	V^2	-	-	1	1 (4.2)	
	VCV	6	8	7	21 (87.5)	
	VCVC	-	-	1	1 (4.2)	2
	CVCV	-	1	-	1 (4.2)	
C^3VC^2	V	-	-	1	1 (4.2)	
	CV	-	-	1	1 (4.2)	
	C^2V	-	1	3	4 (16.7)	
	C^3V	1	-	1	2 (8.3)	24
	CVC	-	-	2	2 (8.3)	
	C^2VC^2	2	2	1	5 (20.8)	
	C^3VC	1	3	-	4 (16.7)	
	C^3VC^2	2	3	-	5 (20.8)	
C^2VC^3	CV	-	-	5	5 (20.8)	
	CVC	-	5	3	8 (33.3)	
	C^2VC^2	4	4	1	9 (37.5)	24
	C^2VC^3	2	-	-	2(8.3)	
C^2VC^4	V	-	-	1	1 (4.2)	24
	CV	-	-	1	1 (4.2)	
	C^2V	1	1	4	6 (25)	
	C^3V	-	1	-	1 (4.2)	
	CVC	-	-	2	2 (8.3)	
	C^2VC	-	4	1	5 (20.8)	
	C^2VC^2	4	3	-	7 (29.2)	
	C^2VC^3	1	-	-	1 (4.2)	

Table 4.21 shows instances of closed syllable structures represented by the following words: *sculpts, sculpt, sprite, plunge, drink, proud, sprint, pat, put, court, cup, sun come, with, girl, head, neck, bag, thank, little, bottle, tickle, fine, mouth, shine, bears, peered, boys, down, colleague, garden, arrive, about, fountain, golden, navigate,* and *impediment*. The observable pattern from the output mostly reveals reduction of complex structures to a manageable size that is convenient for the autistics to produce. This was done for the most part through deletion of consonant sounds at every point of cluster production. Complex onsets seemed to be preferred to complex codas and open structures to closed structures.

The first closed structure tested, CVC –/pæt, pʊt, kɔ:t, sʌn, kʌm, gɜ:l, wɪθ, nek, bɑg/, was retained 54.4% of the time by all the mild autistics, the majority of the moderate autistics and a few of the severe autistics. The majority of the severely affected ones (26) deleted the simple coda structure CV –[pæ, pʊ, kɔ:, ge, bɑ] and 7 other moderate autistics did the same thing, making the total output for the next popular variant, of the input structure 33 (41.8%) out of a total of 79 expected tokens. Two other moderately affected autistics (2.5%) presented an open structure with a complex onset, deleting the coda which closes the structure.

The next structure tested was a variant of the CVC structure also but with a diphthong representing the peak, thus, creating CVVC or CV^2C –/fɑɪn, mɑʊθ, ʃɑɪn, beɑz, pied, bɔɪz, dɑʊn/. This structure was mostly retained by the mild and moderate autistics and barely by the severe ones 29 (37.2%). In close proximity to that output was the coda deleted output, rendering the structure open, CV^2 [bie, pie, bɔi]. Most of the severe autistics and more of the moderate ones and few of the mild ones produced the structure thus with a frequency of 26 (33.3%). The third prominent option, CVC was rendered mostly by severe autistics and some moderate ones with a frequency of 10 (12.8%). Nine (11.5%) severe autistics further monophthongised the peak after rendering the structure open and creating a CV –[fɑ, bɔ] structure instead and two severe ones (2.6%) totally deleted the onset and coda, and also monophthongised the peak, leaving the structure with only a V. Contrarily, one moderate and one severe autistic (1.3%) each produced the structure as VCV^2 and CV^3C. Although it was minor, it still had an impact on the input structure.

The prominent structure for the input closed structure, CVC^2 –[wɔnt, θæŋk, lɪtl, bʌtl, tɪkl] was CVCV –[li:tu, bɔtu, ti:ku]. It was uttered by most of the participants across the three categories of severity with a frequency of 22 (75.9%) out of 29 tokens received for the structure. All the other variant structures, CVC, CVC^2 and CVC^2V were produced by 4 (13.8%), 2 (6.9%) and 1 (3.5%), respectively. And these were from mostly moderate and severe autistics.

C^2V^2C –/prɑʊd/ was the most retained structure as presented in the table. Most mild, moderate and a few severe autistics readily retained the structure. For the severe ones (2: 8.3%), they mostly explored other variants of the structures – CV, C^2V, C^2VC –[pɑ, prɑ, prɑd]. While 2 (8.3%), 1 mild and 1 moderate autistic, rendered the structure as C^2VC^2 –[prɑwd]. Another structure that was mostly retained by mildly and moderately impaired autistics was C^3V^2C –/sprɑɪt/ which emerged as the most prominent choice, was produced by 7 (29.2%) of them - 4 mild and 3 moderate autistics. No severe autistic produced the emerging structure, rather, they explored other structures such as CV, C^2V, C^2V^2C, CVC –[pɑ:, spɑ:, spɑɪt, pɑt] at varying degrees. The other varying closed structure rendered by 2 mild and 2 moderate autistics (16.7%) was C^3VC –[sprɑt]. Because of the close knitted frequencies of most variants of this structure, there is no conclusive pattern for the structure.

Still belonging to the group of retained closed structure determined mostly by mild and moderately impaired autistic is C^2VC^2 structure, which had a frequency of 10 (40%); most severe autistics and some moderate ones, explored other options such as CVC^2, CV, C^2V, and C^2VC, had frequencies of 4 (16%), 2 (8%), 5, 4 (16%) and (20%) respectively. The next closed structure, C^3V^2C, was one unifying structure, one in which all the autistic types replaced with VCV with a frequency of 21 (87.5%). All the other variant outputs, V^2, VCVC and CVCV, did not have more than one (4.2%) output mostly from severe autistics.

The C^3VC^2 structure –/sprɪnt/ presents a worthy competition as all the autistic categories did not settle for a particular emerging choice, hence, a producing tie for all the output structures. The most prominent choice was a tie between the actual input structure and C^2VC^2 –[spi:nt], closed structures by 5 (20.8%) each, from mostly mild and moderate autistics. The next tied option was between C^2V –[spi:] andC^3V –[spri:] open structures by 4 (16.7%) mostly moderate and severe autistics. The competition of the next emerging structure was between open and closed structure, C^3V and CVC –[sit, pit] by mostly severe autistics. The last group of this structure was either reduced to the minimum structure V –[i:], or added a simple onset to the now open structure, CV –[si, pi] by singular severe autistics (4.2%).

The pattern noticeable for the closed structure is that there are mostly no clear emerging structures as other variants have percentages that cannot be ignored. Another point is that the C^2VC^3 structure that was mostly replaced by C^2VC^2 structure was uttered by 9 (37.5%) mostly mild and moderate autistics; this was closely followed by CVC, with a frequency of 8 (33.3%) of mostly moderate and severe autistic participants. Most severe autistics (5: 20.8%) simplified the structure to CVC, while only 2 (8.3%) mildly affected autistics were able to retain the actual input structure.

The final monosyllabic structure tested, C^2VC^4 –/skʌlpts/, was not without its own varying structural outputs. The most frequent outputs were, C^2VC^2 –[skɔpt, skɔts] 7 (29.2%); C^2VC^3 –[skɔ:], 6 (25%); and C^2VC –[skɔt] 5 (20.8%) as variously produced by all the categories of participants. They were the significant structures. Other variants V, CV, C^3V, had only one (4.2%) occurrence each as well as the actual input structure, while the CVC also had a negligible frequency of 2 (8.3%).

From the table, there were only thirty-three instances where words with complex onsets were reduced from C^3 or C^2 to C^2, C, or totally deleted; that is, 9.4%, out of three hundred and fifty-two tokens of occurrence. On the other hand, complex codas were mostly reduced or completely deleted. There were a hundred and seventy-seven (50.3%) instances of total deletions of both complex and simple codas and 84 (23.9%) of reduction of complex codas either to C^2 or single C. Only 17 autistics in all, (4.8%), mostly mildly impaired ones, were able to retain actual complex coda structures, with the moderate ones following after; while the severely autistic were poorly able to do so. A total of 147 (41.8%) tokens retained actual simple coda structures. In two cases, the actual input complex coda structures had zero realisations.

The peaks of the structures above mostly went through substitution and monophthongisation which can be owed to environmental factors because these factors are also peculiar to Nigerian phonology. It is also worthy to note that the internal operations of phonological processes overlapped to help the autistics render the closed structure with 67.5% deletion, 60% substitution and 50% epenthesis. Below are some of the prominent structures in the autistics' utterances.

Tableau 4.38: The emergence of /CV/

Input: /CVC/ → [CV]

CVC /CVC/	**NO-CODA**	**MAX**
☞ (i) CV		*
(ii) CVC	*!	

Constraint ranking: NO-CODA>>MAX

Optimal Candidate: [CV]

Tableau 4.38 reveals the process engaged in the making of CV an optimal structure. Two candidates interact with two constraints namely, NO-CODA, which forbids an output from ending with a consonant; and MAX, which disallows any form deletion in the output. Candidate (ii) incurs a fatal violation against the higher ranking constraint of the two, NO-CODA, by retaining a consonant in the coda position of the output. Candidate (i) becomes the optimal output structure despite violating the lesser ranking constraint, MAX, by deleting the consonant at the coda position. The following is the figure showing the acoustic analysis of the emergence of CV that has been rendered in place of CVC in *boys*.

