People's Democratic Republic of Algeria
Ministry of Higher Education and Scientific Research
University of Tlemcen

Faculty of Letters and Languages
Department of English
Section of English

Effects of Congenital Agrammatic Broca's Aphasia on the Arabic Morpho-Syntactic Structure: The Case of Down Syndrome Children in Tlemcen

Dissertation Submitted to the Department of English as a Partial Fulfilment of the Requirements for Master's Degree in Language Studies

Presented by
Ms. Rayene KHOUDOUR
Mr. Hassimi Salif GUINDO

Supervised by
Prof. Amine BELMEKKI
Co-Supervised by
Dr. Sarra Menal FERKACHE

Board of Examiners

Prof. Zoubir DENDANE	**President**
Prof. Amine BELMEKKI	**Supervisor**
Dr. Sarra Menal FERKACHE	**Co-Supervisor**
Prof. Nassim NEGADI	**Examiner**

2022 - 202

Declaration of Originality

We hereby declare that this submission is our own work and that, it contains no material previously published or written by another person nor material which has been accepted for the qualification of any other degree or diploma of a university or other institution. We also certify that the present work contains no plagiarism and is the result of our own investigation, except where otherwise stated.

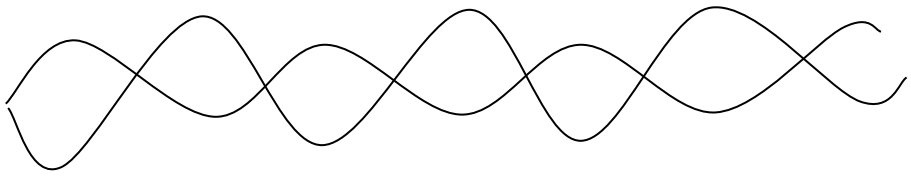
Ms. Rayene KHOUDOUR

Mr. Hassimi Salif GUINDO

Dedications

From this vile ash with vilest cries
From your disdainful, prideful eyes
From this oppression on the right
From your deterrent, gloomy sight
With my propitious thoughts in fire
With my auspicious bright desire
With my supreme being at dense hour
The inexhaustible source of power
With Mockingjay capacious wings
Above I rise and my soul springs
With my resounding voice in ear
A proof that I will never adhere
All I do I do for my sake
For who endeavour to awake
Who rap and squeal in every door
Implore and every try deplore
Extol yourself and push it high!
Embody dreams that will not die!

Rayene



In the memory of my cousin, Boureima Guindo and all the victims of terrorism in Mali

To my loving mother, Hawa and my hero and self-taught father, Salif

To my brothers and sisters, especially my elder brother and mentor, Dr. Amadou Salif Guindo

To my dear country, Mali

Hassimi

Acknowledgments

Foremost, we praise Allah, the Almighty, whose abundant mercy permitted us to fulfil this humble work. We cannot have enough words to thank and express our gratitude to our supervisor Professor Amine BELMEKKI and co-supervisor Dr. Sarra Menal FERKACHE for their resolute supports, their constructive comments, their counselling, and their guidance throughout the realisation of the present project.

We would like to utter our infinite gratefulness to the board of examiners, Professor Zoubir DENDANE and Professor Nassim NEGADI, who accepted to evaluate our work. Our immense thankfulness to the Department of English and to all our teachers for their priceless teachings and wisdom, and for inculcating in us the flame of knowledge seeking.

Our unconditional gratitude to the whole staff of AWIT for their valuable assistance all along this project. We cannot sufficiently thank all the participants in our study, specially to all the angelic children with Down syndrome, to the teachers, to the specialists in Psychology and Genetics, and to the school authorities who accepted to accompany us throughout this unique adventure. Our gratefulness shall be extended to the Academy of Tlemcen for granting us the research authorisation.

We express our sincerest appreciation and profound gratitude to Mr. Nacereddine KHOUDOUR, the IT engineer, for his unwavering support throughout the entire process. His expertise in building the database, invaluable assistance with statistical analysis, and steadfast guidance have played an indispensable role in the successful completion of this work. We are truly fortunate to have had him as a part of our team. His unwavering dedication, meticulous attention to detail, and exceptional technical skills have consistently exceeded our expectations.

We would like to express our heartfelt gratitude to Dr. Leila BENFERHAT for her invaluable contributions in the field of medical expertise, particularly in relation to reading scans and comprehending the medical challenges faced by children with Down Syndrome. Dr. BENFERHAT's ability to effectively communicate complex medical concepts has empowered us to bridge the gap between the technicalities of medical information and the practical implications for our work.

Finally, our dearest thankfulness to our families and parents for their love and support and for encouraging us to follow this path. Special thanks to all our friends and colleagues who, in one way or another, supported us along this humble contribution. Special thanks to our dear colleague Ahmed Lotfi BELAREF from BBA University for his continuous support along with proofreading several parts of the work. Particular gratitude shall be addressed to Ms. Rosa CHEGRANE for the Arabic courses delivered to Hassimi. .

Abstract

The current landscape of language studies necessitates an interdisciplinary approach, merging the realms of neurology and genetics, in order to unravel the complexities of language and its associated disorders. Within this framework, the investigation of congenital agrammatic Broca's aphasia in individuals with Down syndrome presents a fertile ground for amalgamating neurolinguistics and genomic linguistics. This study delved into the morpho-syntactic impairments in the Arabic language among children with Down syndrome, scrutinising their linguistic disabilities, interrogating Universal Grammar, and unravelling the genetic underpinnings. This study employed a combination of inductive and deductive reasoning, utilising an exploratory, single instrumental, and holistic case study approach with a mixed method design. The research was conducted in Tlemcen province, including Down syndrome children, their teachers, a psychologist, and an expert in molecular genetics and neurology. Data collection involved semi-structured interviews with three teachers and the psychologist, a test administered to16 pupils, and classroom observations. Additionally, an online interview was conducted with a specialist in molecular genetics and neurology. The data collected unequivocally supported the prevalence of Arabic agrammatic representations of Broca's aphasia in Algerian children with Down syndrome. Remarkably, the Arabic language highlighted these linguistic challenges more prominently than other languages. Additionally, the agrammatic representations exhibited by children with Down syndrome challenged the foundational principles of Universal Grammar. Furthermore, the study established a direct link between the genetic anomaly associated with Down syndrome and the manifestation of language disorders in affected children. These insights drive a paradigm shift, fostering an interdisciplinary field that transcends traditional boundaries.

Keywords: Language disorders, Neurology, Genetics, Congenital agrammatic Broca's aphasia, Neurolinguistics, Genomic linguistics, Down syndrome, Morpho-syntactic

impairments, Arabic language, Linguistic disabilities, Universal Grammar, Genetic underpinnings.

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List of Acronyms

ABA: Agrammatic Broca's Aphasia

ACGT: adenine (A), cytosine (C), guanine (G), thymine (T)

ANIT: *Association Nationale pour l'Insertion des Trisomiques /* National Association for the Integration of people with Down syndrome

ASPM: Abnormal Spindle-like Microcephaly-associated

AWIT: *Association de la Wilaya pour l'Insertion des Trisomiques/* Regional Association for the Integration of people with Down syndrome

DBMS: Database Management System

DNA: deoxyribonucleic acid

DS: Down syndrome

FOXP1: Forkhead Box Protein P1

FOXP2: Forkhead Box Protein P2

LAD : Language Acquisition Device

MRI: Magnetic Resonance Imaging

NRXN1 : Neurexin gene

ROBO1: Roundabout Guidance Receptor 1

SLI: Specific Language Impairment

SQL: Structured Query Language

TD Children: Typically developing children

TDH: Trace Deletion Hypothesis

TPH: Tree-Pruning Hypothesis

UG: Universal Gramm

VB: Visual Bas

Glossary

Term	Meaning
ACGT	Adenine (A), cytosine (C), guanine (G), thymine (T) an acronym labelling the four DNA molecules
Agrammatism	A speech representation, sometimes related to Broca's aphasia, in which grammatical skills are impaired
ASPM	Abnormal Spindle-like Microcephaly-associated: a gene associated with a neurological disorder called microcephaly
Autism Spectrum	A neurological and developmental anomaly affecting people's way of interacting, communicating and behaving with others.
Broca's Aphasia	An aphasia in which the spontaneous speech is affected resulting in non-grammatical structures in speech production, comprehension and even in writing
Chromosome	An element inside the nucleus of every cell
Database Management System	A software used to create and manage databases, allowing users to read, create, update and delete information in a database
Dementia	Cognitive disabilities that affect thinking, problem solving and other daily activities
Dendrite	A thin cord that extends from a nerve of a cell
DNA	Deoxyribonucleic acid; a genetic material found in human beings and other organisms
Dosage sensitivity	A changing force that can result in gene variations

Dyslexia	A learning defect that negatively impacts reading skills
FOXP1	A gene whose mutation is related to a number of anomalies such as autism spectrum disorder, and language impairments
FOXP2	A gene that can cause language disorders in infancy
Gene	The basic unit of material that every child receives from his parents
Genome	The whole system of DNA that exists within human beings and organisms
Hippocampus	A brain zone found in the temporal lobe
Neural circuits	An assemblage of neurones and the connection among them
Neurone	A type of cell that helps to send and receive information from the brain to the body and vice versa
Operant conditioning	A learning method utilised by Behaviourism consisting of employing reward punishment processes to modify behaviour
Pivot	An operation done in SQL that refers the process of transforming data from rows into columns
Primary Progressive Aphasia	A rare genetic disorder affecting the nervous system and causing language disorders
Protein	Complex molecules that play vital roles in the body
NRXN1	A gene linked to language disorders and its delay
ROBO1	A gene associated with dyslexia and other language disorders
Specific Language Impairment	A type of language disorders caused by a genetic mutation in chromosome 7

Structured Query Language	A computer language that allows to interact with databases to retrieve, analyse, and manipulate data through the use of statements like select,update, delete, and more
Synapse	The location where electrical signals are transmitted from a nerve cell to another
Visual Basic	A computer program permitting developers to initiate graphical user interfaces (GUI) and write codes to determine the functionality and behaviour of the created software. It also upholds event-based programming, where actions provoke particular code execution.

General Introduction

Enormous interest on the syntactic deficits is at the core of concurring research on language disorders. Following Chomskyan new theories on generative grammar, many language practitioners turned their attentiveness into investigating whether syntactic shortfalls prevail in language disorders, which linguistic structures have deteriorated and how to capture this latter in a well theoretical framework. Recent research on this matter focused on congenital anomalies affecting the left frontal brain regions; over and above that, Broca's aphasia. Drawing from Chomsky's generative approach, the impairment in the organ stated should lead to language impairments that are in this regard a product of genetic disorders which are responsible for the stagnation of the genetically encoded blueprints controlling the evolution and operation of the brain (Hasina, Wang &Wang, 2022; Penke, 2015). Accordingly, scrutinisation on syntactic deficits put language disorders such as Down syndrome, Williams syndrome, and Autism into focus.

Nowadays, syndromes escorting acquired or developmental language disorders like Down Syndrome are of a great inquisitiveness. Down syndrome patients evinced deficits in both language comprehension and production. Shortfalls in this latter are exhibited especially in the spontaneous-speech by hurdles in bound inflectional morphemes and free function words that are omitted or substituted in most cases (Comblain and Thibault, 2009; Laws and Bishop, 2003; Menn and Obler, 1990a). Moreover, the sentence length is generally lessened with a reduced syntactic complexity habitually restricted to canonical word order (Friedman, 2002; Grodzinsky, 2000; Penke, 2015; Wimmer and Penke, 2020; Witecy, Wimmer and Pinker, 2017). Unlike the aforementioned symptoms, syntactic deficits in language comprehension are rigorous to locate. Ergo, experimental data display a plethora of quarrelling theories amongst which the impaired understanding of passive sentences represents a great challenge (Gavarró and Dotti, 2013; Penke and Wimmer, 2020). Therefore,

research on the Arabic language tackling the effects of agrammatic Broca's aphasia on the morpho-syntactic structure of Down syndrome children in Algeria_ most precisely in Tlemcen_is yet a must.

In investigating the effects of agrammatic Broca's aphasia on the morpho-syntactic structure of Down Syndrome children the aim is twofold. A first goal is to situate and to evoke the aspects of Arabic language that are deteriorated due to the anomaly, i.e. to thoroughly grasp the impaired language system. This knowledge can eventually provide a strong underpinning for a therapeutic intervention. A second goal in investigating syntactic deficits is depicting cases where the human language capacity seems to break down, defying the core principles of Universal Grammar. This might provide a breadth of view on what is actually happening inside the black box. Similar anomalies represent a window into the system of language. This window can help in delineating the blackout of the agrammatic representations that abscond Universal Grammar. If this latter is proven, a huge breakthrough in the history of modern linguistics is to happen with its major headlines incorporating a statement that the anomaly in the genome is the ultimate reason for the aforementioned syntactic shortfalls. Consequently, it is the genome that is controlling language with the brain being just an executive organ.

Eventually the researchers venture to answer the questions that follow:

1- Do the agrammatic representations of children with Down syndrome in other languages prevail in Arabic?
2- Do the agrammatic representations of children with Down syndrome defy the core principles of Universal Grammar?
3- Is the anomaly in the genome responsible for language disorders in Down syndrome?

The questions alluded atop lead the researcher to draw three hypotheses:

1- The complex morphosyntax and declinability of the Arabic language, encompassing conjugation patterns and case declensions, contribute to its exceptional effectiveness in projecting agrammatic representations of Down Syndrome better than any other language.