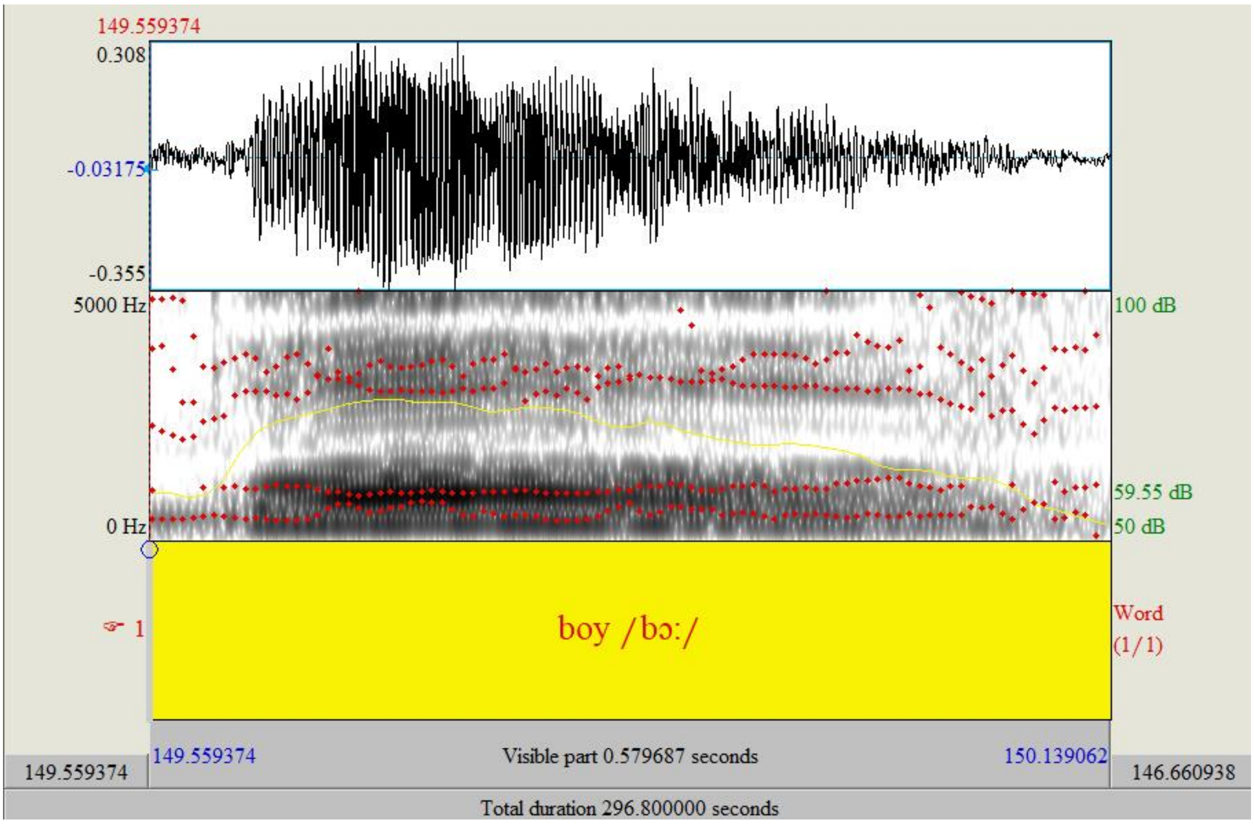

Figure 4.13: Representation of the acoustic analysis for *boys*

A small wave of energy shows that it is a plosive sound and then the formants are clearer. The first and second formants (514.58Hz and 1657Hz, respectively) evidenced by the red dots which fade away towards the end of the image showing that no consonant sound closed the vowel.

Tableau 4.39: The emergence of /CCCV/

Input: /CCCVVC/ → [CCCV]

C^3V^2C /CCCVVC/	**NO-CODA**	**DEP-V**
(i) CCCVVC	*!	
☞(ii) CCCV		*
(iii) CCCVC	*!	*

Constraint ranking: NO-CODA>>DEP-V

Optimal Candidate: [CCCV]

Tableau 4.39 presents autistics' interactions with the constraints responsible for enabling Candidate (ii) to emerge as the optimal for the competition. One important rule for most autistics is the NO-CODA rule which prohibits coda from ending an output. Candidates (i) and (iii) fatally violate this constraint and are eliminated from the competition, leaving Candidate (ii) to emerge winner for complying with this rule at the expense of DEP-V which requires faithfulness to the underlying vowel.

Tableau 4.40: The emergence of /CCVCC/

Input: /CCVCCCC/ → [CCVCC]

C^2VC^4 /CCVCCCC/	**COMPLEX CODA**	***MAX**	**FAITHC**
(i) CCVCCCC		*	
(ii) CCVC	*!		
☞ (iii) CCVCC			*

Constraint ranking: COMPLEX CODA>>*MAX>>FAITHC

Optimal Candidate: [CCVCC]

Tableau 4.40 reveals the processes involved in the emergence of the dominant structure, /CCVCC/. COMPLEX CODA was ranked highest requesting that all output structure must be closed with multiple consonants; Candidate (ii) disobeys this constraint and is excused from the competition. *MAX is the next constraint in the hierarchy, the asterisk (*) there shows that it allows for deletion of segments in the output which Candidate (i) does not adhere to and so did not emerge as the optimal structure. Candidate (ii) obeys all the highly ranked constraints but fails at the least ranked constraint, FAITHC, which demands faithfulness to the underlying consonants in the output; thus, it emerges as the optimal structure.

4.22: An overview of autistics' productions among subtypes

Word (RP)	NE	Mild	Moderate	Severe
Sculpt /skʌlpt/	[skɔlpt]	[skɔpt]	[skɔt]	[tɔp]
Sculpts /skʌlpts/	[skɔlpts]	[skɔpts]	[skɔts]	[skɔ:]
Sprint /sprɪnt/	[sprint]	[spint]	[spi:nt]	[spi:]
Impediment /ɪm.pe.dɪ. mənt/	[im.pe.di.ment]	[im.pe.di.ment]	[im.pe.di.men]	[i.pe.di.me]
colleague /kɔli:g/	[kɔli:g]	[kɔ.lig]	[kɔ.lɪ]	[kɔ.jin]
pat /pæt/	[pæt]	[pɑt]	[pɑt]	[pɑ:]
Put /pʊt/	[put]	[put]	[put]	[pu:]
About /ə.baʊt/	[æ.bɑot]	[ɑ.bɑot]	[ɑ.bɑot]	[ɑ.bɑ]
Screw /skru:/	[skru:]	[skru:]	[skʊ]	[du:]
Car /kɑ:/	[kɑ:]	[kɑ]	[kæ]	[kɑ]
early /ɜ.lɪ/	[e.li]	[e.li]	[e.ji/e.ri]	[e.ji]
court /kɔ:t/	[kɔt]	[kɔt]	[kɔ:t]	[kɔ]
Fountain /faʊn.tɪn/	[fɑon.tin]	[fɑn.tin]	[fɑn.tin]	[fɑ:.tin]
Navigate /næ.vɪ.geɪt/	[næ.vi.get]	[nɑ.vi.get]	[nɑ.vi.get]	[nɑ.vi.ge]
arrive /ə.raɪv/	[ɑ.rɑɪv]	[ɑ.rɑɪv]	[ɑ.rɑɪv]	[ɑ,rɑ]
Boys /bɔɪz/	[bɔis]	[bɔis]	[bɔis]	[bɔs]
peered /piəd/	[pied]	[pie]	[pi.e]	[pi.e]
bears /beɑz/	[bies]	[biez]	[bi.e]	[bes/be]
pure /pjʊə/	[pjɔ]	[pjo]	[pjo]	[pɔ]
go /gəʊ/	[go]	[go]	[go]	[go]
prayer /preɪə/	[pre.jæ]	[pre.jæ]	[pre.jæ]	[pe.jæ]
flower /flɑʊə/	[flɑ.wæ]	[flɑ.wæ]	[flæ.wæ]	[fæ.wæ]
fire /fɑɪə/	[fɑ.jæ]	[fɑ.jæ]	[fæ.jæ]	[fæ.jæ]
lawyer /lɔɪə/	[lɔi.jæ]	[lɔ.jæ]	[lɔ.jæ]	[lɔ.j]
sower /səʊə/	[so.wæ]	[so.wæ]	[so.wæ]	[o.wæ]
Are /ɑ:/	[ɑ:]	[ɑ:]	[ɑ:]	[ɑ:]
air /eɑ/	[e]	[e]	[e]	[ɔ:]
our /ɑʊə/	[ɑ.wæ]	[æ.wæ]	[æ.wæ]	[ɑʊ]
hour /ɑʊə/	[ɑwæ]	[æ.wæ]	[hæ.wæ]	[hɑ]
player /pleɪə/	[ple.jæ]	[ple.jæ]	[pe.jæ]	[pe.jæ]
Flour /flɑʊə/	[flɑ.wæ]	[flɑ.wæ]	[flæ.wæ]	[fæ.wæ]
Choir /kwɑɪə/	[kwɑ.jæ]	[kwɑ.jæ]	[kwɑ.jæ]	[wɑ.jæ]
Loyal /lɔɪəl/	[lo.jæl]	[lo.jæ]	[lɔ.jæ]	[lɔ.jæ]
Mower /məʊə/	[mo.wæ]	[mo.wæ]	[mo.wæ]	[mo.mæ]
Bottle /bʌt.ᵊl/	[bɔ.tul]	[bɔ.tu]	[bɔ.tu]	[bɔ.tu]
Sprite /sprɑɪt/	[sprɑɪt]	[sprɑit]	[spɑ:t]	[spɑ:]
Proud /prɑʊd/	[prɑʊd]	[prɑud]	[prɑ;d]	[prɑ:]
plunge /plʌŋg/	[plɔŋʤ]	[plɔnʤ]	[plɔʤ]	[plɔ]
Plunged /plʌndʒd/	[plɔŋʤd]	[plɔʤd]	[plɔʤ]	[plɔ.ʤ]
Royal /rɔɪəl/	[ro.jæl]	[ro.jæ]	[ro.jæ]	[jo.jæ]

Table 4.22 displays an overview of dominant variant realisations of actual productions by mild, moderate and severe autistic children. It displays the RP as the ideal pronunciation and the NE as the target output. From the table, it can be observed that the mild autistics had the most intelligible productions and just below target in a few of their productions. The pattern of their phonotactics accommodated the $C^{0-3}V^{1-2}C^{0-3}$ structures as against the $C^{0-3}V^{1-2}C^{0-4}$ structures of the target NE phonotactics. The moderate autistics had the intermediate productions between the mild and the severe outputs. Their realisation of the words was average compared to the target NE productions and relatable to either the mild or severe autistics output depending on the input. The pattern of their phonotactic as observed above accommodated $C^{0-2}V^{1-2}C^{0-2}$ structures. For the severe autistics, their renditions were the least intelligible in the table. Their productions were far from the target NE and their mild counterparts but shared few similar features with the moderate autistics. Their phonotactics accommodated $C^{0-2}V^{1}C^{0-1}$ structure.

From the table, the phonotactics of all productions presented, including the input RP are represented thus: RP = $C^{0-3}V^{1-3}C^{0-4}$; NE = $C^{0-3}V^{1-2}C^{0-4}$; Mild = $C^{0-3}V^{1-2}C^{0-3}$; Moderate = $C^{0-2}V^{1-2}C^{0-2}$; Severe = $C^{0-2}V^{1}C^{0-1}$. The interpretation of this is that the RP accepts up to three consonant clusters at the onset position, up to three vocalic clusters can take the mandatory element at the peak position, and up to four consonant clusters at the coda position. For NE, there could be up to three consonant clusters at the onset position but only up to two vocalic clusters is acceptable in the NE phonotactics, any addition to that number would introduce an epenthetic sound to break it apart. NE can still accommodate up to four consonant clusters at the word final position. The Mild autistics are able to recreate the onset and peak of the NE structure, they can however only accommodate up to three consonant clusters at the coda position. While the Moderates can recreate the vowel structure of both the NE and the Mild autistics, they can only retain two consonant clusters at the onset and coda positions of a word. The severe autistics were only able to reproduce the onset similar to the moderates' onset but limited their peak and coda to accommodate a single nucleus.

4.5 Impact of intervention on autistics' phonotactics

Six participants were purposively selected and tracked from the commencement of data collection till the end, two years later. Three (3) males and three (3) females were selected and their age ranged from 7 to 15 years at the initial stage of data collection and 9 to 17 years at the final stage of data collection. Two participants each represented the different diagnostic types for autism: Mild, Moderate and Severe. Participants were labelled Candidates 1, 2, 3... 6; they were paired under each diagnostic type. This section of the analysis was also based on when intervention started, that is, early, intermediate or late intervention. These labels were determined based on how old they were when they were introduced to an intervention programme. Presented below are the first and last data collections from each candidate under each category. The standard of the intervention facility and some other factors that have been discussed below impacted the performances of candidates.

4.5.1 Early intervention

The first candidate in this group is a 9-year-old female child born in the United Kingdom. She is from south-eastern region of Nigeria. She was 7 years old at the commencement of data collection. She was introduced to multidisciplinary professional attention from the moment she was diagnosed with autism spectrum disorder (ASD) at 18 months of age. She enjoyed these interventions until three years of age when she returned to Nigeria. She was immediately taken to an intervention facility in Lagos, (south-western, Nigeria) to continue with the intervention treatment.

The second candidate in this group is a 12-year-old Nigerian born male child who was 10 years old at the initial time of meeting. He also hails from the eastern part of Nigeria. He was born in Lagos, (south-western, Nigeria) and had rarely visited his state of origin; he also does not speak his native language. He was diagnosed at 6 years of age and commenced intervention immediately.

Table 4.23: First and second performances for the mildly affected autistics

Input	Candidate 1 (female)		Candidate 2 (male)	
	(at 7 yrs)	**(at 9 yrs)**	**(at 10 yrs)**	**(at 12 yrs)**
Plunge /plʌnʤ/ CCVCC	/plʌnʤ/	/plɔnʤ/	/plɔnʤ/	/plɔnʤ/
Proud /praʊd/ CCVVC	/praʊd/	/praʊd/	/praʊd/	/praʊd/
Screw /skru:/ CCCV	/skru:/	/sku:/; /skru:/	/sku:l/	/sku:/
Sculpts /skʌlpts/ CCVCCCC	/skɔps/	/skups/; /skɔps/; /skɔpts/	/skɔpts/	/skɔpt/
Our /ɑʊə/ VVV	/ɑʊə/	/ɑwɑ/	/ɑ:/	/ɑ:/

Table 4.23 gives an overview of Candidates 1 and 2's first and final performances, which were two years apart. These two candidates enjoyed early diagnosis and intervention. This was determined by when they were diagnosed, that is, between the ages of 18 months and 3 years of age, respectively, and how long they had enjoyed qualitative intervention, which was more than 4 years. Candidates 1 and 2 both fall within these categories. The words from this table are intelligible and can be compared to those of any typical Nigerian speaker. Candidate 1's interactions with the clusters seem flawless in column A. She read the list of words by herself and there was no effort from the researcher to correct her once. Although there is a case of substituting /ʌ/ for /ɔ/ in the realisation of *sculpts,* in the RP but hit the target in NE. The substitution does not inhibit communication, neither does it affect the structure (V) in the data. However, her omission of C_1 /l/, and C_3 /t/, in the same word greatly does affect the structure of the output from C^2VC^4 to C^2VC^2.

Two years later, some downward trend owing to some factors such as a pause to intervention during the pandemic, the child retrogressed in her speech and reading skills. The multiple outputs from her data at 9 years were intentional as the researcher left the candidate unattended to read as she had done before. However, the child could hardly do so without some form of assistance from the researcher. It turned out that the long break caused by the pandemic, COVID-19 in 2020 had a negative effect on the candidate and now the intervention facility is helping her recover.

Candidate 2 is Nigerian bred and was diagnosed early and introduced to intervention early. In the data from candidate 2, there were instances of epenthesis in /sku:l/, deletion of C_1 /l/, in /skɔpts/ which both affected the structure of the data, changing it from C^3V and C^2VC^4 to C^2VC and C^2VC^3, respectively. Unlike Candidate 1, Candidate 2 seems not to be so adversely affected by the long break caused by the pandemic as can be seen in the respective column. Everything remained almost identical in both columns with the exception of *screw* and *sculpts.* While there is no record of epenthesis, the cases of substitution and deletion still persisted. But concerning *screw* and *sculpts,* there is an improvement because the epenthetic [l] that disrupted the structure in the first column was no longer featured in the second. However, this candidate that was able to produce a C^3 coda structure in the first column was only able to manage a C^2 coda structure in the second, deleting the C_4 /s/, along with the C_1 /l/, that was deleted earlier in /skɔpt/. This greatly affected the structure from C^2VC^4 to C^2VC^2.

4.5.2 Intermediate intervention

The candidates in this group are Candidates 3 and 4. Candidate 3 is a 13-year-old Nigerian male who was 11 at the first point of meeting. He comes from the northern part of Nigeria and moved to Lagos a few years ago. It was while in Lagos he was diagnosed, and started his intervention journey at 9 years. He understands his mother tongue minimally but does not express it. He was mistaken for dumb until a proper diagnosis was carried out and intercepted with intervention. Candidate 4 is a 10-year-old male that was born in Lagos. He hails from south-eastern Nigeria and visits his place of origin from time to time. He was 8 years old at the beginning of data collection and was mistaken for an extremely willful and obstinate noisy kid, who did not want to communicate intelligibly but made loud cacophonous sounds until he was 7 years. It was not until 7 that proper diagnosis was sought and it was realised that he indeed had ASD as well as Attention Deficit Hyperactivity Disorder (ADHD). He had since been enrolled for intervention and other relevant treatments.

Table 4.24: First and second performances of moderately affected autistics

Input	Candidate 3 (male)		Candidate 4 (male)	
	(at 11 yrs)	(at 13 yrs)	(at 8 yrs)	(at 10 yrs)
Plunge /plʌŋʤ/ CCVCC	/præng/	/plɔnʤ/	/plɔ/	/plɔ.ʤ/
Proud /prɑʊd/ CCVVC	/plɑʊd/	/prɑʊd/	/prɑ:/	/prɑ:.d/
Screw /skru:/ CCCV	/sku:/	/skru:/	/sku:/	/sku:/
Sculpts /skʌlpts/ CCVCCCC	/skɔts/	/skɔlts/	/skɔ/	/skɔ.ps/
Our /ɑʊə/ VVV	/ɑ:/	/ɑwɑ/	/ɑ:/	/ɑ:/

Those in the moderately affected group are those that have enjoyed some form of intermediate intervention. This group of autistics had been victims of misdiagnosis, denials and wrong labels. However, they have enjoyed intervention for up to four years and are classified as intermediate. Candidate 3 in the first encounter substituted greatly, although these substitutions did not affect the structure. However, the cases of deletions affected the structures of the words. The C^3V was realised as C^2V, deleting the C_2 /r/ in the onset position; C^4 structure was also affected in the realisation of *sculpts* as only C_2 and C_4 were retained in the output, deleting C_1 and C_3. The last item was monophthongised, reducing the V^3 structure to V. The second encounter with this candidate showed evidence of growth and improvement. His progress is owed to age assistance and environmental factors which included engaging the services of professionals during the long break caused by the pandemic. There were fewer cases of substitutions and his speech could be compared to those in the mild section of diagnosis or any typically NE language user.