2- The agrammatic representations of children with Down syndrome defy specific core principles of Universal Grammar, particularly those related to syntactic structures and language acquisition processes. This hypothesis is based on the observation that children with Down syndrome exhibit significant difficulties in acquiring and producing grammatically structured language, suggesting a deviation from the innate language acquisition abilities proposed by Universal Grammar.

3- The genetic anomaly in individuals with Down syndrome is responsible for language disorders, aligning with Gopnik's claim that impaired grammar construction results from genetic disorders. This supports the notion that the language system is encoded in the genome rather than solely localized in the brain, as the genome influences brain development and function. Wei, Adamson, Schwendemann, Goucha, Friederici, and Anwander's (2023) study revealed robust inter-hemispheric connectivity in Arabic-speaking participants, providing additional support for the relationship between genetic factors and language abilities.

To achieve the research objectives, this study combines inductive and deductive reasoning and adopts an exploratory, single instrumental, and holistic case study approach. The study takes place in the province of Tlemcen, specifically at two primary schools named Alabili and Khalil Abdeslam, as well as at AWIT association. The primary focus of the study is on children with Down syndrome, their teachers, a psychologist, and an expert in molecular

genetics and neurology. The data collection process involves several methods. Firstly, three teachers from the two schools, along with the pedagogical responsible psychologist from AWIT, participated in semi-structured interviews, which served as the initial data collection instrument. Additionally, out of a total of 26 pupils, 16 of them took part in a test administered at the two schools. Furthermore, classroom observations were conducted in two classes at Alabili primary school. The first class comprised seven pupils between the ages of 12 and 15, studying in the 4th year. The second class included eleven pupils between the ages of 14 and 17, studying in the 3rd year

Moreover, the last instrument included a specialist in molecular genetics and neurology who was interviewed online through Google meet. In order to ensure the highest level of accuracy and validity in the research, meticulous attention was given to every aspect of the data collection phase. Recognizing the significance of even the smallest details, a careful and thorough selection process was employed to choose the most appropriate research instruments. This selection process followed a systematic progression, where each instrument was chosen strategically to complement and build upon the preceding one. This approach was crucial in ensuring a comprehensive and a cohesive collection of data. To preserve the integrity of the collected data, a specialised database was utilised as a secure repository. Continuing with the same logical reasoning and commitment to precision, the findings from the initial data collection were subjected to a comprehensive examination. This thorough analysis aimed to extract valuable insights and establish a solid foundation for the development and refinement of subsequent research instruments. By undertaking this rigorous process, the researchers aimed to enhance the overall quality and reliability of the study, further strengthening the validity of the research findings.

The adjacent study is structured into two interconnected chapters. The first chapter deals with a theoretical framework on Down syndrome which is divided into seven subparts.

The first one describes the aetiology of Down syndrome and its presence in Algeria. In the second subpart, the researcher tackles Chomsky's generative approach to language including the principles and parameters of Universal Grammar. The third subpart appertains to the genetics, pathogenesis, types and neurology of Down syndrome. The fourth part takes into consideration the linguistic profile of Down syndrome including a comparison between the language development in children with Down syndrome and typically developing one. The fifth subpart tackles Broca's aphasia in Down syndrome including the typical symptoms of agrammatism covering both the syntactic deficits in spontaneous speech production and comprehension. This part also tackles the bulk of syntactic deficits theories and approaches. Additionally, the sixth subpart discusses the morpho-syntactic structure of Arabic including both syntax and morphology and the representations of these two in children with Down syndrome. Lastly, the seventh part covers the conclusion.

In the second chapter, the first subpart addresses the ethical considerations involved in the research, ensuring that ethical guidelines were followed throughout the study. It highlights the importance of conducting the research in an ethical manner, protecting the rights and well-being of the participants. The second subpart focuses on the methodology design, providing a detailed explanation of the chosen research approach. It covers various aspects, including the sampling technique employed to select participants, the description of the research setting, and a comprehensive overview of the participants involved in the study. Additionally, it outlines the research instruments that were carefully selected and utilised during the data collection phase. Moving on, the third subpart delves into the analysis and interpretation of the data collected. It describes the methods and techniques employed to analyse the gathered data, ensuring a systematic and rigorous approach to drawing meaningful conclusions from the dataset. The fourth subpart is dedicated to discussing the outcomes of the research. It presents a thorough interpretation of the findings, comparing them to existing literature and

theories, and highlighting the implications and significance of the gathered results. Addressing the limitations of the study, the fifth subpart critically examines the constraints and shortcomings encountered during the research process. The sixth subpart presents the conclusion of the study, summarising the main findings and their implications. It serves as a comprehensive wrap-up of the research, highlighting the key insights gained from the investigation. Finally, the seventh subpart offers recommendations based on the study's findings. These recommendations provide guidance for future research and suggest potential areas for improvement or further exploration. Collectively, these subparts are designed to assist the investigator in answering the research questions and ultimately confirming or refuting the hypotheses established earlier in the study.

Chapter One :

Theoretical

Framework

1.1 Introduction:

Throughout history, scholars focused on the study of different aspects of human language; including its origin, its functions, and its structures. The emergence of the Chomskyan 1957's generative theory attributed a fundamental attention to syntax, which had been less common in prior linguistic theories. Therefore, this sudden shift in the course of the study of language prompted a revolution in Linguistics, setting an unswerving bridge between language and the brain. According to this assumption, human language is contained in a self-standing material known as Language Acquisition Device (or LAD), which is situated in the left hemisphere of the brain and is responsible for the inborn faculty of language acquisition (Chomsky, 2008, 1957; Stromswold, 2000). Thus, it might be fair to draw the conclusion that any anomaly or lesion affecting this part of the brain may result in an impairment of language, which in turn causes an abnormal manifestation of this human faculty. Henceforth, the generative theory served as a ground for inquiries in syntax-related developmental language disorders observed in populations with Broca's aphasia, Down syndrome, Specific Language Impairment or Autism since the 1980s.

Eventually, in the case of Down syndrome, which is the emphasis of the current study, the observed language disorders seem to be the result of the triplication of chromosome 21 (Center for Arab Genomic Studies, 2013). Therefore, language deficits in Down syndrome were captured in the production and comprehension of these individuals, together with their written production (Penke, 2015; Buckley, 1993; Frizelle, Thompson, Duta, & Bishop, 2019). The morpho-syntactic manifestations of these disorders include the omission or substitution of inflectional bound morphemes (Menn & Obler, 1990a; Penke, 2018), the omission of free function words leading to an excessive use of canonical telegraphic shortened utterances with reduced complexity (Menn & Obler, 1990a; Comblain & Thibault, 2009). Besides, Down syndrome patients employ a linear interpretation technique that parades their difficulty in

comprehending non-canonical structures such as the subject-object reversion found in the passive voice, which was recorded in languages among which are English, German, and Hebrew (Penke, 2015, Grodzinsky, 2000, Ring & Clahsen, 2005). Furthermore, the manifestation of the above mentioned disorders in Down syndrome individuals' spontaneous speech production and comprehension, mainly those observed in the previously cited languages, seems to defy the core principles of Universal Grammar (henceforth, UG).

Nevertheless, from the advent of generative theory till these days, the bulk of studies steered on language disorders in Down syndrome focused momentously on western languages. Therefore, it seems to be essential to investigate this matter from the perspective of the Arabic language, being the case in the present study. Thus, the outcomes of such an inquiry might, first, help to figure out whether the previously mentioned agrammatic representations of children with Down syndrome that were recorded in other languages, similarly prevail in Arabic or not, and second, they might give insights about a possible defiance of the principles of UG that these grammatical oddities might constitute, and finally, they might contribute to exploring the genetic implications of the mentioned language disorders.

Accordingly, this chapter attempts to impart a theoretical overview of the genetic profile of Down syndrome patients, with regards to their neurological, cognitive and behavioural specificities, in reference to preceding studies. Furthermore, it introduces these individuals' linguistic profile through a comparative portrayal of language development in both children with Down syndrome and their typically growing peers along with the Chomskyan generative approach. Besides, this chapter comprises an overview of the morpho-syntactic challenges faced by Down syndrome population with respect to the agrammatic Broca's aphasia and fetches up previously recorded data delineating the current state of affairs of the concerned disorders in the Arabic language.

1.1.1 Down Syndrome: Aetiology and Down Syndrome in Algeria:

Discovered in 1866 by the British physician, John Langdon Down after whom the syndrome is named, Down syndrome is the most recurrent genetic disorder affecting one in every 650 to 1000 births per year globally (Overk & Mobley, 2023, p. 45). This syndrome is instigated by an abnormal number of chromosome 21. In fact, at birth, babies typically possess 23 pairs of chromosomes (Center for Arab Genomic Studies, 2013). However, according to the latter, babies with Down syndrome carry a non-standard sum of 47 chromosomes due to their inherent genetic anomaly (2013, p. 1). In addition, Down syndrome is designated as the most frequent source of intellectual disability ranging from mild to severe gravity (Hodapp & Zigler, 1990). This might affect their ability to execute daily cognitive activities ranging from an effective use of language to learning in general. Moreover, individuals with Down syndrome are more susceptible to developing Alzheimer disease and over 75% of this population aged 65 years are inclined to develop dementia (Overk & Mobley 2023, p. 45). Eventually, advances in the fields of medicine contributed to raising more interest in the study of this anomaly and to extend these people's life expectancy, which considerably increased from 10 years old in 1960 to 40 years old in 2007 (Centers for Disease Control and Prevention, 2022).

In Algeria, the exact number of individuals with Down syndrome remains unknown, however, this population is estimated to evolve around 80.000 (Hamdaoui, Aouar, Moqaddem, Khater, Belkhatir, & Moussouni, 2020, p. 559). A number of local organisations such as the National Association for the Integration of people with Down syndrome (ANIT) and the Regional Association for the Integration of people with Down syndrome (AWIT) are dedicated to support these individuals at different levels including schooling, social, and professional integration.

1.2 Chomsky's Generative Approach to Language:

The advent of controversial theories of language acquisition raised interest in language-specialised fields. In fact, prior to the second half of the twentieth century, the arena of language acquisition debates was significantly dominated by Behaviourism, which equated language with any other human behaviours that can be learnt through an imitative reward-punishment process named the Operant Conditioning (Skinner, 1957, p. 29). Even though Skinner supported his assumption with experimental data, the latter was later refuted by Noam Chomsky who came up with a radical reaction against the Behaviourist view, mainly in his 1957 work entitled *A Review of B. F. Skinner's Verbal Behavior*. In fact, for Chomsky, language is the product of an inherent predisposition that permits human beings to acquire this faculty which the scholar assumes to be contained in the Language Acquisition Device (henceforth LAD), which is "part of our biological endowment, not acquired by learning, still less by training in the course of experience" (Chomsky, 2008, p. 251). Analogically, human beings are equipped with a genetically encoded system that is destined for language acquisition. Straightforwardly said, Chomsky (2008, p. 254) assumed that this faculty is a reflection of a "genetic endowment" which allows children not to learn language by imitating others doing so, but rather by employing subconscious and intrinsic rules to construct an infinite number of novel structures from a rich vocabulary storage and with a minimum exposure. Moreover, according to Chomsky, the innate principles which govern the internalised linguistic creativity that children possess, are common to all languages despite their individual particularities. In other terms, there is only one inborn grammar that supplements the individual grammars proper to individual languages. This is what Chomsky baptised "Universal Grammar" (or UG) (Chomsky, 2008, p. 35) which became the centre of the generative approach. Additionally, Universal Grammar, described by Chomsky (1986) as a highly intricate and puzzling structure, contains a range of principles and parameters that regulate the use of the inborn language constituents such as word classes including nouns,

verbs, adverbs along with morpho-syntactic rules like inflectional and derivational morphemes (Chomsky, 1986; Ouhalla, 1994; Stromswold, 2000; Cook & Newson, 1996; Guasti, 2002). Hence, Cook and Newson (1996) claimed that the acquisition of language is the result of a successful application of the Universal Grammar principles. This marked probably the first time, in the secular history of language studies, where the human genetic system was given the stage in the endless debate on the matter of language acquisition. Eventually, the generative assumption influenced a wide range of studies on language acquisition in general, and language disorders in particular.

Moreover, to support their assumption, Chomsky and his followers proposed various arguments accounting for the validity of Universal Grammar. The two most solid arguments in this regard include the poverty of stimulus and the negative evidence, which are often conflated due to their interrelated features (Dabrowska, 2015). First, the argument of the poverty of stimulus is considered as the most prevalent one proving the universal nature of UG, and this last is sometimes referred to as the logical problem of language acquisition (Tong, 2022; Pinker, 2004). In fact, for Pinker (2004), this aforementioned phenomenon explains the enigmatic, yet, correct generalisation undertaken by children using a limited number of structures to construct a novel and infinite range of contextually accurate sentences and with a humble exposure to minimum inputs. Additionally, the argument of negative evidence supports the assumption according to which children are able to identify ungrammatical constructions in their languages while they are not explicitly taught or exposed to every single rule of grammar. For instance, when a non-speaker of English utters a sentence like: "Last week, I will go to the*" a native English child would be able to correct the misuse of the simple future tense in this ill-structured utterance. Thus, the child could explain to the non-native learner that, first, the future tense is grammatically inappropriate to describe completed actions, but the latter rather recounts upcoming events. Second, the child could

elaborate that the sentence remains syntactically incomplete which leads to semantic oddness. Therefore, the correct tense for completed actions is the simple past. Thus, the verb is to be in its past simple form "went" and the sentence can be comprehensive by adding a noun representing a destination like "market". Hence, it is grammatically appropriate to say "Last week, I went to the market." Accordingly, the proof of negative evidence suggests that children develop an inherent ability that permits them to avoid inaccurate structures in their languages without any overt teaching of the overall rules. This may be the reason why Chomsky (2014, 10:30) assumed that everyone speaks a rich and fluent language prior to school age. Therefore, children naturally understand that there are five-word or six-word sentences but ultimately not six-and-a-half word sentences (Chomsky 2008).