Candidate 4, aside from being moderately affected with autism, also suffers from (ADHD). During the first interaction, this child could not construct any form of coda, simple or complex, and so he only produced open syllabic structures with tedious efforts. When the pandemic struck, his parents still sought professional engagement all through the period of lockdown. This paid off because the child did not suffer retrogression, rather he improved. From the second column in the table, it can be noted that this child made efforts to produce some form of coda, even in their multiples as seen in the case of /skɔ.ps/. Another thing worthy of note is the break between the onset, peak and the newly acquired coda in the outputs in the second column. This candidate produces the coda structure with great difficulty such that he would go a full breath before uttering any coda consonant(s) and as such, outputs as /plɔ.ʤ/, /pra:.d/ and /skɔ.ps/, were produced. It is suspected that the candidate is yet to master complex vowels, that is, diphthongs and triphthongs as these complex vowels in the output were all monophthongised, /aʊ/ to /a:/ and /aʊə/ to /a:/, also substitution was employed to achieve the output.

4.5.3 Late intervention

The candidates in this group have been victims of misdiagnosis and abuse. Candidate 5 was recently diagnosed for severe autism at the age of 14 years and more recently commenced intervention a few months to the commencement of data recording. Having being mistaken for a lunatic, she had been abandoned and locked away for a very long time. It was not until a well-meaning relative with some knowledge about autism brought her to Lagos a year prior to the initial meeting, that she was then diagnosed and given proper treatment and intervention. Now, at 17 years old, she speaks her first language sparingly and is improving fast in her second language acquisition. She is from the eastern part of Nigeria.

Candidate 6 is an 11-year-old from south-western Nigeria. She is female and has suffered all sorts of abuse from parents and relatives for being so mute and tactless. She lived in constant fear of everyone because she had been beaten for so long as a result of her inability to follow instructions through or do things correctly and irresponsiveness. Born to parents with no formal knowledge about the disorder, there was no intention to seek help until a coordinator of one of the facilities met and informed the parents at a worship centre when the candidate was about 7 years of age. The parents' first instinct was to 'reject' and live in denial for another two years before seeking professional help. This candidate had just commenced intervention and treatment as of the time of initial data collection. She understands her first language minimally but does not speak it.

Table 4.25: First and second performances of severely affected autistics

Input	Candidate 5 (female)		Candidate 6 (female)	
	(at 15 yrs)	**(at 17 yrs)**	**(at 9 yrs)**	**(at 11 yrs)**
Plunge /plʌŋʤ/ CCVCC	/prɑː/	/plɔʤ/	/plɑ/	/plɔn/
Proud /prɑʊd/ CCVVC	/plɑ/	/prɑd/	/pɑ/	/prɑ/
Screw /skruː/ CCCV	/duː/	/sku/	/uː/	/sku/
Sculpts /skʌlpts/ CCVCCCC	/stɔː/	/skɔp/	/kɔ/	/skɔ/
Our /ɑʊə/ VVV	/ɑː/	/ɑwɑ/	/ɑwɑ/	/ɑː/

For this last table, these candidates had suffered mostly from misinformation, unawareness, misdiagnosis mostly on the part of the parents and care givers and as a result, had become victims of late diagnosis and intervention. At the initial meeting, Candidates 5 and 6 were barely in the intervention programme for up to two years. Because of the late encounter with intervention, Candidate 5 did not witness any form of age assistance as did Candidate 3. This reveals that no matter how old autistics are, without any form of intervention, their performances will not be intelligible as can be seen in the first column of Candidate 5. The older they get without intervention, the more exerting the effort it takes for them to attain intelligibility; but with consistent intervention, they may experience age-assisted intelligibility –a stage where age assist them to acquire language rapidly. For the second column, with the aid of the introduced online intervention during the lockdown, Candidate 5 was able to continue with intervention enthusiastically and as a result produced a more intelligible output in her second column.

Candidate 6 had suffered from misinformed and unaware parents who exposed her to physical and emotional abuse such as beating and abusive words and as a result, she lived in constant fear of everyone that came around. She was rarely audible in the first meeting and getting data from her took great effort. Just like Candidate 5, her first utterances at the initial meeting were not intelligible but with consistent practice, all through the period of lockdown, she gained steady confidence and is now more audible and intelligible. This was achieved with concentrated efforts in sensitising the parents against child abuse and accepting the child and her differences.

4.5.4 Factors that affect intervention

For this aspect of the work, the researcher interviewed the coordinators of the facilities visited to know more about intervention programmes for autism in Nigeria. There were four (4) of them in all; and some of the questions asked are presented below (some of the questions were asked in different ways just to ascertain answers given). Answers to these questions were mostly unanimous and summarised below. All respondents were middle-aged women; two are from south-west, Nigeria; the third is from south-east, Nigeria and the fourth is from north-central, Nigeria. For the purpose of confidentiality, the respondents will be referred to as Coordinator A, B, C and D where necessary.

4.5.4.1 Background of affected child

Questions asked for this segment are regarding age, state of origin, spoken language(s), cases of first language (L1) interference, environmental and socio-economic factors affecting the child and autistic type of the child.

The age of the candidates affected the impact of intervention, either positively or negatively. The average age of affected children interacted with during the course of this study was 8.3 years. When affected children are correctly diagnosed early enough, the effects are mostly delightful as such children are able to compete in speech with typical language users and are intelligible. However, the reverse is the case when they are not correctly diagnosed on time. They can become severely affected due to lack of timely intervention. Autistics can be age assisted when they receive timely intervention. The assistance comes in a way similar to how typically growing children attain intelligibility.

A total of 58.3% of the autistic candidates interacted with were from south-eastern Nigeria, while 20.8% each hailed from south-western and north-central regions of Nigeria. Only about 20% understood their first language minimally and 6% out of them were able to express sparingly. They all understood and spoke the English language at different degrees. Participants' spoken first language or mother tongue had an impact on their performances as the case of linguistic interference cannot be ruled out when an individual possesses more than one language in their repertoire; however, cases of this interference in their phonotactics existed marginally since only a few actually spoke their first language. There is the case of one candidate in who hailed from Benue State, she realised *impediment* as /imkpedimen/ the epenthetic [kp] in the output was an interference of her mother tongue (MT) which she was able to use to some extent.

The autistic's place of origin or social background also affected intervention to a large extent. In the case of Candidate 1 who was born and first diagnosed and treated in the United Kingdom, this early exposure had a great influence on her as can be noted in her first column. She was intelligible and could read and speak without any form of prompting. Nevertheless, all that can be lost easily if it is not improved upon as can be seen in column B. This candidate was left unattended to during the lockdown and as a result, she retrogressed. Autism is a disorder that is first identified among other things, by language regression which can happen at any time; while Candidate 1 did not engage in any form of intervention programme during the long break (Covid-19 lockdown), she experienced retrogression. Social media, popular song registers, children television series, cartoons and games were part of the socio-economic factors that impacted the phonotactics of autistic children.

All children were aware of the multi-ethnicity nature of Nigeria by virtue of the metropolitan city of Lagos. One Local Government Area (LGA), Amuwo-Odofin, where two of the facilities visited were located was dominated by Igbos (south-south/easterners) who coexisted with Yorubas (south-westerners) and had Hausas (northerners) mainly as street vendors and bike riders. Ikeja, another LGA, is also a central town which hosted mostly the elites, being the capital of the state. The last LGA, Badagry, is a border town, and is home to French-speaking Yorubas, Hausas and Igbos.

4.5.4.2 Effects of diagnosis on affected children

Questions asked under this category were: who diagnosed the child for autism, when, where and how were they diagnosed, any cases of misdiagnosis, average age of diagnosis and diagnosis type.

According to Bakare et al. (2015), the low level of knowledge about autism among medical personnel and health workers is still overwhelming even today. All coordinators (100%) agreed that the health sector still had a long way to go when it comes to diagnosing a child for autism. As reported by these coordinators, there have been cases of misdiagnosis and false hopes which resulted in squabbles between the health sector and the intervention and management facilities in Nigeria. As against the multidisciplinary approach to diagnosis in advanced countries, the clinical psychologists, psychiatrists or paediatricians are mostly saddled with the task of diagnosing a child for autism in Nigeria. A combination of two or three professional confirmation of diagnosis in Nigeria is rare but not totally ruled out.

The average age of children diagnosed for ASD in Nigeria is 8 years old as stated by 75% of the respondents; the other 25% chose 14.2 years as the average age of diagnosis. The children are mostly diagnosed in Federal- or State-owned teaching hospitals. They are diagnosed based on series of tests run on them for co-morbid of ADHD, spectrum, flexibility, stereotypical attitude and communication impairment. Cases of misdiagnosis are more common than accurate diagnosis to the tune of 55% to 45% chances most of the time. This is as a result of many uninformed parents and guardians who readily assume that any indication of slow development will pass as the years go by but are disappointed when the situation only seems to grow worse. Their first point of call is to seek spiritual help, enforce strict training (including getting lesson teachers for the child by those who can afford it) and then resign to fate.

Caring neighbours or colleagues at work place and worship centres might relate the symptoms of the child to something they have once witnessed and based on that, issue their verdicts which these parents/guardians take seriously until they are finally proven wrong much later in life. These and many more reasons have been shared by the coordinators as reasons for late diagnosis and misdiagnosis. While 30% still identify affected children by DSM-4 standards (core autism, Asperger's syndrome and pervasive developmental disorder), 70% have caught on with the recent categorisation as labelled by DSM-5: mildly, moderately and severely affected.

4.5.4.3 Effects of intervention and management on autism

Questions asked under this section are: when did intervention and management start, procedures and schedules of intervention and management, how long will intervention start taking effect in the life of participants, importance of early diagnosis and intervention, can progress be tracked, what is the success rate of intervention in Nigeria.

After diagnosis, the first reaction to the news is to 'reject' the report, then live in denial, after which the period of acceptance sets in; learning more and searching for help spurs. These conflicting emotions in the parents or guardians usually take about a year. The average age of children's commencement of management and intervention in Nigeria is 9 years of age. The procedure of intervention entails assessment of basic language skills, counselling parents and guardians, form filling and other protocols that last between one and four days. The schedule of intervention includes several interactions between professionals such as occupational therapists, behavioural therapists, motor skills therapists, speech therapists/coordinators and special educators were more common among the four facilities, and others included physiotherapists, psychologists and psychiatrists.

Depending on the standard of intervention facility and other factors such as the severity of their diagnosis as well as child’s motivation and bio-physiological preparation, effects of intervention and management are usually seen in a year or four-five years based on these. The significance of early diagnosis and intervention cannot be over emphasised; it is directly proportionate to their success in life as it makes management easier, aids mental alertness and guides against mental retardation. Late diagnosis as afore discussed may be as a result of lack of awareness, finances or access to informed diagnosis.

The experience in most of the intervention facilities (75%) in Nigeria was such that many of these facilities were started mostly by concerned parents of affected children who did not get ready or affordable help for their affected children and they did not have recognised training or certification to run an institution of this magnitude as of the time they started. In turn, they recruited non-professional helpers who were being trained on the job. Seventy-five percent (75%) of facilities visited run a boarding school where affected children can remain after school learning activities for other co-curricular engagements that occupy them for the rest of the day prior to the pandemic in 2020. As of November, 2021, none of the facilities had resumed the boarding programme as a result of such factors like the current economic situation in the country and dearth of research about the effects of COVID on autistic children among others.

4.5.4.4 Autism in Nigeria today

Questions under this part are: rate of diagnosis and intervention of ASD in Nigeria, knowledge of ASD among medical personnel and health workers, among parents, government, and the general public.

The rate of diagnosis and intervention is relatively still too low. The first attempt for intervention in Nigeria, as stated by the pioneer coordinator of the first private intervention facility in Nigeria was in 2006. she is a mother of an affected child herself. Prior to that time, she reported that there was no help coming from anywhere and so she took it upon herself to learn about the disorder and in turn opened her doors to other lost and wandering parents. Similar stories were shared by two other coordinators only one of the coordinators started the intervention facility due to her qualification as a special needs educator and speech therapist. What this means is that 75% started the intervention facility without experience and in turn employed inexperienced caregivers but trained them while on the job, while only 25% started an intervention centre through passion and qualification in Nigeria.

The medical field still has a lot to do regarding autism diagnosis and awareness. There is still room to brush up on the information and be updated on daily research in the field of psychology, neurology and related findings on autism and other special needs conditions. Experience from this study showed that many medical personnel and health workers have average to low level of knowledge about the disorder.

Parental factors such as financial status, level of education and exposure were factors that affected intervention of the children as most children in Nigeria are diagnosed mostly between the ages of six and nine years at an average. Many parents of affected children in Nigeria are ignorant of their children being affected by the spectrum and they live in denial of these facts when they begin to notice the differences in their children and wards. Secondly, they take too much time before they come to terms with the truth after seeking professional or medical consultation. Also, it costs a fortune to get help in Nigeria and with the economic situation in the country today, most parents are more concerned with making ends meet than getting help for affected children. Furthermore, the level of parental exposure to education and to the world may help to improve how they treat these affected children in order to work together for a better outcome. During data collection, most parents and guardians of affected children did not permit research to be conducted on their children because they did not want to 'expose' their children – this is so disheartening because it is through researches like this, that better methods of intervention can be discovered.

The knowledge about ASD among government is quite poor despite awareness. This is due to the nonchalant nature of the government to things of this nature. The coordinators recount the 'promise-but-fail' syndrome demonstrated by the government at the local, state and federal levels. Government have only met up to their promises about 20% of the time which is so poor. Care for special needs is so expensive and not everyone can afford it. It is only fair if governmental policies can be more favourable to the citizenry. Government needs to be more sympathetic to the plight of her citizens. Unlike what is achievable in advanced countries where multidisciplinary departments have been funded and mandated by the government to treat and completely cater for any affected citizen for life; Nigeria still depends on aids, grants and funds to treat her citizenry. Government can ensure that there is at least one special need intervention centre that is well equipped in strategic wards of every local government area in the country to make intervention and management affordable and accessible to the masses.

About 65% of the general public does not know what ASD is in Nigeria. More awareness is needed, training and community support that are needed should be provided so the public can be more helpful in their comments and even render some sorts of assistance when they come in contact with affected persons or parents/guardians of an affected child.

4.6 Discussion of findings

The findings of the study are discussed in line with the objectives of this study below:

4.6.1 Phoneme sequences in autistic utterances

Autistics interactions with phonemes according to their level of severity followed these patterns: The mildly affected autistics were able to retain front vowel sequences 70% of the time, while the moderately affected retain actual input 51.3% of the time. The severely affected autistics performed poorly and only retained front vowel phonemes 26.3% of the time. Autistics generally performed above average in the sequence of back vowel phonemes. Mildly affected autistics retained the back vowel sequence to the tune of 73.3% while moderately affected ones retained the back vowel sequence to the tune of 62.7% of the time. Even severely impaired autistics articulated the back vowel sequences better than front vowels because they had a performance of 45.1% for the back vowels. The greater part of back vowels are open, implying that the tongue is at its lowest and mobility is minimal when productions are made, compared to the closed and front vowels where the tip of the tongue is at the highest which may have posed more challenge to the autistics.

All autistics regardless of their levels of severity performed poorly mostly in the central vowel sequences. Out of 164 tokens received for the central sounds, only 11 (6.7%) retained the input sound –this is not far-fetched from what is achieved in the Nigerian English as submitted by Sunday (2021). Despite this, the difficulties experienced by the autistic children are more pronounced in the production of the central vowels along with other uniqueness that characterise their utterances, this, differentiates their performances to NE production of central vowels. The open vowels, [e], [ɔ] and [æ] are the variants mostly used to substitute the central vowels, /ɜ:/, /ʌ/ and /ə/, respectively and the behaviour of the schwa, /ə/, is mostly determined by its context of occurrence. At word initial or final positions, it was realised as [æ], while at word medial position, it was realised as [e]. Also, short vowels were retained 42.9% of the time and substituted 57.1% of the time. The long vowels were often retained (60%), and their shorter variants were used in place of the actual input. Autistics preferred long vowels to short ones – the short vowels generated more outputs. Substitution pervaded autistics' rendition of monophthongs (61.19%), while deletion featured only in 3.17% of the output. Epenthesis was the least used process (1.12%). The peak positions occupied with monophthongs were mostly unaffected because substitution did not affect structure.

Autistics monophthongised diphthongs, except the centring diphthong /ɪə/ which was usually replaced with another diphthong /ie/. Centring diphthongs were only retained 9 (9%) times out of the expected 100 tokens received for central diphthongs; the issues that pervaded pure central vowels as discussed above, resulted in the poor performances recorded in the autistics interactions with centring diphthongs. All the autistics performed better in their productions of closing diphthongs and Mildly affected autistics excelled in this aspect above its counterparts. Moderately impaired autistics were able to produce closing diphthongs but were slightly more prone to substituting the sound. Lastly, the severe autistics were hardly able to articulate closing diphthongs. The reason is not far-fetched, the diphthong is a more complex form of the monophthongs and if they had difficulty articulating monophthongs, then more difficulty is to be expected for diphthongs. Again, autistics thrived better in the closing diphthongs than in the centring diphthongs but perform averagely in all. All the diphthongs presented had not more than four variant outputs at most.

With regards to triphthongs, the trend showed that the mild autistic children achieved the greatest success 14 (18.9%), relative to the other subgroups, and the moderately impaired ones followed closely 11 (9.4%). The severely impaired children were only able to retain 4.2% of the total expected triphthongs. The severe autistics have the highest number of variants for each of the tested sounds because they have not mastered the skill of coordinating their speech organs to produce target sounds. This finding is similar to the submission of Tager-Flusberg and Joseph (2003), they averred that low intelligence quotient is consistent with the level of language ability which is linked to the severity of autism.

The mildly impaired autistics had the least variants for each tested sound, mostly because they have mastered the coordination of their tongue. This motor skill is clearly missing in the articulation of severely impaired autistics and is not so mastered in the articulation of the moderately impaired who tend to be distracted when uttering the words, though they have the ability to utter target sounds if they put their minds to it.

Most autistics (85.03%) are able to produce simple onsets, irrespective of their diagnostic type or the articulation features of the consonant phonemes which contradicts Ojo (2012) who said that autistics had largely divergent issues with consonants although the study looked at consonants in isolation and not in the company of other sounds or syllable. From the present study, only 9.11% of variant occurrences were recorded, and these were mostly from severely affected autistics and a few moderately affected autistics. This affirms the fact that all the mildly affected autistics in this study performed better in simple onset renditions. There is however a negligible (5.86%) number of deletions that occurred, mostly in the severely affected autistics' speech and rarely in the moderately affected autistics' speech. Less than 2% of mildly affected autistics deviated from the actual input and so are able to realise simple onsets mostly.

For the simple codas, deletion was the dominant process that frequented outputs to the tune of 49.07%; while the retention of the actual sound was up to 43.27%. Each simple coda generated at least a lone variant, except /l/ and /n/, while /v/ generated two variants, /f/ and /s/, which had a negligible percentage of 7.65% in all. So far, the most neglected coda is the lateral, /l/, only about 10.53% of autistics were able to produce the sound; it did not generate any variant but was often deleted. Autistics were able to realise the lateral sound, /l/, to the tune of 85.71% at the onset position but found it much more difficult to produce the sound at the coda position and therefore deleted it.

4.6.2 Patterns of autistic's interactions with cluster

A total of 43.11% of the participants were able to retain variant complex structures at the onset position. About 28.74% were able to retain the C^2 structure while 8.46% were only able to utter simple onsets and a negligible percent (1.9%) deleted the entire complex onset structures. In all, 4.33% retained the actual structure of C^3 and a total number of 5.91% reduced the structure from C^3 to C^2 while 2.16% further reduced it to C^1; 0.78% others deleted the entire structure. The remaining 7.28% further reduced the C^2 to C^1, while 2 others further reduced it from C^2 to C^0.