Moreover, the universality of language is another argument according to which human languages have more shared properties than distinct ones; this is because children are born with an innate capacity to acquire any language they are exposed to (Stromswold, 2000). For instance, Arabic does not sound like English nor does English like Chinese. These latter seem to be so disparate when judged from their writing or pronunciation systems, however, the principles that make them common go beyond their perceptible appearances. For instance, consider the following sentences, in English "He is a good student" and its corresponding sentence in Bambara (a language in Mali) "Ale ye kalanden ɲuman ye" and in Arabic " إنه طالب جيد". The sentences in the three languages seem to appear dissimilar, ranging from their constituting words to their written forms along with their sound systems. Moreover, even though the syntactic arrangement is similar in the English and Bambara sentences, the latter seems to follow another order in the Arabic example. In addition, the auxiliary “to be” is hidden in the Arabic sentence which does not occasion any syntactic erroneousness, while this phenomenon becomes ungrammatical in the two other languages. However, the similarities between these languages are underlying and may be paradoxically stunning. The sentences in

the three languages are all made up of words arranged together, one after another, and each of them carries its own pronunciation and meaning. Additionally, the pronunciation can be divided into smaller constituents such as syllables, which in turn are the combination of vowels and consonants. Therefore, the aforesaid underlying commonalities seem to facilitate language acquisition to any child. Chomsky (2008, p. 289) went further to assume that the converging language properties are so well established that it is possible to assert that there is, in fact, one single human language.

Furthermore, Chomsky suggested cognitive and neurological arguments to support the universality of UG. First, he sets a dissociation between language and cognition; in other words, the faculty of language does not rely upon the general cognition (Stromswold, 2000). Hence, impairments affecting general cognition might preserve language and vice versa. This aligns with the theory of modular cognition, which assumes that there are different autonomous modules in the overall cognition (Harris, 2003). Accordingly, a study conducted by Smith and Tsimpli (1995) reported that a linguistic savant with an impaired cognition exhibited a well preserved language faculty. Besides, individuals with Specific Language Impairment are reported to have an intact cognition while they manifest a defective language (Dabrowska, 2015).

Additionally, the discovery of Broca's area and Wernicke's area in the left hemisphere of the human brain monumentally shortened the relationship between language and brain. In consequence, the fact that this region of the brain is assigned language processing influenced scholars such as Stromswold (2000); Tettamanti, Alkadhi, Moro, Perani, Kollias & Weniger (2002) to hypothesise that this zone ultimately lodges neural substrate for UG (Dabrowska 2015). Yet, this assumption might be controversial, since other studies demonstrated that language is not confined to a specific brain region (Dabrowska 2015, Fisher & Vernes, 2015). In fact, it was shown that during language processing, synaptic activities occur in areas

outside of the traditionally designated language location (Anderson 2010; Fedorenko, Behr, & Kanwisher, 2011). In addition, a more recent inquiry undertaken by Wei, Adamson, Schwendemann, Goucha, Friederici, & Anwander (2023, p. 1, p. 3, p. 8), on 94 healthy, young adult native speakers of Arabic and German, by the use of high-resolution diffusion-weighted MRI and tractography-based network statistics of the language connectome, revealed that language activity leads to the abstruse connection of both the left and the right hemispheres of the brain with a stronger interhemispheric connectivity in the Arabic speaking participants. As a result, the human brain is intricately malleable and various regions of the brain can take over language processing if the standard region undergoes damages (Dabrowska, 2015). Thus, the location attributed to UG, in the human brain, seems to be only hypothetical and might be less evident.

Additional proofs of UG comprise, first, the uniformity of learning stages according to which all children go through similar developmental processes in language acquisition (Stromswold, 2000, 1990a; Brown, 1973). For example, children pass through the stage of babbling before transiting to the construction of one or two-word utterances and this, regardless of their individual specificities. Second, there is the converging nature of grammar; in other terms, children acquire language under different circumstances and the type of inputs they receive is different, however, they develop the same grammar. For example, two children who acquire Standard Arabic in different Arab countries will develop the same Arabic grammar despite the fact that they may have not received the same number and sort of inputs. Third, the argument of ease and speed of language acquisition puts forward the idea that children effortlessly develop a highly intricate grammar in a humble span of time and exposure (Chomsky, 1999; Gopnik, 1997; Guasti, 2002, p. 3). This is in accordance with what Chomsky (2014, 10:30) claimed: children have already acquired a rich and fluent language at preschool stage. Finally, the argument of maturational effects suggests that language

acquisition is tremendously influenced by age, while it is insensitive to environmental factors (Stromswold, 2000; Crain & Lillo-Martin, 1999). To be more specific, they argue that language faculty evolves according to an internal biological framework while the latter remains unaffected by the environmental conditions in which children grow up.

1.2.1 Principles and Parameters of Universal Grammar:

As it was stated in the preceding section, Universal Grammar encompasses rules or constraints that administer the transformative facet of grammar applicable to any human language (Cook & Newson, 1996). In fact, the above mentioned rules are what Chomsky (1986, 1995) proposed and referred to as principles and parameters; they encompass the core foundations of the universality of UG (Cook & Newson, 1996; Frank, 1990). Thus, these principles and parameters comprise sub-theories among which are the so-called deep and surface structures theory, the movement theory, the X-bar theory, the theta theory, the government theory, the case theory and the binding theory.

1.2.1.1 Deep Structure and Surface Structure Theory:

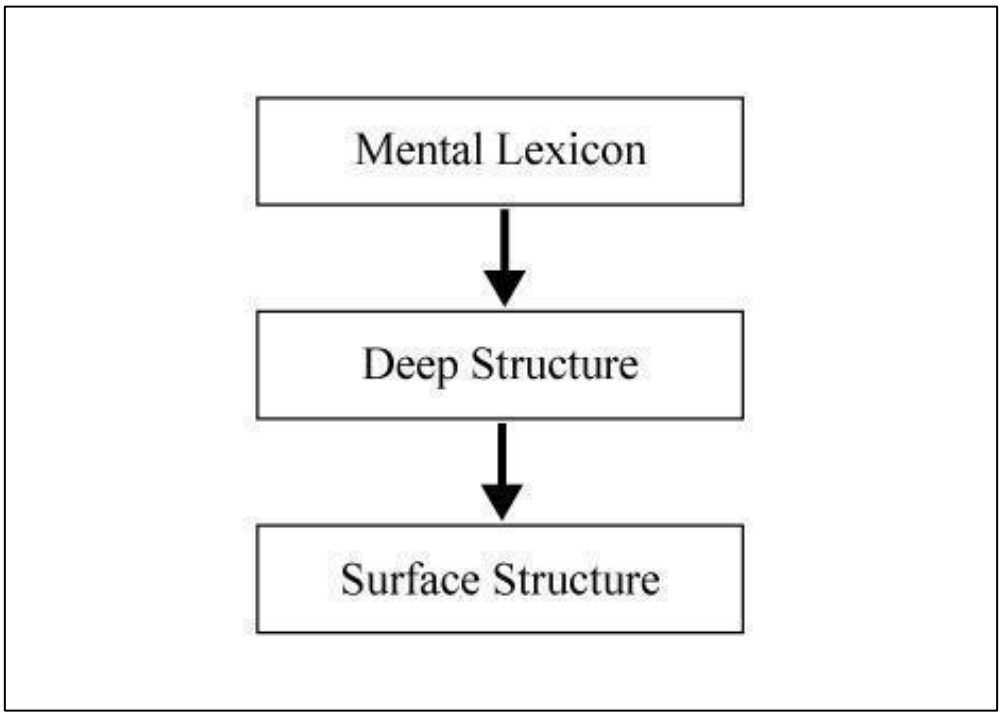
Deep structure and Surface structure might be the most known principles of UG. On the one hand, deep structure represents the mental, unseen and unstated structural level rooted in the metal lexicon; on the other hand, surface structure is the uttered and/or the perceptible interpretation of deep structure through a movement transformation (Chomsky, 1957; Ouhalla, 1994; Penke, 2015; Cook & Newson, 1996). Consider the following example:

-This flower looks beautiful.

The above mentioned syntactic representation is a surface structure, which is an interpretation of a deep structure that semantically implies that the flower that the speaker refers to is the opposite of an unpleasant one. As mentioned above, the transition from the deep structure to the surface structure requires a movement transformation that can be portrayed as in the Figure 1 hereunder.

Figure 1:

Movement Transformation from the Deep Structure to the Surface Structure Representation

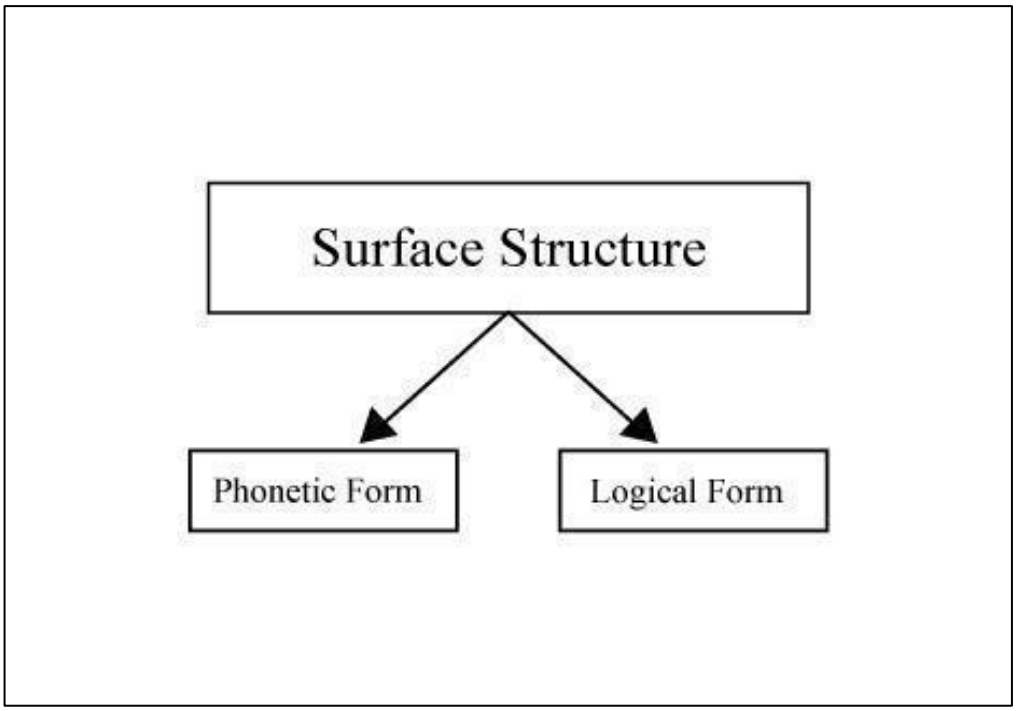


Note: This figure demonstrates the transformation of non-verbal information existing in the mental lexicon into a verbal structure (Frank, 1990).

The information articulated in the form of sentences (surface structure) is stored in the mental lexicon which can be perceived as an underlying meaningful idea (deep structure). The surface structure, in turn, is projected into a Phonetic Form (PF), which is the sound representation of the sentence, and a Logical Form (LF), which concerns its semantic depiction (see Figure 2).

Figure 2:

Projection from the Surface Structure to the Phonetic Form and the Logical Form



Note: This figure demonstrates the representation of the surface structure into its phonetic and semantic forms (Frank, 1990).

Furthermore, the deep structure and the surface structure are crucial principles, for they are found in any sentence. For example, they can reflect the link between the cognitive system and language and most importantly, they serve as a way of identifying syntactic traces when a sentence undergoes movement (Cook & Newson, 1996). However, it is observed that individuals with Down syndrome manifest a defective surface structure (Penke, 2015).

1.2.1.2 Movement Theory:

A sentence undergoes movement when some or all of its constituents are moved out of their original locations which leads to the construction of non-canonical structures i.e., sentences that do not follow the most basically used word order in a given language (subject-verb-object in English, for example); this principle is referred to as the movement theory

(Chomsky, 1986, 1995). In fact, movement is exceedingly common in languages such English, French or German where lexical elements are displaced according to the nature of the sentence. Questions, embedded questions or passive passives are ideal examples of the above mentioned principle.

1- You are doing what?*

2- What are you doing?

These sentences show an example of how grammatical constraints cause movement. In fact, the sentence (1) is the deep structure illustration where all the elements of the sentence are in their original positions; whereas at the surface structure level, the constituents are moved. The same applies to the following active-passive shifted structures:

3- He wrote the book.

4- The book was written by him.

As it was previously mentioned, the surface structure representation serves to designate the actual locations from which words are moved; this process is labelled as traces (abbreviated as t) as shown in the example that follows:

5- What^{1} are^{2} you (t^{2}) doing (t^{1})?

(t^{1}) is related to (^{1}) that indicates the position from which the word 'what' has moved and (t^{2}) designates the one of the auxiliary 'are'. Therefore, the inability in identifying traces might lead to a comprehension deficit in non-canonical structures such as passive forms or wh-questions; this is frequent in Down syndrome (Grodzinsky 2000; Penke 2015; Wimmer & Penke, 2020; Friedman, 2002; Witecy, Wimmer and Penke, 2017).

1.2.1.3 X-Bar Theory:

The X-Bar theory constitutes another outstanding principle of UG (Chomsky, 1986, 1995); yet the latter is a complex one. X-Bar stands for the syntactic categories such as Noun Phrase (NP), Verb Phrase (VP) or Prepositional Phrase (PP). Eventually, these syntactic

categories project different heads like Nouns (N), Verbs (V), Adverbs (A), and Prepositions (P), according to the projection principle, which determines the correctness of the projected heads. Briefly said, the X-Bar construction is made up of the projections of heads taken from the mental lexicon (Chomsky, 1995).

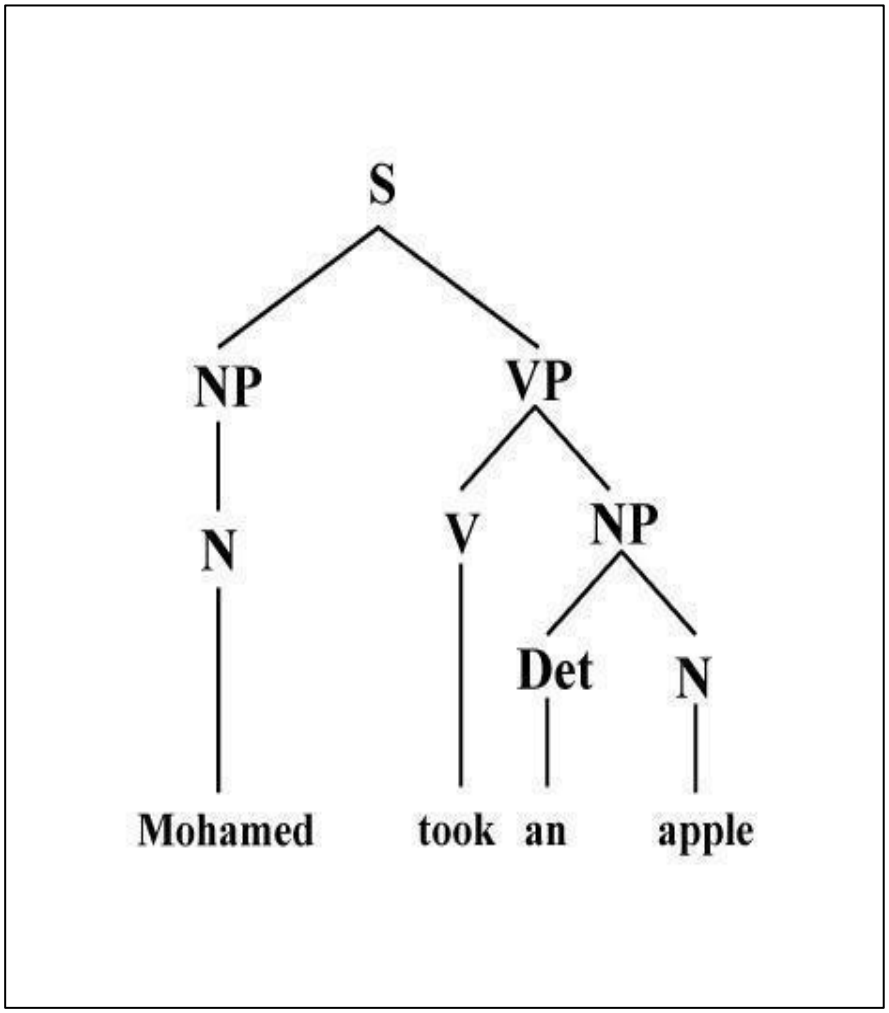
Thus, the phrase structure depiction of the following sentence (see Figure 3) is the result of the application of the projection constraints that dictates that the NP must project a N (Mohamed) and that the VP must have a V (took) plus a NP since the verb requires a direct object which must project a Det (the) along with a N (apple). Ergo, the order in which the heads are projected is vital without which the sentence will be uncoordinated. For example, the head rule indicates that the verb 'took' must come before the direct object 'an apple' and not the opposite order. Furthermore, the X-Bar principle is a substantial principle of UG for it shows the accuracy of the representation of the deep structure through the surface structure. Logically, the impairment affecting the surface structure in Down syndrome seems to reflect that of the X-Bar, since the projection of functional heads, i.e., function words like determiners, articles and prepositions, is inaccessible in individuals with DS (De Bleser & Bayer, 1991; Ouhalla, 1993).

6- Mohamed took the apple.

This sentence falls under the following phrase structure:

Figure 3:

An Example of the Phrase Structure Representation



Note: This figure demonstrates the representation of the phrase structure.

1.2.1.4 Theta Role Theory:

Syntax is not merely the arrangement of words within a sentence for the latter is comparable to an umbrella that embraces other levels of analysis including semantics. Hence, the semantic relationship between parts of a sentence constitutes an additional concern of syntax (Chomsky, 1986, 1995; Cook & Newson, 1996); this is the scope of the Theta theory or the theta role. In fact, this UG principle indicates who does what to whom; in other words,

the theta theory reveals the semantic relationships existing in the sentence like the agent, the experiencer or the patient, along with the goal.

7-Mohamed gave Ali the apple.

8-Ali was given an apple by Mohamed.

In the example above, 'Mohamed' is the doer of the action (agent), 'the apple' is affected by the action (experiencer) and Ali receives the apple (goal). Even though individuals with Down syndrome do not manifest any impairment in assigning the theta roles in canonical structures like the example (7), they do exhibit deficits involving non-canonical constructions like the passive sentence (8) due to challenges caused by movement (Penke, 2015; Wimmer & Penke 2020).

1.2.1.5 Government Theory:

Within the wider scope of the UG principles stands the syntactic relationship between a 'governing' and a 'governed' constituent; which is known as the Government theory(Chomsky, 1986, 1995; Cook & Newson, 1996). To be more specific, this principle specifies how the governing component affects the governed one.

E.g.:

9- He greets him.

10- You talked to me.

In the example (9), the verb governs the NP 'him' and in the sentence (10), the preposition governs the NP 'me'. Thus, the governing elements in the aforementioned sentences require that the noun phrases they govern must not conform to the patterns exemplified below:

11- He greets he.*

12- You talked to I.*

In more specific terms, the last noun phrases must remain object pronouns like in (9) and in (10) and not personal pronouns as it is discernible in (11 and 12). Besides, this

constraint also concerns the Case theory which is very common in languages that constantly use apparent cases like German. In addition, the Case theory embodies the inflections, which embraces tenses in verbs, and agreements in both nouns and verbs as portrayed in the subsequent example:

13- She brings a few chairs.

In the example (13), the verb is conjugated in the present simple tense and inflected according to the third person singular which necessitates the addition of the tense inflection (-s) to the verb ‘bring’. Moreover, the presence of the plural quantifier 'a few' indicates that the noun 'chair' must be inflected into plural and thus, a suffix (-s) is to be added to this last. Eventually, the Government and Case principles are tightly close for they deal with how certain syntactic components affect others in the sentence. Once more, individuals with Down syndrome are reported to unveil impairments with constructions falling under these two principles since the omission of inflectional morphemes and function words are some of the most prevalent symptoms of their agrammatic representations (Penke, 2008, 2015; Grodzinsky, 1984; Laws & Bishop 2003; Menn & Obler, 1990a).

1.2.1.6 Pro-Drop Theory:

Furthermore, while the principles of UG apply to all the human languages, its parameters illustrate the grammatical discrepancies existing across languages (Chomsky, 1986, 1995; Dabrowska, 2015). The Pro-drop or Null subject is an example among the UG parameters. The latter determines whether a language allows or not the dropping of the subjects in declarative finite structures. For instance, in English this parameter is not grammatically appropriate, otherwise, the sentence becomes syntactically odd, however, in languages like Arabic, it is grammatically permissible to hide the subject.

E.g.

English:

14- He does not go out at night.

15- *does not go outside tonight.

Arabic:

16- لِأ يَخْرُجُ فِي اللّيْل

17- هُوَ لِأ يَخْرُجُ فِي اللّيْل

As it may be noticeable here, the English sentence (14) does not comply with the pro-drop parameter for the dropping of the subject results in a syntactic oddness (see example 15). On the contrary, in Arabic, the application of this parameter like in (16) and its absence like in (17) do not result in any syntactic or semantic issues. Ergo, despite the fact that there is the case inflectional morpheme (-s) in English, the oddness still prevails since the inflection does not provide any precision about the exact gender of the doer (he, she or it). However, in Arabic, the inflection is indicative of the gender of the doer.

1.2.1.7 Binding Theory:

Finally, syntax also takes into consideration the relationships existing between pronouns and their antecedents; this is the traditional syntactic aspect of pronoun/antecedent relationship. Eventually, with the Binding theory, Chomsky widens this phenomenon to the relationships between noun phrases having the semantic features of dependent references (Chomsky 1988; Cook & Newson, 1996) as depicted in the examples hereunder:

18- Ali hits him.

19- Ali hits himself.

The example (18) shows that the object pronoun 'him' does not refer to the subject Ali since the latter constitutes a separate entity; thus, the person who is hit is someone else. Nevertheless, the reflexive pronoun in the example (19) does refer to the subject Ali; in other terms, Ali is the agent and the experiencer at the same time, if analogically referred to the theta terms. Furthermore, a previous study showed that individuals with Down syndrome are

inclined to interpret the reflexive 'himself' (19) as the object pronoun 'him' (18) (Ring & Clahsen, 2005). In short, the principles of UG show the underlying commonalities existing between human languages.

1.3 Down Syndrome: Genetics, Pathogenesis, Types and Neurology:

Down syndrome seems to have a genetic origin that might present into different forms according to individual particularities. In addition to that, it tends to have a number of consequences on the neurological, cognitive, linguistic and physical conditions of the affected individuals. Moreover, this section attempts to delve into the cause of the anomaly from a genetic perspective, then elucidate its role in occasioning a number of health issues in DS population. Eventually, this section tackles the types of DS and the way this anomaly potentially results in neurological, linguistic and cognitive impairments as reported by previous inquiries.

1.3.1. Genetics and Pathogenesis:

As it was previously mentioned in section 1.1, Down syndrome is an anomaly caused by a triplication of chromosome 21. In this realm, the Center for Arab Genomic Studies (2013) suggested that there are different factors that can increase the risks of having babies with this anomaly among which are highlighted an extended maternal age, an increased number of children and a consanguineous marriage. Genetically, DS is reported to be associated with an abnormal gene dosage in chromosome 21; to be more specific, a certain degree of gene dosage is more likely to lead to genetic variations, which can lead to a phenotype; this phenomenon is known a dosage-sensitivity (Korlimarla, Hart, Spiridigliozzi, & Khisnani, 2020). Accordingly, Korlimarla and colleagues (2020) suggested that there is a variation in the dosage of the genes contained in chromosome 21, which may result in the Down syndrome genotype. The aforesaid assumption goes hand in hand with what was suggested by Vilardell, Rasche, Thormann, Maschke-Dutz, Pérez-Jurado, Lehrach, & Herwig

(2011) and Prandini, Deutsch, Lyle, Gagnebin, Vivier, Delorenzi, Gehrig, Descombes, Sherman, Bricarelli, Baldo, Novelli, Dallapiccola, & Antonarakis (2007): the imbalance in the gene dosage observed in chromosome 21 leads to Down syndrome phenotype.

Ergo, people with DS tend to exhibit common physical characteristics due to their genetic anomaly. In consequence, their physical particularities make them easily distinguishable. According to the Center for Disease Control and Prevention (2022), the most common among these physical features include a short height; a flat face, mainly the bridge of the nose; a short neck and minuscule ears. Additionally, DS patients possess an oversized tongue sticking out of the mouth, slanting up almond-shaped eyes with a tiny white mark on the iris; small hands and feet with a large gap between the first and second toes; a single line across the palm of the hand curving around the thumb; poor muscle tones along with loose joints. Eventually, these characteristics might have one explanation: the anomaly in the genome, since the latter is responsible for shaping the body, its organs and the way they function (Fisher & Vernes, 2015, Sabatini, 2016). In addition to the above mentioned physical abnormalities, the DS anomaly is reported to increase the risk of developing a range of health issues such as heart defects, Alzheimer's Disease, leukaemia, along with vision and hearing obstacles (Lawler, 2023).

1.3.2 Types of Down Syndrome:

It is to be acknowledged that Down syndrome tends to be slightly heterogeneous. In fact, according to the Center for Disease Control and Prevention (2022), the genetic anomaly is manifested into three forms. The first type is known as trisomy 21 and the latter constitutes 95% of people with DS. Trisomy 21 occurs when chromosome 21 carries three separate copies instead of two typical ones. However, the second type, known as the translocation Down syndrome, concerns a small number of cases (about 3%). This last happens when an extra part of chromosome 21 is attached to a different chromosome instead of remaining

separately like in trisomy 21. Finally, the last category known as mosaic Down syndrome affects about 2% of the DS population. Patients with this type have, in some of their cells, three copies of chromosome 21 and in some others, two typical copies like in healthy cells. As a result of this hybrid manifestation, individuals with this type of DS may display the same physical characteristics as their other compeers, however, the former may encounter fewer health challenges. From this categorisation, it seems to be noticeable that the similarities existing among Down syndrome populations are more dominant than they appear to be since their common anomalies are related to the same chromosome 21 (Center for Disease Control and Prevention, 2022).