A sum of 31.96% entirely deleted the coda segments from the tested words; another 28.87% were able to correctly maintain the structure while the remaining 39.17% produced complex codas in different variants most of which included some form of deletions. Among the number that rendered coda in varying degrees, 97.37% deleted one or more segments of the coda; 13.16% inserted new segments or substituted some sounds in the segment. This corroborates the submissions of Ojo (2012) and Umera-Okeke and Iroegbu (2016), who listed deletion and substitution mostly as the processes involved autistics utterances. The trend suggested that autistics found it more difficult to produce codas than onsets, and so deletion and substitution helped them in uttering the complex coda to an extent.

4.6.3 Autistics syllable structure

Autistics simplified the complex vowels that represented minimum structures using three main processes, which sometimes overlap – substitution (83%); deletion (50%); then epenthesis (33.33%). Only 26.5% of autistics were able to render the actual vowel sounds that represented the minimum structures, with the correct syllabic structure and variants of the structure thriving to the tune of 73.5%. This finding again refutes Ojo (2012) who claimed that autistics had limited issues with vowels. Though Ojo's study looked at the vowel sounds in isolation, minimum syllable in the present study technically considered vowel sounds in isolation and has divergent submissions from Ojo's view.

Two open syllabic structures are easily realised by autistics, they are CV and VCV; this is because 88.46% and 87.50% comfortably reproduced the structures, respectively. There are only 15.99% chances for autistics to retain the actual sounds representing an open syllabic structure. There is an 84.0% chance that they would rely on deletion, substitution and epenthesis to help them achieve simpler open syllabic structures, instead of complex ones. This finding corroborates with Esan (2018) who submitted that simpler syllabic structures were preferred to complex ones.

For closed syllable structures, the observable pattern in the output reveals reduction of complex structures to a manageable size that is convenient for autistics to produce. This was done for the most part through deletion of consonant sounds at every point of cluster production. Complex onsets were preferred to complex codas and open structures were preferred to closed structures.

There were only 9.38% instances where words with complex onsets were reduced from C^3/C^2 to C^2/C or totally deleted. Also, complex codas were mostly reduced or completely deleted to the tune of 50.28% within the total deletions of both complex and simple codas and 23.86% of reduction of complex codas either to double Cs or single C. Only 4.83% of the autistics were able to retain actual complex codas and 41.76% others were able to retain simple codas. In two cases, the actual input of complex codas had zero realisations.

All autistic types showed the same pattern of phonotactics acquisition: vowels first: front and back vowels were acquired at varying degrees first, then, central vowels were fairly mastered much later, similar to what is achieveable in Nigerian English. The pattern for consonants was that simple onsets were preferred to complex onsets and complex onsets were favoured over simple coda which in turn was chosen over complex codas. Lateral sound /l/ was the most challenging phoneme to produce at the coda position, whether in a simple or complex coda; however, it was much easier to produce this sound when it occurred at the onset position. Open syllabic structures were preferred to closed ones and minimum syllabic structures were produced in varying degrees.

4.6.4 Constraints responsible for the emerging patterns

In a study of this nature, it is expected that constraints ranking should favour markedness over faithfulness as asserted in previous works by Sunday (2008), and Esan (2018). This happens to be the case in the present study as the outcome of autistic phonotactics permitted autistic-peculiar patterns. The constraints ordering responsible for autistic phonotactics is presented as follows: *SCHWA>>MAX-V>>DEP-IO and *MAX>>*L-ONS>>CODA>>DEP-V helped to achieve the patterns for short vowels. NOCODA >> *V:# >> DEP-V were responsible for the outcome of long vowels; NODIPH >> FAITH-V; NODIPH >> *V:#>> DEP determined the outcome for diphthongs, while *HIATUS >> COMPLEX NUCLEUS >> FAITH-V, *HIATUS >> *L-ONS >> MAX were responsible for triphthongs. *COMPLEX ONSET >> NOCODA >> MAX V >> DEP-IO determined the simplified outcomes for complex onsets and complex codas. *HIATUS ranked higher than MAX-V in order to achieve the minimum syllabic structure; *COMPLEX ONSET prevailed over *HIATUS >> NO DIPH >> DEP for the emergence of open syllable; and *COMPLEX CODA ranked higher than FAITHC to help achieve an open syllable instead of a closed one.

4.6.5 Impact of intervention on autistics' phonotactics

The varying degrees of difficulties experienced by autistics in the pattern of their phonemes, clusters and structural renditions suggest that early diagnosis along with early speech and language intervention is needed for better performance in the phonotactics of autistics. This sustains the submissions of Nodgren (2015), and Wolk, Edward and Brennan (2016) on the effect of intervention on their speech performance. Several factors still affected their performances despite intervention. For the moderate autistics, if diagnosed earlier, they could enjoy early intervention, and become as fluent as mild autistics or even typical language users. Mildly affected autistics with delayed diagnoses and late intervention could still measure up to their typical peers within a short time, depending on their level of concentration and their ability and willingness to learn. The mild autistics are able to grasp target sounds more easily, and are faster learners similar to Asperger's autistics in DSM-IV category of autism categorisation. Finally, the severely affected autistics are usually slow learners with low intelligence quotient (Tager-Flusberg and Joseph, 2003) and as a result, need more qualitative and intensive intervention plan immediately they are diagnosed. In this study, severe autistics found it difficult to enunciate words with clusters and thus, produced words that sounded distant from the input such as [skwɔ], [du:], [u:] for *screw*; [skɔ], [stɔl], [ɔ] for *sculpt* and so on.

4.6.5.1 Factors that affected intervention

Some of the factors that affected intervention were:

1. **Background of the child:** The age of the candidate sometimes affected the impact of intervention. Autistics can be age-assisted when they get timely intervention that is similar to how typically growing children attain intelligibility. However, the reverse is the case when they are not correctly diagnosed or not diagnosed on time. First language interference in their phonotactics existed marginally, since only a few actually spoke their first language. The autistics' place of origin or social background also affected intervention to an extent which confirms Tager-Flusberg (2001) observation that autistics level of language improvement can be related to their social relation or background. Social media, popular songs, children television series, cartoons and games were part of the social factors that impacted the phonotactics of autistic children.

2. **Time of diagnosis:** The health sector still has a long way to go when it comes to diagnosing a child for autism. The average age of children diagnosed for ASD in Nigeria is 8 to 14.2 years which does not tally with with NRC (2001) recommending guidelines for diagnosis and intervention. Cases of misdiagnosis are more common than accurate diagnosis and this happens 55-45% of the time. Delayed diagnoses and intervention is owed mostly to low awareness, parental denial and financial issues.
3. **Time and quality of intervention and management:** It took about a year or more for the parents and guardians of autistic children to take action after diagnosis had been made. The average age of a child at the commencement of management and intervention in Nigeria is 9 to 15.2 years. The procedure of intervention entails assessment of basic language skills. Depending on the standard of the intervention facility, the severity of their diagnosis as well as the child's motivation and bio-physiological preparation, effects of intervention and management are usually seen in one year or in four to five years based on these factors mentioned above.
4. **The Nigerian factor:** Most facilities are established by concerned parents of affected children who did not get ready or affordable help for their affected children and do not have the recognised training or certification to run an institution of that magnitude. The first attempt for intervention in Nigeria was in 2006 as stated by the pioneer coordinator of the first private intervention facility in Nigeria.

Parental factors such as financial status, level of education and exposure were factors that affected intervention of the children. During data collection, most parents and guardians of affected children did not permit research to be conducted on their children because they did not want to 'expose' their children.

Medical personnel and health workers still have a lot to do regarding autism diagnosis and awareness as issues affecting the medical sectors pertaining the diagnosis of autism as stated by Bakare et al (2008, 2015) and Igwe et al (2011) still exist. The government seems to be clueless when it comes to the issue of autism spectrum disorder (ASD), unlike what is achievable in advanced countries. Despite awareness, the knowledge about ASD within the government is quite poor, due to the nonchalant nature of the government to things like this which is evident in their policies.

4.7 Summary

This chapter analysed the vowel realisations, consonants realisations, simple and complex onsets and codas, minimum structures, open and closed syllabic structures as well as the impact of intervention on the phonotactics of autistics and the factors that affect intervention in Nigeria. It also discussed the findings of each objective. The summary and conclusion of the research are presented in the next chapter.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.0 Preamble

This chapter focuses on summary, conclusion and recommendations of the research. The limitations, contributions and suggestion for further studies are also discussed.

5.1 Summary of the study

The first indication of autism is language regression since the condition is not associated with any form of deformity that is noticeable to the human eye as found in Down syndrome or Cerebral Palsy, and so on. Language is therefore a very important factor to consider when diagnosing autism in a child. A very good place to begin is phonotactics which concerns how the sounds autistic people make are arranged into sequences. Three diagnostic autistic types were observed according to the level of severity: mild, moderate and severe autistics and their levels of intervention were also put into consideration. This study distinguishes itself from existing research that has been conducted mostly in advanced countries because the socio-economic realities of these countries are not the same in Nigeria. Below is the summary of the findings.

Following the research objectives, as well as the theoretical and acoustic analyses, the following observations were made about Nigerian autistic children's phonotactics.