1.3.3 The Effects of Down Syndrome on Language:

Eventually, genetic anomalies are susceptible to cause speech and language disorders (Newbury and Monaco, 2010, p. 309). Thus, this might align with the identification of certain genetic variations that are associated with language disorders, such as those observed in Specific Language Impairment (SLI), in Dyslexia and in Autism Spectrum. The aforementioned genetic variations concern the Forkhead Box Protein P2 (FOXP2), the Forkhead Box Protein P1 (FOXP1), the Neurexin gene (NRXN1), and the Roundabout Guidance Receptor 1 (ROBO1) (Fisher & Vernes, 2015; Newbury and Monaco, 2010). Therefore, a genetic variation might result in language impairment as Gopnik (1997, p. 5) stipulated: "A genetic disorder can impair the ability to build a normal grammar". Even though Gopnik's aforesaid statement dates back from a long time, it seems to be valid till present days for no other recent study invalidates this assumption. Furthermore, Gopnik’s 1997 assumption and that of Newbury and Monaco (2010) in addition to the identification of several genetic mutations causing language disorders mentioned above might suggest that the language disorders prevailing in children with Down syndrome may have a genetic ground.

1.3.4 Neurological Profile of Down Syndrome:

Before discussing the possible consequences of DS on the brain, it is important to establish the importance of the genome in the human being and its relationship with a typical brain. First of all, in order to make a human being, the genetic system seems to follow an intricate process. In fact, the content of the deoxyribonucleic acid (henceforth, DNA) ladder plays a significant role in this matter; the latter embodies a wide range of molecules incorporating four types of genetic codes which are labelled adenine (A), cytosine (C), guanine (G), and thymine (T). According to Sabatini (2016), 3 billion of these codes are needed to build a human being (3:04). Sabatini and his research institution, Human Longevity, printed all the three billion codes of a specific person using a special machine learning program which resulted in the astronomic sum of 262, 000 pages and weighted 450 kilograms of paper (3:54). These codes work in an intricate synergy to determine every function of the human body and its organs in addition to defining physical appearances such as the eye colour, the skin tone, and the height. Stunningly, out of the 3 billion code package, only 500 hundred pages of the genetic codes make a person distinct from another one as Sabatini highlighted: "Five hundred pages — is the miracle of life that you are. The rest—we all share it" (6:03). In other terms, human beings are genetically more similar than they might have ever imagined. Therefore, the genome may be considered as the code of life.

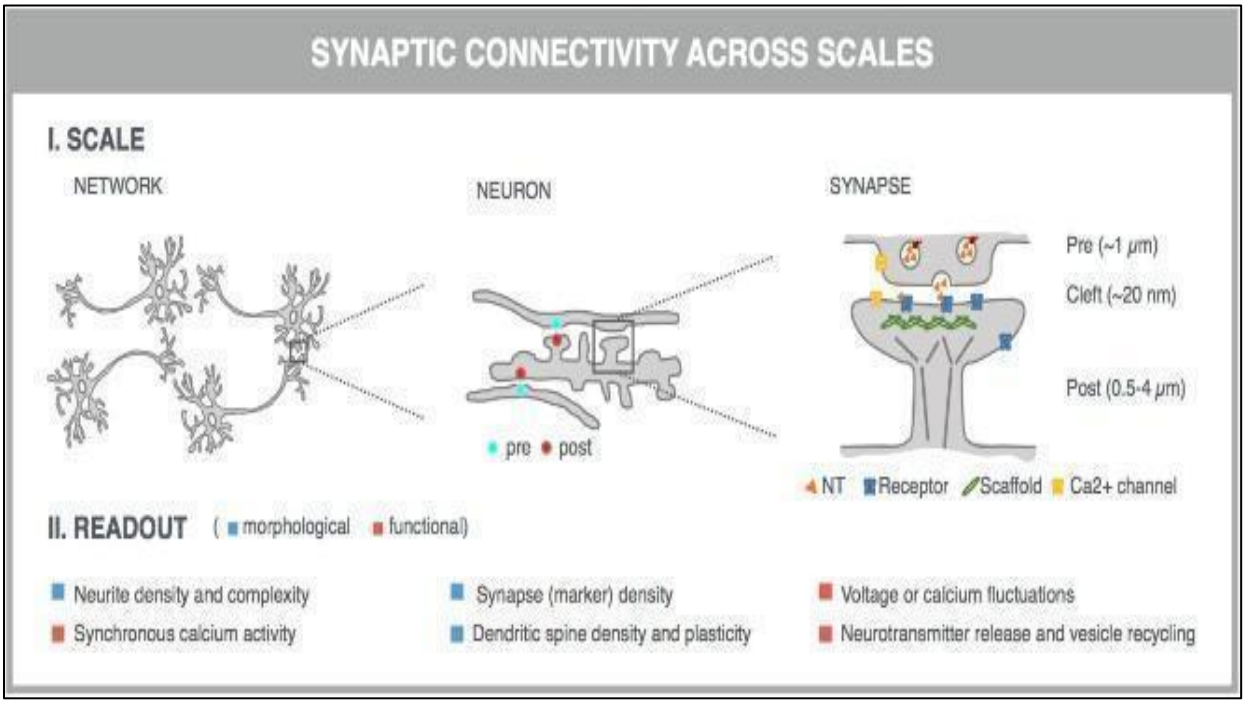
1.3.4.1 The Genome and the Brain:

Moreover, it is noteworthy to highlight that the genome is responsible for the development and function of the human brain; in more specific terms, the genetic system ensures the formation of this body organ and dictates the way it functions in addition to influencing the way human beings walk, feel or behave (Bae, Jayaraman, & Walsh, 2015; National Institute of Neurological Disorders and Strokes, 2010). According to the National

Institute of Neurological Disorders and Strokes (2010, p. 2) and Duet, Chang, Cloak, and Ernst (2014, p. 1), one out of three, in the total number of the thousands of genes that constitute the human genome, is expressed in the brain, which makes this organ rank the first among the body organs with the highest proportion of gene expressions. Consequently, this wide range of gene expressions is necessary to regulate the brain properly and to carry out such an enterprise, different genetic materials play vital roles (National Institute of Neurological Disorders and Strokes, 2010). According to the above mentioned institute, the genes contained in the DNA produce proteins called protein-coding genes and among the synthesised proteins, some are responsible for brain development in early infancy such as the production of new neurones. Others ensure the proper inter-neuronal connections; more specifically, they guarantee that neurotransmitters connect appropriately between one another in order to transmit information from one neurone to another (see Figure 4 and 5); this phenomenon is referred to as the synaptic activity (Robinson, 2015; Fisher & Vernes, 2015).

Figure 4:

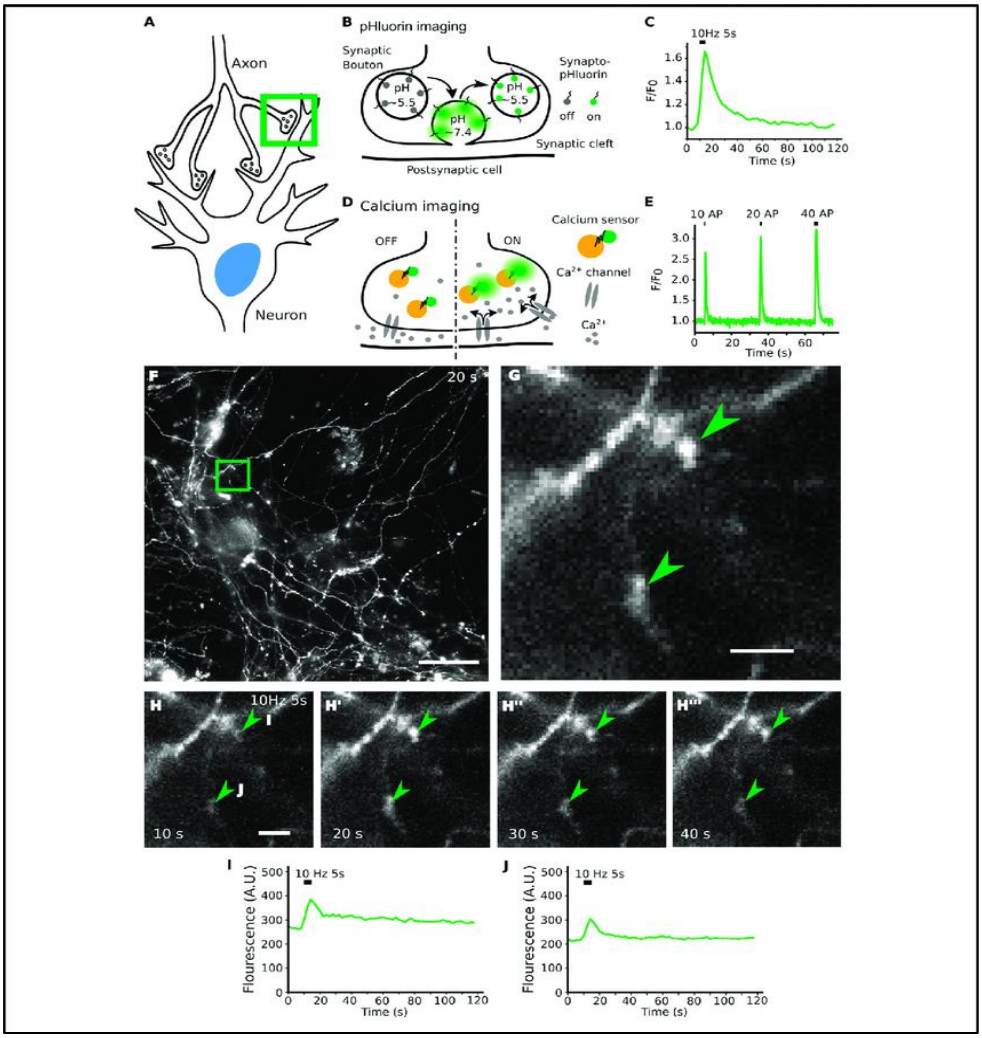
Synaptic Connectivity Across Scales



Note: This figure demonstrates how the synaptic connectivity occurs from the neural network to neurone and then from the latter to the connection between the edges of two neurones. From *Image-Based Profiling of Synaptic Connectivity in Primary Neuronal Cell Culture.* By Verstraelen, Van Dyck, Verschuuren, Kashikar, Nuydens, Timmermans, & De Vos (2018).

Figure 5:

Live Synaptic Activities



Note: This figure demonstrates live synaptic activities. *From SynActJ: Easy-to-Use Automated Analysis of Synaptic Activity.* By Schmied, Soykan, Bolz, Haucke, & Lehmann (2021).

Beside the above mentioned roles, other genes produce proteins that safeguard the well-being of neurones in the brain (National Institute of Neurological Disorders and Strokes, 2010). This was demonstrated by a recent inquiry conducted by the University of Bonn (2021), which concluded that a genetic material contributed to protecting the neurones of a fruit fly from a degeneration and the researchers presumed that this genetic material functioned similarly in human beings. Furthermore, the genome is also responsible for moulding the brain dimension; in other terms, it can determine the size of the brain. Accordingly, this was proved by a study conducted by Evans, Mekel-Bobrov, Vallender, Hudson, & Lahn (2006) which stipulated that a gene called microcephalin regulates the size of the brain throughout its development. This might play a tremendous role in the reduction of the brain volume in Down syndrome patients, which constitutes a neurological particularity among this population (Nadel, 2006; Pinter, Eliez, Schmitt, Capone, & Reiss, 2001). Moreover, genetic mutations and variations may lead to the genesis of a wide range of brain abnormalities among which are found Wilson Disease (MedlinePlus, 2016) and Down syndrome (Hasina, Wang, & Wang, 2022); the case of DS will be discussed further hereunder.

1.3.4.2 The Effects of Down Syndrome on the Brain:

The neurological distinctions between babies with DS and ordinary ones seem to be more ostensible in early infancy and these discrepancies were observed in the size of the brain, that tends to be more reduced than that of a healthy one (Nadel, 2006; Kremper, 1991). For instance, it was shown that variations in the ASPM (Abnormal Spindle-like

Microcephaly-associated) gene affect the brain size; which can result in microcephaly (National Institute of Neurological Disorders and Stroke, 2010). Accordingly, a Magnetic Resonance Imaging (henceforth MRI) study conducted by Pinter and colleagues (2001, p. 1660), testified an approximate decrease of 18% in the brain size of children with DS. In addition, the latter reported a selective reduction in the volume of the hippocampus and the temporal lobe. This might affect the memory and emotional functions of Down syndrome patients since these brain gears play important roles in memory and emotion. Moreover, children with DS display 20% to 50% decrease of neurones from birth to the age of 60 months, which tend to cause a deceleration in the genesis of the neurones after 22 weeks of gestation (Schmidt-Sidor, Wisniewski, Shepard, & Sersen, 1990, p. 181). Furthermore, additional abnormalities afflicting the synaptic connectivity in DS were recorded by Benavides-Piccione, Ballesteros-Yanez, Martınez de Lagran, Elston, Estivill, Fillat, DeFelipe, and Dierssen (2004). The above mentioned researchers associated the mentioned defects with cognitive impairments and mental retardation. Besides the previously cited abnormalities, Benavides-Piccione and colleagues (2004) believed that dendritic alterations might be occasioned by the overproduction of proteins coded by the triplicated copies of chromosome 21 in DS patients; in other term, these irregularities have a genetic basis. In addition, individuals with DS seem to exhibit signs of a congenital Broca's Aphasia even though to this date, the author could not find any scientific study that establishes a straightforward bridge between Down syndrome and Broca's aphasia. However, the linguistic manifestations of individuals with Down syndrome, described in the subsection 1.5.1 might be suggestive of the existence of such a neurological defect which might possibly be the outcome of the genetic mutation. Likewise, a language disorder known as the Primary Progressive Aphasia, positioned in the frontal lobe, was revealed in the 1980s (Northwestern University, 2023) and the latter is associated with genetic variations (Rohrer & Schott, 2011). This disorder does not

directly concern Broca's aphasia, yet it might intensify the probability of the presence of the latter in DS patients.

1.3.5 Early Development, Behaviour and Late Adulthood:

Despite some individual variations, the development of infants with Down syndrome is notably slower than that of typically developing ones; this comprises physical, cognitive and even language development. Furthermore, the overall growth of infants with Down syndrome hinges on a range of factors; however, this section delves into those related to potential language-related obstacles in this population. Accordingly, previous studies showed that the development of language in children with Down syndrome is considerably affected by defects in non-linguistic factors including cognitive and social ones (Buckley & Le Prevost, 2002; Korlimarla et al., 2020; Martin, Klusek, Estigarribia, & Roberts, 2009; Roberts, Price, & Malkin, 2007).

1.3.5.1 The Effects of Down Syndrome on Cognition:

The cognitive abnormalities in people DS seem to cause significant hindrances to a typical language development. As stated earlier in the present chapter, DS is commonly associated with intellectual disabilities (Hodapp & Zigler, 1990). Consequently, the aforementioned cognitive deficits are associated with a defective verbal short-term memory that affects daily activities such as learning, writing, reading, language processing, and even imagination (Costa, Purser, & Passolunghi, 2015) and comprehension deficits and the reduction in the length of utterances were also witnessed (Laws, 2004). In addition, impairments affecting the long-term memory seem to decrease the ability of a normal information retrieval (Flórez, 1999, cited in Campana, 2012); this may suggest that children with DS might struggle recalling words stored in their long-term memory. Accordingly, a recent experiment revealed that children with DS showed a more impaired verbal long-term

memory than everyday memory. In this realm, the experimental tasks of the verbal long-term memory consisted of recalling a list of unrelated terms and the ones of everyday memory required the subjects to retain events happening in daily life such as personal facts and daily activities (Yang, Himmelberger, Robinson, Davis, Conners, and Merrill, 2021). Hence, the defects in the memory of individuals with DS might probably be the product of the abnormal synaptic activities which in turn is associated with the inborn genetic mutation (see subsection 1.3.4.2). Moreover, the cognitive irregularities in the working memory are said to lead to a defective phonological loop; which is responsible for the ability to store received sounds and repeating them in addition to the capacity of wiring words with their meanings (Buckley & Le Prévost, 2002; Baddeley, 2007). Furthermore, the memory defects suggest that children with language disorders, such as those with DS, require conscious efforts to process language in contrast to their typically growing peers (Gopnik 1997, p. 8). Therefore, the above-mentioned impairments in the cognitive abilities of individuals with DS tend to demonstrate that non-linguistic cognition may have a tremendous impact on these individuals' language development. Therefore, the general cognition and the language-specialised one might be closely conflated.

Moreover, individuals with DS tend to be highly empathic and affectionate towards others. However, as they become older, their social skills tend to be negatively influenced by their difficulties in effectively using language; this is mainly because the impairment in expressive language may make these individuals manifest hostile behaviours (Capone, Goyal, Ares, & Lannigan, 2006). It was suggested that among those who show these unfavourable behaviours some may exhibit symptoms of Autism Spectrum Disorder (Hepburn, Philofsky, Fidler, & Rogers, 2008) and psychiatric disorders such as depression (Antonarakis & Eptein, 2006). Additionally, Korlimarla et al. (2020) suggested that DS children tend to dodge challenging errands by getting themselves occupied interacting with fictive friends. However,

this is more of an adaptive behaviour rather than an underlying pathology (Korlimarla et al., 2020). Considering the aforementioned behaviours of individuals with DS, it is noteworthy to suggest that good language skills might contribute to sustaining more stable social skills. Most of the defects observed in children with Down syndrome are also recorded in adults with this anomaly including language disorders, cognitive deficits, and social challenges (Carfì, Antocicco, Brandi, Cipriani, Fiore, Mascia, Settanni, Vetrano, Bernabei, & Onder, 2014). Moreover, it was concluded that language ability tends to plateau or stop progressing in adulthood (Witecy, Wimmer, & Penke, 2017). This may imply that language remains one of the most challenging capacities in individuals with Down syndrome.

1.4 Linguistic Profile of Down Syndrome:

As it was described in the section 1.2, every child receives thousands of inputs from his surroundings and according to the generative approach, these inputs, regardless of how few they are, can trigger language faculty and the overall development of the latter becomes a matter of applying a set of UG principles and an inborn creativity (Cook & Newson, 1996). However, this faculty seems to be more challenging for individuals with DS for whom language use requires more than effortless and subconscious processes (see subsection 1.3.5.1). Furthermore, the receptive language in Down syndrome is considered to be stronger than the expressive one (Down Syndrome Resource Foundation, 2017, 3:00; Martin et al., 2009; Roberts et al., 2007; Korlimarla et al., 2020). Eventually, to cope with the expressive language challenges, individuals with DS tend to recurrently utilise non-verbal communication; for example, they use more sign language and gestures than their typical peers do (Buckley, 1993; Down Syndrome Resource Foundation, 2017, 5:38). Additionally, the speech of Down syndrome individuals is marked by tremendous challenges such as the constant production of scattered short telegraphic utterances (Buckley, 1993). This is to say that their speech might be uncoordinated and syntactically flawed. For example, according to

Buckley (1993) a child with DS may produce an utterance similar to the example (20) instead of grammatically appropriate sentence as depicted in (21).

20- Me dad market tomorrow*

21- Dad and I will go to the market tomorrow.

The first example (20) lacks grammatical accuracy and may be less intelligible than the second one which is the grammatically correct form. These challenges might be apparent at different levels of language such as morphology and syntax. Eventually, these levels of language in Down syndrome will be described along with the pre-linguistic and linguistic periods in the subsequent section.

1.4.1 Language Development in Children with Down Syndrome Vs Typically Developing Children:

Language development seems to be momentously delayed in DS children compared to their typically developing peers. It was suggested that regardless of their chronological or mental age, individuals with DS do not reach a language level similar to that of the typical population (Witecy, Wimmer, & Penke, 2017). Language development in Down syndrome is described into two transitional stages: the first one is marked by the non-verbal phase called the pre-linguistic stage and the second one is the verbal phase labelled the linguistic stage.

1.4.1.1 Pre-Linguistic Stage:

Language-related challenges might seem less noticeable in this phase since it is dominated by non-verbal behaviours. Noteworthily, this stage extends from 12 to 18 months for ordinary children while it may last for years or even constitute a lifetime obstacle for those who suffer from extremely severe oral-motor disorders (Roberts et al., 2007, p. 27). In addition, communication goes through gestures, vocalisations, facial expressions and other body movements during the aforesaid period. Accordingly, Caselli, Vicari, Longobardi, Lami, Pizzoli, and Stella (1998) concluded that at early ages, children with DS use more types of

gesture than their ordinary peers. Thus, gestures might be a considerable communicative strength for children with DS. However, it was reported that typically developing (TD) children tend to utilise more gestures combined with words in contrast to their peers with DS (Iverson, Longobardi and Caselli, 2003). In this realm, a study initiated by Iverson, Longobardi, Spampinato and Caselli (2006) on child-mother interaction demonstrated that the mothers of children with DS employed one gesture with one verbal utterance while the ones of their typically developing mental aged peers used more complex structures along with multiple verbal utterances escorted by a single gesticulation.

Furthermore, the communicative functions of the gestures utilised by children with DS tend to differ from that of their typically growing peers (Roberts et al., 2007). In fact, Mundy, Block, Delgado, Pomares, Van Hecke and Parlade (1995) observed that typically developing children used more requesting gestures accompanied by comments in comparison to their DS peers. In consequence, Mundy et al. (1995) assumed that the more the use of gestures, the better later language development will be for children with DS. Thus, the number of gestures used in early ages might play a significant role in the process of language development in children with Down syndrome. In addition, according to Rondal (2009) Dodd (1972) and Smith & Oller (1983), the development of vocalisations is the same in children with DS and their mental age matched TD peers. However, the canonical babbling (consonant-vowel combination) is delayed by about two months in children with DS (Lynch, Oller, Steffens, Levine, Basinger, & Umbel, 1995, p. 68). Besides the delay in the apparition of the canonical babbling, the overall period of babbling is suggested to be longer in children with DS (Korlimarla et al. 2020). These difficulties may widen the gap in language development between children with DS and TD ones and thus, the aforementioned challenges may affect the linguistic stage of children with DS.

1.4.1.2 Linguistic Stage:

The evidence of delay in language development tends to become more apparent at the stage of verbal language which incorporates the linguistic stage. In fact, at this stage, TD children aged from 18 to 36 months develop a single-word vocabulary storage of about 50 words and then start constructing two-word utterances, while the ones with DS need to reach a 100 single-word lexical repertoire to transit to the construction of two-word utterances (Roberts et al., 2007, p. 28; Buckley 1993, pp. 5-6). Additionally, Miller (1998) assumed that children with DS have a larger vocabulary storage at this level, however, they face difficulties acquiring syntactic rules. These challenges will be described in more details below according to their phonological, morpho-syntactic, semantic and pragmatic skills.

Besides, the development of the articulatory abilities in children with DS is unhurried and difficult (Rondal 1995, p. 6). Accordingly, Rondal (1985, pp. 15-36) suggested the following deficits as the most frequent ones prevailing in children with DS at the phonological level: articulatory defects, a critical stuttering, a delayed emergence of certain phonemes, and a slow speech rhythm. Moreover, Shriberg and Widder (1990) stipulated that TD children's speech becomes fully intelligible at 48 months of age, while it may last for a lifetime in their peers with DS. Thus, this poor intelligibility may be due to the reduction and omission of morphosyntactic items or other factors like deviations in speech patterns or voice quality (Stoel-Gammon, 1997). In addition, Timmins, Hardcastle, Wood, and Cleland (2007) reported that individuals with DS struggle with the production of fricative sounds.

Furthermore, the receptive vocabulary constitutes a significant strength in Down syndrome compared to the productive one (Down Syndrome Resource Foundation, 2017, 3:00); however, the development of vocabulary follows the same process in both DS and TD children, nevertheless, a delay was observed in infants with DS (Rondal, 1975). Besides, while the first words emerge around 10-18 months of age in TD infants, it does appear around 20-24 months of age in their DS peers along with a slow growth of the lexical stock, whereas

the production of more than one-word utterances appears around 3 to 4 years of chronological age (Rondal, 2006, pp. 104-105). Moreover, Roberts and al. (2007) assumed that, later in adolescence and in early adulthood, receptive vocabulary is strengthened thanks to more life experiences. Furthermore, Glenn and Cunningham (2005) suggested that adolescents and young adults with DS have a better understanding of experience and event-based terms exceeding their nonverbal and cognitive abilities, while Chapman (2006) emphasised that the comprehension of conceptually difficult words is reduced in children with DS. In addition, children with Down syndrome exhibited more challenges in the use and comprehension of abstract words than concrete ones (Lorusso, Burigo, Tavano, Milani, Martelli, Borgatti, & Molteni, 2017). In more specific terms, they manifest a better understanding of concrete words such as book and pen than abstract concepts like friendship and happiness. Besides, TD children are skilled at fast mapping, which permits them to wire words with their meanings (Hoff, 2001), however, this is not the case for DS infants. This may be due to the impairment in the working memory, specifically in the phonological loop as evoked by Buckley and Le Prévost (2002).

In addition, syntax and morphology are reported to be the most impaired language skills in individuals with DS (Frizelle, Thompson, Duta, & Bishop, 2019; Laws & Bishop, 2003; Penke, 2015; Wimmer, & Penke, 2020; Iverson et al., 2003; Buckley, 1993; Menn & Obler, 1990a). In fact, the development gap between children with DS and their TD peers seems to become wider during the transition from one-word to two or three-word utterances. In this realm, Rondal (2009, pp. 75-76) suggested that while TD children start this transition around the 19 months of age, this last starts from around the age of 3 years in their peers with DS and the grammatical challenges tend to become more discernible in the latter. In addition, the production of utterances in children and adolescents with DS of age between 5 to 20 years, are similar to that of their mental age matched TD peers according to the mean length of

utterance (henceforth MLU), which is the measurement unit of language production in children. Furthermore, the intelligibility of language is reported to be affected in DS children (Chapman, Seung, Schwartz, & Kay-Raining Bird, 1998, p. 861). Thus, the poverty of language intelligibility might be related to factors including the omission of function words and bound morphemes, the reduction of the length of utterances and other challenges in the acquisition of morpho-syntactic knowledge (Comblain & Thibault, 2009, p. 19-21). Besides, the outcomes of a study conducted by Frizelle et al. (2019) demonstrated that children with DS manifest difficulties with the comprehension of complex syntactic structures. Additionally, a recent study undertaken by Witecy, Wimmer and Penke (2017) reported that the comprehension of morpho-syntax stops increasing or may decline later in adolescence and early adulthood. Moreover, the speech of individuals with DS is characterised by the persistent omission of bound inflectional morphemes and functional morphemes, which leads to the use of scattered telegraphic utterances (Camblain and Thibault, 2009; Ouhalla, 1993; Buckley, 1993). Further descriptions of the morpho-syntactic deficits in DS patients will be undertaken in section 1.5.1.