5.1.1 Phoneme sequences in Nigerian autistic utterances

The patterns noticed in autistics' interactions with monophthongs are that autistics retain monophthongs to the tune of 37.7%. Substitution pervaded autistics' rendition of monophthongs (61.19%) which did not affect the structure of the peak position because substitution does not affect structure. Some of the issues that permeated the English pure central vowels also featured in the English central diphthongs, some of these features are commonly found in the Nigerian English. Generally, autistics are able to produce diphthongs as much as monophthongs. Their most preferred variants of the diphthongs were the monophthongised sounds achieved by substitution; the peculiarity of their speech however, differentiated their productions from what is obtainable in NE. Autistics found triphthongs to be problematic. Retention of triphthongs by all categories of autistics happened 32 (8.9%) times out of 361 tokens expected for the triphthongs in the data. The articulation of triphthongs was poor because of the complexity of the sound. Epenthesis and substitution occurred frequently, and sometimes, simultaneously. Monophthongisation was also a process that the participants used to attempt to produce triphthongs. Most autistics (85.03%) are able to produce simple onsets, irrespective of their diagnostic type or the articulation features of the consonant phonemes. For the simple codas, deletion was the dominant process that frequented outputs to the tune of 49.07%; while the retention of the actual sound was up to 43.27%.

5.1.2 The pattern of autistic children's consonant clusters

A total of 43.11% of the participants were able to retain variant complex structures at the onset position. About 28.74% were able to retain the C^2 structure while 8.46% were only able to utter simple onsets in place of complex ones and a negligible percent (1.9%) deleted the entire complex onset structures. A sum of 31.96% entirely deleted the coda segments from the tested words; another 28.87% were able to correctly maintain the structure while the remaining 39.17% produced complex codas in different variants most of which included some form of deletions. Among the number that rendered coda in varying degrees, 97.37% deleted one or more segments of the coda; which suggested that autistics found it more difficult to produce codas than onsets, and so deletion and substitution helped them in uttering the complex coda to an extent.

5.1.3 The syllable structure of autistic children

Autistics simplified the complex vowels that represented minimum structures using three main processes, which sometimes overlap – substitution (83%); deletion (50%); then epenthesis (33.33%). Two open syllabic structures are easily realised by autistics, they are CV and VCV; this is because 88.46% and 87.50% comfortably reproduced the structures, respectively. There are only 15.99% chances for autistics to retain the actual sounds representing an open syllabic structure and an 84.0% chance that they would rely on deletion, substitution and epenthesis to help them achieve simpler open syllabic structures, instead of complex ones. For closed syllable structures, the observable pattern in the output reveals reduction of complex structures to a manageable size that is convenient for autistics to produce. This was done for the most part through deletion of consonant sounds at every point of cluster production. Complex onsets were preferred to complex codas and open structures were preferred to closed structures.

5.1.4 Constraints responsible for all the outcomes

Constraints rankings favoured markedness over faithfulness in the outcome of autistic phonotactics because it permitted autistic-peculiar patterns. *SCHWA>>MAX-V helped to achieve the patterns for short vowels. NOCODA >> *V:# was responsible for the outcome of long vowels; NODIPH >> FAITH-V determined the outcome for diphthongs, while *HIATUS >> COMPLEX NUCLEUS was responsible for triphthongs. *COMPLEX ONSET >> NOCODA dictated the simplified productions for complex onsets and complex codas. *HIATUS ranked higher than MAX-V in order to achieve the minimum syllabic structure; *COMPLEX ONSET prevailed over *HIATUS for the emergence of open syllable; and *COMPLEX CODA ranked higher than FAITHC for the production of an open syllable instead of a closed one.

5.1.5 Impact of intervention on autistics' phonotactics

The varying degrees of difficulties experienced by autistics in the pattern of their phonemes, clusters and structural renditions suggest that early diagnosis along with early speech and language intervention is needed for better performance in the phonotactics of autistics. Several factors affected their performances despite intervention. For the moderate autistics, if diagnosed earlier, they could enjoy early intervention, and become as fluent as mild autistics or even typical language users. Mildly affected autistics with delayed diagnoses and late intervention could still measure up to their typical peers within a short time, depending on their level of concentration and their ability and willingness to learn. The mild autistics are able to grasp target sounds more easily, and are faster learners. Finally, the severely affected autistics are usually slow learners with low intelligence quotient and as a result, need more qualitative and intensive intervention plan immediately they are diagnosed. Some of the factors that affected intervention were: Background of the child- age, place of origin, social background also affected intervention to an extent; Time of diagnosis; Time and quality of intervention and management; The Nigerian factor- parental factors (finance, education and exposure), medical expertise, governmental policies and public awareness.

5.2 Conclusion

Nigerian autistic children's phonotactics has been established to be much alike to that of typically growing children because of their preference for simpler phonotactic patterns. However, while typically developing children acquire more complex phonotactic patterns as they grow (Coady & Aslin, 2017), autistic children are mostly static, needing consistent and persistent speech intervention to gradually gain mastery of complex phonotactics, from monophthongs to triphthongs, from simple onsets to complex ones, and from simple codas to complex codas. Autistics favour markedness constraints above faithfulness constraints because the utterances they produce are peculiar.

5.3 Limitations of the study

Firstly, reluctance of special needs centres to grant access to researcher, claiming that parents and guardians of affected children do not want to 'expose' their children frustrated the researcher's efforts many times. These centres have not accepted the fact that the studies benefit these children. As a result, many of the ethical consideration protocols were not met, thus, hindering the research from taking place in such facilities.

Twelve facilities were visited, covering the major geopolitical zones in Nigeria, but data were only got from four facilities all within Lagos State. The reasons data were not got from these other places were that some of the respondents were mainly non-verbal and had just begun the process of intervention and some were unresponsive and uncooperative. Other times, the processes of ethical consideration were not completed.

Also, the process of data collection was demanding and arduous, partly because it involved children that were autistic. Getting them settled enough to take the test was time-consuming, mostly because they suffered from Attention Deficit Hyperactive Disorder (ADHD) at varying degrees. Also, getting a conducive environment to test them depended on the structure of the facility which affected the quality of some of the data that were got. As a result of this, the autistic children's speeches were sometimes not very intelligible and this affected the quality of the acoustic analysis.

The period of lockdown adversely affected the results that intervention had achieved in the children before the pandemic. Most of the children who did not gain access to therapy during that period lost some of their communication skills, while only those who were age-assisted and had access to private therapy during the period improved.

During this period, the researcher could not access the participants and this strained the efforts of data collection. At the level of research, listening to the collected data was monotonous and tedious and some of the children did not follow the prepared instrument but said whatever came to their mind. This robbed the data of its uniformity of phonemes and frequencies.

Acoustic analysis was taxing as the participants' outputs were not clear enough or had a noisy background, which made the spectrogram difficult to read. Finally, the research is limited by the geographical region it covers which is only some parts of Lagos State.

5.4 Recommendations

To advance the discussion on the phonotactics of autistic Nigerian children, with a view to improving their phonotactic skills and aiding diagnosis in Nigeria, the following recommendations have been made:

1. Speech coordinators and special educators should pay special attention to central vowels and complex structures so that when the autistics are eventually age-assisted, they will not find it difficult to realise such sounds as central vowels and complex structures. They should also help autistics realise the right vowel sound rather than be satisfied with substituted vowels; substitution could be acceptable at the commencement of the intervention programme but not eventually.
2. Speech coordinators should also pay attention to centring diphthongs so that autistics can learn to realise the diphthongs in their correct quality. Being a controversial issue, triphthongs can be adapted to receive epenthetic sounds that are similar to what is achievable in Nigerian English.
3. Concentrated efforts should be placed on codas and closed syllabic structures because they are more problematic to produce by all autistic types.

4. Autistics should be encouraged to render vowels with more quality to avoid continuous simplification, reduction and deletion of vowels representing the minimum structures
5. From the markedness constraints that ranked high over faithfulness constraints, speech coordinators and therapists can focus their attention on *SCHWA, *L-ONS, *V:, NO DIPH, *HIATUS,*COMPLEX CODA to identify the issues that plague the phonotactics of Nigerian autistics. These issues are central and long vowels, diphthongs, triphthongs and complex codas.
6. This study raised a lot of findings in the Nigerian autistic community. The government should invest in the diagnosis of children less than two years of age by ensuring that proper diagnoses are included and run on each child at their 18 months' investigation and immunisation routine. This can be achieved by employing qualified medical and health workers and other relevant therapists in government-owned hospitals.
7. Consultancy and diagnoses usually cost a lot for the average Nigerian and government can help to ease this stress by ensuring that there is at least one special need intervention centre that is well equipped with human and technical resources in strategic wards of every local government area in the country to make intervention and management affordable and accessible to the masses.
8. Speech therapists are very scarce human resource in Nigeria. Those who exist are speech coordinators who often pose as speech therapists. This is why the communication aspect of diagnoses is usually not carried out in the hospitals, thus, making the process of diagnosis incomplete. Institutions within the education sector, such as tertiary institutions and ministries of education should encourage undergraduates and postgraduates to study courses that point them in the direction of getting certified as speech therapists so that they can in turn contribute their quota in correctly aiding the diagnosis of a child for autism in Nigeria.
9. The speech therapists can in turn use the information in this study to establish whether or not a child suspected to have ASD really has it. Such therapists can then suggest inputs from multidisciplinary arms to ascertain the diagnosis.
10. There is still a need to create and continue awareness on ASD among parents and the general public, so as to identify and educate them about ASD. This will aid quick and early detection of ASD which can then be well managed.

5.5 Contributions to knowledge

The following are the contributions this study has made to literature:

1. The research revealed the importance of phonology in the identification of specific sound issues that affect the speech and intelligibility of autistic children. It also proffers recommends method of treating such problematic sounds.
2. The research unveiled the importance of not just early diagnosis and intervention, but also consistent and persistent intervention. Therefore, it exposes the need for the Federal Ministry of Health to ensure that medical personnel, including psychologists, psychiatrists, paediatricians and therapists, are to be well informed and equipped to carry out early and correct diagnosis, so as to commence qualitative and quantitative intervention.
3. It reinforced the importance of continuous intervention to aid consistent acquisition of communication skills.
4. It unveiled the need for more trained human resources on the field. Professionals who are borne out of deep-seated knowledge and passion for the job, and not just parents of affected children should establish special needs facilities. The study exposed the fact that so far, only 25% of experts are on the field while 75% others are parents of affected children who could not afford professional help and chose to startup on their own and help others along the way.
5. It provided the linguistic data for a successful therapy.
6. It created awareness among parents, guardians, medical personnel, coordinators of special needs facilities, government and the general public to aid improved access to research, funding and treatment among others.