Moreover, for children with DS, pragmatics constitutes a strength in contrast to syntax and morphology with certain challenges (Roberts et al., 2007). In fact, the latter are able to perform daily communicative functions like requesting, affirming, rejecting, or ordering (Rosenberg & Abbeduto, 1980); however, formulating a request is reported to more challenging compared to their mental age matched peers (Beeghly, Weiss-Perry, & Cicchetti, 1990). In this regard, Beeghly and colleagues (1990, p. 344) reported in their study that 17 boys and 11 girls with DS used fewer requests while the subjects did not differ in maintaining the topic or in the use of additional communicative functions like answers, comments, protests in comparison to their TD peers. Furthermore, children with DS are able to repair communication breakdowns, nevertheless, they are less likely to undertake this task unless

they are requested to do so (Abbeduto and Murphy 2004; Abbeduto, Murphy, Richmond, Amman, Beth, Weissman, Kim, Cawthon, & Karadottir, 2006).

Additionally, the narrative skills of adolescents with DS are stronger with the presence of visual supports. Besides, it was reported that the latter narrated as many story elements as their TD subjects with the same mental age when they are provided with visual supports like wordless picture books or movies (Boudreau & Chapman 2000; Miles & Chapman, 2002). Hence, it might be possible to suggest that the utilisation of visual references constitutes an advantage for Down syndrome children. However, they were reported to recall less story elements when they are orally recounted stories without any visual supports (Kay-Raining Bird, Chapman, & Schwartz, 2004). This may result from the deficit in the verbal long-term memory, which affects the retrieval of information. In short, the pragmatic skills might be relatively strong in Down syndrome, but when it comes to certain abilities such as repair strategies and storytelling, DS patients seem to require supports from their interlocutors and the use of visual references to communicate effectively. In a nutshell, children with DS and TD ones follow the same stages of language development, however, the former seem to manifest a significantly delayed process.

1.5 Broca's Aphasia in Down Syndrome:

The discovery of the two tremendous language regions in the human brain during the nineteenth century influenced a number of theories tackling language disorders. These language zones are Broca's area and Wernicke’s area and these latter are situated in the left hemisphere. The former was discovered by the French surgeon, Paul Broca in 1861, while the latter was found in 1874 by the German neurologist, Carl Wernicke. Whereas Broca’s area is responsible for language production and grammatical knowledge processing, Wernicke’s region is concerned with language comprehension. Therefore, anomalies affecting Broca's region leads to Broca’s aphasia and this brain disorder results in agrammatic representations

(Penke, 2015), and is characterised by the loss of appropriate grammatical structures in speech production and comprehension, including written production; this is referred to as agrammatic Broca's aphasia. Thus, if the inherent language faculty (LAD) is found in the brain as claimed by Chomsky's generative theory, any anomaly affecting this organ will automatically result in an aphasia disturbing the aforesaid faculty (Penke, 2015). Nonetheless, it is crucial to acknowledge that the source of adult Broca's aphasia, resulting from brain strokes or Alzheimer's disease, for instance, seems to differ from the one existing in children with Down syndrome. Supposedly, the latter might be a result of the congenital anomaly in the genome; in other terms, there might be a congenital Broca's aphasia in DS patients. In consequence, the language deficits resulting from Broca's aphasia are characterised by agrammatic representations, which are mainly captured in the morpho-syntactic performances of the affected patients. For example, individuals with DS are unable to access function words stored in their mental lexicon, which blocks the projection of these functional heads in the syntactic structures (Ouhalla, 1993; Grodzinsky, 1990). Furthermore DS patients exhibit other symptoms such as the omission of inflectional morphemes, short simplified telegraphic utterances, deficits with the production and understanding of non-canonical sentences along with deficits affecting movement and reflexives (Ring & Clahsen, 2005; Frizelle et al., 2019; Buckley, 1993). Consequently, different theories studying language disorders attempted to delineate these agrammatic representations observed in Down syndrome. In this realm, syntax was considered as the ideal variable (Penke, 2015).

1.5.1 Typical Symptoms of Agrammatism in Down Syndrome: Syntactic Deficits in Spontaneous Speech Production and Comprehension:

The major symptoms of Broca's aphasia in individuals with Down syndrome are captured in their agrammatic representations. In fact, the speech of individuals with DS seems to lack grammatical accuracy. Thus, the agrammatic representations of these individuals are

characterised by morpho-syntactic deficits such as difficulties with bound inflectional morphemes. Accordingly, these challenges were observed in a range of languages such as English (Laws & Bishop, 2003; Menn & Obler, 1990a), French (Comblain & Thibault, 2009), Hebrew (Grodzinsky, 1984) and Malayalam, an Indian language (Nandhu, Vishnu, Screelakshmi, & Satish, 2015). In fact, the agrammatic representations of Down syndrome patients are marked by the omission or substitution of inflectional morphemes. According to Grodzinsky (1984), the omission arises when the remaining stem can stand as a full word. For example, they may produce utterances like "many *girl and *boy" since the inflectional bound morpheme marking the plural (-s) is omitted while the remaining stems (girl and boy) are possible words in English. This can also be applied to the French corresponding words (fille et garçon). However, the omission does not occur when the stem is not a possible word in the concerned language (e.g., Italian *libr- instead of libri (pl); Russian *knig- instead of knigi (pl) (Grodzinsky, 1984); in this specific case, the inflectional markers are not omitted, but the latter are wrongly substituted. Additionally, deficits in inflectional morphology in verb conjugation and tense marking are symptomatic in the agrammatic representations of individuals with Down syndrome. Accordingly, Freedmann and Grodzinsky (1997) reported the case of a 70-year-old Hebrew speaking agrammatic aphasic who constantly failed at placing verb and tense marking inflections on the correct stems. In fact, the patient would use sentences like "Yesterday, my friend goes/will go home". Besides, the researchers reported that the subject wrongly placed gender and number agreement morphemes. For instance, the subject was inclined to add female plural morphemes to masculine singular nouns. In addition, a study initiated by Penke (2018) reported similar deficits in German speaking children and adolescents with Down syndrome compared with their age matched TD pairs. However, the subject-verb agreement in German seems to be less severe than that of Hebrew since Penke's results suggested some accurate answers from, not all of the DS subjects, but

some of them. Nonetheless, TD subjects performed better than DS ones in the study. Furthermore, Katsarou & Andreou (2022, p. 943) concluded that in their study conducted in the Greek language, all the subjects with Down syndrome gave no correct answers in subject-verb agreements and the conversion of verbs from present tense to past and future tenses. Hence, this may defy the principles of government (agreement and inflection), since the bond between the governing and the governed elements are non-existent (see examples 11, 12, 13).

Second, the omission of free functional morphemes like determiners, conjunctions, prepositions, or auxiliaries is common among this population as it was observed in English (Menn & Obler 1990a; Eadie, Fey, Douglas, & Parsons, 2002; Buckley, 1993), and in French (Comblain & Thibault, 2009). Consequently, their speech is full of telegraphic uncoordinated utterances where only lexical words tend to be constantly utilised. This might indicate a deficit affecting the X-Bar principle (see Figure 3). Third, the reduction in the sentence length is another common feature in English speaking subjects with DS (Menn & Obler 1990a; Tager-Flusberg, Calkins, Nikon, Baumberger, Anderson, & Chiswick-Dias, 1990; Buckley, 1993), and in French speaking ones (Rondal and Comblain, 1996). This might considerably slow down DS individuals' communication and limit their abilities to effectively express their thoughts. Moreover, the produced utterances seem to be shortened with no syntactic complexity.

In addition, in languages with varying word orders, individuals with DS prefer using canonical structures to non-canonical ones; for instance, the SVO structure in English is preferred to the OVS one. Consequently, complex structures like subordinate clauses, passives and wh-questions are rarely employed by DS patients (Penke, 2015). Moreover, in languages with overt obligatory verb movement, conjugation is rarely applied; in other words, the verbs are generally used in the infinite form as it was observed in German (Penke & Wimmer, 2020), and in Hebrew (Grodzinsky, 2000; Friedmann, 2002). This is additionally

concerned with the challenges in the comprehension of complex sentences that undergo movement which were recorded in Hebrew (Grodzinsky, 2000), in English (Frizelle et al., 2019) and in Japanese (Koizumi, Maeda, Saito, & Kojima, 2020). As a result, the ability to transform deep structures into surface structures through movement seems to be impaired in DS subjects(see examples 1 and 2 and 5). Finally, the agrammatic representation in DS individuals might constitute a deficit with binding (see examples 18 and 19). In fact, people with DS tend to interpret reflexives like 'himself' as 'him'; this phenomenon was reported in languages like English (Ring & Clahsen, 2005), and Brazilian Portuguese (Fortuno-Tavares, Andrade, Befi-Lopes, Limongi, Fernandes, & Schwartz, 2015).

The above mentioned symptoms of morpho-syntactic deficits in the spontaneous speech production and comprehension of individuals with Down syndrome seem to suggest that all individuals with Down syndrome regardless of their languages might unveil universal agrammatism. Moreover, these symptoms of agrammatism may be severely displayed in Arabic speaking individuals with DS since neuronal network connectivity is more prevalent in Arabic native speakers as recently recorded by Wei and colleagues (2023). Eventually, a number of theories of language disorders attempted to describe the aforementioned syntactic deficits in different languages in the generative framework.

1.5.1.1 Syntactic Deficits in Language Comprehension:

It seems apparent that the effects of agrammatism in DS patients are more observable in their spontaneous speech production than it might be in their comprehension capacity; this may possibly be why most of the previous studies focused on their expressive language. Thus, the results obtained from studies on the comprehension ability are hypothetical and susceptible to raise controversies (Penke, 2015). In this realm, Weigl and Bierwisch (1970) assumed that a deficit causing syntax impairment should affect both the production and the comprehension in parallel since grammatical competence is necessary in both language

production and comprehension. Ergo, the comprehension challenges are mainly concerned with sentences such as those including verb movement and other non-canonical structures such as passives, wh-questions (Frizelle et al., 2019; Grodzinsky; Gavarró & Dotti, 2013; Penke & Wimmer, 2020). For example, Van Der Lely (1996) designed picture-sentence matching tasks where the subjects with Specific Language Impairment and unimpaired subjects were asked to select the image that depicts the appropriate actions. In order to conduct the above mentioned test, the researcher used active and passive structures similar to the following ones:

The man rescued the dog.

The dog was rescued by the man.

The dog is being rescued by the man.

Interestingly, the results showed that the comprehension of passives was impaired in contrast to active sentences where it was preserved. In fact, according to the researcher, the subjects with SLI tend to interpret the aforementioned passives as "dog rescued man". Accordingly, Ring and Clahsen (2005, p. 484) tested the same method on 18 individuals with Down syndrome and William syndrome and the researchers astonishingly observed that the subjects with DS used the same strategy as those with SLI in Van der Lely's above mentioned experiment. Thus, in languages with canonical word order, agrammatic aphasics seem to have a better comprehension of canonical structures compared to non-canonical ones. In fact, comprehension deficits in passive sentences may be due to the fact that the subjects interpret the first noun as the agent and the last one as the experiencer (see example 8). Eventually, this linear strategy tends to go against the theta principle because of the inappropriate attribution of the semantic roles in the sentence (Grodzinsky, 1984, 2000; Miolo et. al., 2005). In addition, a more recent inquiry conducted by Frizelle et al. (2019, p. 1), using an animation-based test on 33 children with DS in comparison with 33 TD children and 32 children with

cognitive impairments of unknown origin, revealed that children with DS exhibited poorer understanding of complex sentences compared to the two other groups. This might probably imply that even the comprehension of canonical structures in DS individuals is likely to be limited to simple active sentences which seems to reflect the shortening of the lengths of utterances in their spontaneous speech production and comprehension as mentioned earlier. In this regard, deficits in the comprehension of grammatically complex structures were reported in German-speaking individuals with Down syndrome (Witecy, Wimmer, & Penke, 2017) and Greek-speaking children with DS (Katsarou & Andreou, 2022).

Besides the deficits in the comprehension of non-canonical structures, individuals with DS have difficulties with the understanding of reflexives. In fact, DS patients tend to interpret reflexive pronouns such as "herself" as object pronouns "her" (Ring & Clahsen, 2005). Moreover, reading and listening comprehension constitute another comprehension challenge in Down syndrome subjects. Accordingly, a study conducted by Prahl and Schuele (2022) revealed that children with DS displayed poor understanding of short passages read either by themselves or by their examiners. Additionally, the researchers suggested that listening comprehension in DS individuals can constitute a barrier to reading comprehension. These comprehension deficits might indicate that language production and comprehension are tightly interrelated abilities.

1.5.2. Theories of Syntactic Deficits in Agrammatism:

Chomsky's generative approach considerably served as a centre for the emergence of theories that focused on the study of language disorders including those observed in Down syndrome patients. On the one hand, scholars assumed that since syntax can stand as an autonomous language module, a deficit including it will affect all its components. On the other hand, others refuted the idea of a global syntactic deficit and suggested that the latter affect only some specific parts of the syntactic module and preserved the other parts. The

remaining part of the current section will, thus, describe these controversial assumptions accounting for syntactic deficits in Down syndrome.