5.6 Suggestions for further studies

This study engaged the phonotactics of Nigerian autistic children in Lagos State and thus is limited in this regard. The following are therefore suggested for further studies:

1. To have well rounded research on autistic phonotactics in Nigeria, further study needs to be carried out in all geopolitical zones of the country. This study serves

as a springboard to other Nigerian researchers interested in special needs, particularly ASD.

2. This present research was plagued with resistance from parents of autistics and coordinators of intervention facilities mostly in the south-east/south-south and northern regions of the country; therefore, future studies on autistic phonotactics can originate in these regions of the country.
3. Phonotactics of other atypical children can be looked into to create a more robust literature for special needs studies in Nigeria and comparison between autistic phonotactics and other disorders can be carried out for a more generalised phonotactics studies.

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APPENDICES

CONSENT FORM

This research is being conducted Esther Abe, a doctoral student at the University of Ibadan. The focus of the research is to compliment clinical diagnosis of ASD through profiling their sound structures. The information collected about the candidate will be kept confidential. All identifiable information such as the child's name and age will be kept away from the public and adequately destroyed as soon as the research is over. The child's participation is entirely voluntary and may discontinue whenever they so wished. If successful, the study will compliment diagnosis and intervention for autistics.

I, ____ the Coordinator of ____ (name of the special need centre) hereby consent voluntarily for the research to be carried out here at the facility with the consent and permission of the parents and guardians for the furtherance of research that will help our children. Each participant has the right to withdraw from participation if they so desire.

Signature/ date: ______________________________________

Thank you.

Procedure

The instrument has three parts: the first concentrates on background data about the candidates to be answered by consenting parents/guardians of affected children or knowledgeable coordinators; the second part is an interview that focuses on the professionals, special educators or minders of the children while the third part is a list of words that the children are expected to pronounce and their responses would be recorded. Both parts A and B should be answered by professionals or care givers, only Part C is required to be rendered by participating autistic children.

Thank you for participating in the research.

Part A

1. Name:____
2. Age: ____
3. State of Origin: ____
4. Spoken Language(s): Hausa _____ Igbo _____ Yoruba _____ others (specify) ________
5. Place of birth: ____
6. Can the child communicate in their first language? Yes ______ No _______ To an extent _____ Not sure _______
7. Does the child communicate in English? Yes _____ No _____
8. Does the child have cases of first (native) language interfering with their English?
   Yes _____ No _____
9. Does environment or socioeconomic background influence the way they speak?
   Yes ____ No _____
10. What language is mostly spoken around the area where the child lives? English _____ Pidgin English ______ Not sure ______ Others (please specify) ____________
11. What language is mostly spoken around the area where the facility is located?
    English _____ Pidgin English ______ Not sure ______ Others (please specify) ____________
12. Is the child a boarder from another state or a resident of the state where your facility is located? Boarder _______ Resident _______ Not sure _______
13. Autistic Type: ____
14. Year of Diagnosis: ____
15. Year started Intervention: ____
16. Rate progress level since intervention: Impressive ( ), Average ( ), Progressive ( ), Static ( )
17. Was there a previous case of misdiagnosis? Yes/No
18. What was the misdiagnosed label? ____________________________________

Part B

Interview for professionals: educators and caregivers

(Answers in this first aspect, would be recorded on each of the child interacted with at the centre)

1. Who diagnosed them for autism?
2. When was he/she diagnosed?
3. How are they diagnosed and managed (procedure for diagnosis and management)?
4. How are they categorised? (Core, AS, PDD others?)
5. At what age were they diagnosed?
6. At what age did intervention commence?
7. Rate their progress since intervention commenced
8. What does the intervention schedule entail?
9. How much longer would intervention be needed for them to be prepared enough to compete (in speech) with typical non autistics?

Answer based on your years of experience. Answers would be recorded

10. Having interacted with intervention, how would you project their successes as they grow? (living through adulthood)
11. How important is early diagnosis, intervention and treatment to autistics?
12. How would you rate diagnosis of and intervention supply to autistics in Nigeria?
13. Rate the knowledge of autism among the following:
    a) Medical practitioners and health workers
    b) Parents and guardians of these children
    c) Minders and care givers
    d) General public
14. Challenges of autism in Nigeria. Are we doing enough as a country?
15. What more can be done?

Part C (prepared list of words)

1. Sculpts, sculpts, sprint, impediment, bottle, pat, put, about, plunge, plunged.
2. Screw, colleague, car, early, court.
3. Fountain, navigate, arrive, boys, peered, bears, pure, go, sprite, proud.
4. Prayer, flower, fire, choir, loyal, lawyer, royal, flour, player, sower, mower.
5. Air, are, our, hour.

The prepared list represents the vowels and consonant redistributed under various syllabic types. (Kindly guide the children through and record their responses for those that will only participate at odd times)

Once again, thanks so graciously.

Abe, Esther Eyitosho

List of unprepared words

want, drink, water, break, thank, cup, bread, cookie, sun, mister, little, children, come, with, teddy, step, tickle, head, neck tummy, bag, hello, banana, golden, garden, table, correction,

aunty, you, please, asking, shoe and girl, hello, fine, boy, eight, year, old, shine, down, play, round, bear, way, ear, eye, mouth, chair, quiet, round, bear, girl, mouth, play, and *quiet*

UNIVERSITY OF IBADAN, IBADAN, NIGERIA

DEPARTMENT OF ENGLISH

O. A. Ogunsiji, Ph.D.
Professor and Head of Department
+234 (0) 8033939032

E-mail:english@mail.ui.edu.ng

22 May, 2019

[redacted]

Dear Sir/Ma,

TO WHOM IT MAY CONCERN

LETTER OF INTRODUCTION: ABE, Esther Eyitosho (Matric. No. 211971)

This is to confirm that Esther Eyitosho ABE (Matric. No. 211971) is a Ph.D. student of the Department of English.

She wants to access some information in your office that will enable her write her research work.

It would be appreciated if you could accord her the necessary assistance she may need in carrying out her research.

Thank you.

Yours sincerely,

O. A. Ogunsiji
Professor and Head of Department

UNIVERSITY OF IBADAN

[redacted]

Professors: L. A. Banjo (Emeritus), ...

HelpingHands
THERAPY
Speech Threrapy. Learning and Development

The Principal Facility Coordinator,
4th Avenue A1 close ,House 60
Festac Town Lagos.

The Head of Department

Dept.of English

Faculty of Art

University of Ibadan ,Oyo State.

Dear Sir/Ma,

LETTER OF ATTESTATION

TO WHOM IT MAY CONCERN

Helping Hands Centre for Learning and Development) a sister Organization of Disability Aids, we run research backed method of Autism treatment, Learning Remedial Programmes, Speech therapy, Physiotherapy and other Neuro - developmental therapies, to help children overcome both learning and developmental challenges, and also thrive better. We work with children with developmental delays and Learning difficulties. The program is run under the supervision and expertise of an international lincenced clinical child Psychologist, who has undergone both local and international training and education with years of experience.

Esther E. Abe a doctoral student of the University of Ibadan has frequented the centre for about two years from 2019-2021,interacting with the Autistic children in the centre with all protocols duly observed and consent granted by the school and by extension, parents and guardians of the children concerned. She has been carrying out her research diligently. We furnished her the necessary information's and assistance needed to make her work easy.

Thank you for your cooperation.

22/10/2021

Mrs Uchenna Emefoh

Principal Facility Coordinator

patrick
SPEECH & LANGUAGES CENTRE

13b, Remi Fanikayode Street, GRA, Ikeja, Lagos.
Tel: 08033019865, 07055028215, 08180127108
E-mail: patrickspeech1@gmail.com | twitter@patrick_speech
website: www.pslcautism-ng.org

TO WHOM IT MAY CONCERN

This is to certify that the researcher Esther Abe, carried out her research in the above stated Centre with the due permission and authority of the Director: **PATRICK SPEECH AND LANGUAGES CENTRE,** and granted consent of the parents of the participants used in the study. She received adequate assistance of the staff and head of the institution all through her time here.

We wish her all the best in her future endeavors.

Yours faithfully,
For: **PATRICK SPEECH AND LANGUAGES CENTRE**

Funmi 07/11/21
FUNMI ENIKANSELU
Head of School

KINGS PEARL CENTRE
Therapy Services

SPEECH THERAPY | PHYSIOTHERAPY | OCCUPATIONAL THERAPY | BEHAVIOUR MODIFICATION | LEARNING SUPPORT

MONDAY 18TH OCTOBER, 2021

TO WHOM IT MAY CONCERN

This is to affirm that Esther E, Abe a doctoral student of the University of Ibadan has visited the center often for about two(2) years. She spends time interacting and connecting with the autistic children in the center with consent granted by the school and by extension parents and guardians of the children concerned.

....

JOY AHMEDU

PROPRIETOR

KINGS PEARL CENTRE
Therapy Services
22 Road, F Close,
Block 3, Flat 11,
Festac Town, Lagos
KingsPearlCentre@gmail.com
+234 - (0) - 802-426-0717

Consent form and questionnaire

1 message

Irebamibo Pearls Centre <thepearlscentreng@gmail.com> Fri, 12 Nov 2021 at 11:03
To: Tosho Esther omokore <esthertoshoroyalty@gmail.com>

Going through the questionnaires and interview. We observed that there are no noticeable breach of confidentiality to our clients.

You are hereby granted the permission to obtain your data from the children having gotten informed consent from their parents/guardians.

Accept the assurances of our esteemed regards.

-- -

Dr. Olayinka-Aliu
Service Director
IPCH

[Quoted text hidden]