1.5.2.1 Global Syntactic Deficits Approach:

The very first theories of syntactic disorders appeared between late 1970s and early 1980s. In fact, these two periods marked the early ages of generative grammar and researchers focused on finding proofs that could demonstrate that human language faculty is organised into different independent sections such as a syntactic module and a semantic module. Accordingly, researchers like Caramazza and Berndt (1978) hypothesised that Broca's aphasia incorporates a language disorder that selectively affects syntactic features and preserves semantic ones. In addition, Caplan (1985; 2006) proposed a global syntactic deficits approach that accounted for deficits in all syntactic abilities of the aphasics known as the Lexical-Node Hypothesis. In fact, Caplan's theory proposed that agrammatic Broca's aphasics cannot construct a syntactically well-structured phrases since they can only access lexical items like nouns, adjectives, verbs and adverbs and to the information that is stored with these word categories in their mental lexicon (Penke, 2015). Consequently, these lexical items are arranged linearly: the agent is assigned to the noun preceding the verb and the theme is assigned to the noun following the verb. Hence, this approach supports the assumption that all the functional categories are unreachable in agrammatic aphasics (Penke, 2015).

1.5.3 Specific Syntactic Deficits Approaches:

Later, other approaches to syntactic deficits emerged; yet, in contrast to the global syntactic deficits view, they suggested deficits that affect solely specific operations in the overall syntactic module. The latter included syntactic deficits such as those affecting the transformational surface structure, deficits with movement, deficit with functional head projection in the X-Bar scheme, along with deficits afflicting functional heads and binding.

Even though these theories are concerned with distinct specific syntactic deficits with possible controversies, they seem to revolve around a common point: the principles of UG. Therefore, a thorough understanding of these theories can facilitate the indication that agrammatism may lead to the defiance of UG principles in children with DS.

1.5.3.1 Surface Structure Deficits Theories:

As it was explained earlier (see subsection 1.2.1), deep structure and surface structure are fundamental parts of Chomsky's theory. In order to express a thought, it seems to be necessary to use well organised syntactic structures; this is where surface structure intervenes. However, while lexical items are preserved in agrammatic aphasics, function words like auxiliaries, articles and prepositions are impaired in these subjects; this is manifested through the omission of morpho-syntactic items in the spontaneous speech production and comprehension (De Bleser & Bayer 1991; Ouhalla 1993; Buckley, 1993). Therefore, these segregated impairments affecting function words led Grodzinsky (1990, p. 59) to assume that, "The clinical description states that prepositions, determiners, auxiliaries and complementisers (the so-called free-standing function words) are omitted in agrammatic speech. As far as it is known, these tend to be omitted in every language in which they appear." Moreover, Ouhalla (1993) complied with Grodzinsky's above mentioned assumption and claimed that agrammatic aphasics are unable to access their storage of functional categories, which in fact, is part of Universal Grammar; thus, they cannot cast functional heads into the syntactic structures. These researchers' assumptions seem to suggest that the projection of functional items might be blocked in any language. Consequently, theories that supported the idea of surface structure deficits concluded that the latter is impaired in agrammatic Broca's aphasia while the information that comes from the mental lexicon is preserved and can be projected into the syntactic construction through lexical components that are unimpaired (Penke, 2015).

1.5.3.2 Theories of Deficits Affecting the Construction of Specific Functional Projections:

Later, certain theories came up to refute the previously mentioned assumptions according to which all the projections of functional heads are inaccessible to the agrammatic aphasics. Alternatively, they proposed approaches, which assumed that only some specific sub-categories of functional heads are impaired. These approaches include the Tree-Pruning Hypothesis proposed by Grodzinsky & Friedmann (1997) that aligned with Pollock's 1989 Split-INFL Hypothesis. In fact, the latter suggested that the functional category inflections should be divided into two autonomous categories: T category for tense markers and AGR for subject-verb agreement. Thus, in accordance with this assumption, the Tree-Pruning Hypothesis (henceforth TPH) proposed that the deficit affecting functional categories is importantly selective. Therefore, Friedmann and Grodzinsky (1997) scaled the aforesaid deficit from the highest to the lowest level. Thus, the deficit in complementiser (C) is the highest, then, that of tense (T) is higher than the agreement (AGR). Noteworthily, this theory was originally proposed based on data collected from Hebrew-speaking agrammatic aphasic who showed a preserved agreement inflection, but an impaired tense inflection. Stunningly, the subject failed at producing embedded sentences and wh-questions and persistently omitted complementisers at the beginning of the sentences and the wh-phrases (Friedmann & Grodzinsky, 1997, pp. 410-411). Moreover, within the TPH framework, Friedmann (2002, p. 160) observed that 13 Hebrew-speaking, 2 Palestinian Arabic speaking and one English speaking subjects displayed deficits in producing wh-questions and yes/no questions, however, the Arabic and Hebrew speakers preserved their ability to produce yes/no questions. Thus, close-ended questions might be unaffected by agrammatic Broca's aphasia in Arabic speaking children with DS.

Yet, certain scholars assume that the scale on which the T is placed above the AGR node as suggested by the TPH does not apply to all languages. For instance in German, the agreement node is more dominant than the tense one (Baker 1985). Therefore, the level of impairments seems to be dynamic and depend upon the complexity of the constraints that are applied to each of the nodes across languages. Hence, the TPH seems to demonstrate that agrammatic patients might not conform to the principles of government and cases that are in UG (see examples 9, 10, 11, 12 and 13).

1.5.3.3 Theory of Deficits Affecting Movement:

As it was previously mentioned, most individuals with language impairments have a better comprehension of sentences designed in the canonical structure compared to that with non-canonical one such as passives (the dog was rescued by the man), object-clefts (it is the dog that the man rescued), object relatives (the dog that the man rescued is safe), or object topicalisations (Van der Lely, 1996; Penke, 2015). According to Grodzinsky (1984, 2000), the movement of the object from its canonical position leads to comprehension deficits in agrammatic Broca's aphasia. Accordingly, Miolo et al. (2005) also observed this comprehension deficit in movement in a study conducted on 19 English-speaking children with DS and 19 age matched TD ones. Furthermore, another study conducted by Penke and Wimmer (2020, p. 11) on 18 German-speaking children and adolescents with DS concluded that the subjects exhibited 81% of failure in assigning the correct theta roles between the object and the agent. Additionally, Grodzinsky (1984, 2000) supposed that every moved constituent leaves a "trace" and both, the constituent and its trace, are connected via a syntactic chain labelled as A-chain. However, agrammatic Broca's aphasics tend to delete this trace and fail to assign each constituent its actual role; this theory is referred to as the Trace-Deletion Hypothesis (TDH). For example, the passive construction (The dog is rescued by the man) is interpreted in agrammatism as (dog rescued man) (see examples 3, 4, 5, 7 and 8). By

doing so, individuals with DS use what is known as a linear default strategy to assign the agent role to the first noun phrase. Therefore, since the presence of the preposition ‘by’ automatically designate the actual agent being the noun phrase following it, the thematic representation has now two agent roles: one assigned via linearity, which is the impaired strategy, and another one assigned by the existence of the preposition ‘by’ in the sentence. However, in simple active sentences, this deficit is less likely to occur since the linear strategy used by agrammatic individuals seems to work (Penke, 2015).

1.5.3.4 Deficits Affecting Structural Syntactic Relationships:

In contrast to Grodzinsky's hypothesis that assign the cause of the comprehension impairments to deficits affecting movement, other researchers including Mauner, Fromkin and Cornell (1993) hypothesised that the comprehension impairments are due to the deficits in the establishment of a structural relationships between the moved elements and their traces. An example of these structural relationships or dependencies is the one that exists between noun phrases and their antecedents; this is concerned with the binding principle (see examples 18 and 19). Eventually, individuals with DS tend to misinterpret reflexive pronouns as it was mentioned earlier. They may interpret "Ali hits himself" as "Ali hits him" (Ring & Clahsen, 2005; Perovic, 2006). In consequence, they are unable to establish direct relationships between reflexive pronouns and their antecedents. Therefore, the binding principle of UG might be impaired in children with DS. Altogether, the aforementioned theories of deficits in morpho-syntactic structures seem to indicate that agrammatism is symptomatic in all individuals with Down syndrome and discernible in their spontaneous speech production and comprehension. In other words, agrammatism might be exhibited in DS patients according to the structural specificity of every language.

1.6 Morpho-Syntactic Structure of Arabic:

A single section is not sufficient to exhaustively describe the Arabic language; that is why this section will focus on a brief description of the Arabic morphology and syntax; which are the central variables of the study at hand. From the Arabic examples that were previously mentioned in the subsection 1.2.1, it is remarkable that the Arabic language is disparate from Western languages like English or German. Arabic is a Semitic language (like Hebrew) and its orthography has an alphabetic system composed of 28 letters, all of which are consonants except three of them are long vowels (ا و ي). Most Arabic letters possess more than one shape depending on their position in the word (beginning, middle, or end). For example, the letter ج appears as جـ at the initial position, ـجـ in the middle and ـج at the final position (Abd El-Minem, 1987, cited in Abu-Rabia, 2007).

1.6.1 Arabic Morphology:

Arabic possesses a more complex derivational morphology than English does and the Arabic morphological system is referred to as Sarf (صرف). In fact, the latter's derivational morphology has two main word patterns: a verbal pattern and a nominal word pattern. In fact, Arabic words are built from phonological patterns composed of mainly tri-consonantal or quadri-consonantal roots; this is to say that the word stems are made up of three or four consonants. In addition, Arabic has 15 common verb forms derived from the same root each of which conveys a distinctive meaning and determines the type of inflectional morphemes it receives (Abd El-Minem, 1987). Arabic nouns are built in two manners; first, by adding nominal patterns to the stems and second, by deriving a verb from the past tense into the present tense by adding a phonological pattern to the latter (Abd El-Minem 1987, cited in Abu-Rabia, 2007). Besides, it is worthy to mention that the Standard Arabic is slightly different from the Algerian Dialectal Arabic referred to as Darija, which is the most dominant mother tongue in Algeria (Eberhard, Gary, & Charles, 2023, Djennane, 2014).

Moreover, Arabic is described as a highly inflectional language; its inflectional morphology is built by the addition of prefixes and suffixes to free lexical morphemes (Abu-Rabia, 2007). Even though English has an almost similar inflectional morphology, it has less inflectional bound morphemes than Arabic. More specifically said, English inflectional morphemes are all suffixes and notably limited in number, while Arabic has a large number of both inflectional prefixes and suffixes. From this comparison, it is predictable that the omission of bound inflectional morphemes might be more recurrent in Arabic speaking children with DS than their English peers. Arabic inflectional morphemes mark gender (feminine or masculine), number (singular or plural), time (verb tenses) and person (personal pronouns). In present and future tenses, the inflectional morphology indicates person, gender and number through the addition of both prefixes and suffixes (for example, يَخْرُجُ he exits with the prefix (ي) and تَخْرُجُ she exits (ت). Moreover, in the past tense, the functions of the inflectional morphemes are the same, however, the later solely requires the addition of suffixes. For example, خَرَجْتَ you exited (masculine) and خَرَجْتِ you exited (feminine). Additionally, in the imperative mood, the inflectional morphemes indicate gender, person and number with the addition of both prefixes and suffixes. Besides, it is important to acknowledge that Arabic possesses dual pronouns such as أَنتُما you (for two people), and هُما they (for two people), which is not the case of English. Furthermore, there are feminine pronouns such as أنت you (feminine) and هن they (plural feminine). Each of these pronouns has its specific gender and number agreement according to the tense and the mood; this may also increase the morphological challenges for Arabic speaking children with DS.

Moreover, the inflectional morphology indicates gender, number and duals in Arabic nouns. In fact, in Arabic there are two genders, feminine and masculine, which are applicable to humans, animals, and objects. Most of the time, the feminine gender is formed through the addition of the suffix ة- to the masculine noun. For example, the masculine noun معلم teacher

(male), becomes معلمة teacher (female). Furthermore, Arabic numbers have three forms: the singular, the plural and the dual forms. The Arabic singular has no specific marker while the dual is marked according to the cases: it is formed with the addition of the suffix ان- in the nominative case كتابان two books, and the suffix ين- in the accusative and genitive cases كتابَيْن. Moreover, Arabic plural is more intricate compared to that of English for example. In fact, the latter is divided into two types: the sound plural and the broken plural. The former has a fixed rule with specific inflectional morphemes. Additionally, in masculine, sound plurals are formed through the addition of inflectional morphemes to the singular form according to the case: ون- in nominative such as in مُعَلمُون teachers, and ين- in accusative like in معلمين. However, when the plural noun undergoes assimilation, the consonant ن is dropped in the plural inflection; hence, there will be the long vowels و- in the nominative case and ي- in the accusative one; for example in مُعَلِّمو المدرسة the school teachers. Besides, feminine sound plurals are formed by adding the suffix ات- to the singular form; for instance, طبيبات doctor (female). Furthermore, the broken plural in Arabic does not follow the same pattern as the sound one; in other words, the former embraces a larger number of constraints. For example, some patterns require the insertion of infixes inside the root like the singular بيت home which becomes بيوت. Moreover, even though the broken plural does not have a regular inflection, it is more common than the sound plural; thus, according to McCarthy and Prince (1990) the broken plural is generally applied to the words with canonical shapes. As it is noticeable in this case, agreement is very common in Arabic, which is not the case for English. Additionally, the pluralisation follows more puzzling patterns which may lead to more agreement and case challenges in Arabic speaking children with Down syndrome.

1.6.2 Arabic Syntax:

Arabic has three main word classes, which are important in the construction of a sentence. These include the noun الاسم, the verb الفعل and the particle الحرف. In addition, the

class of particles embraces words that are almost comparable to free functional morphemes in English such as prepositions, conjunctions, determiners, quantifiers, interjections and articles. Besides, Arabic nouns, adverbs and adjectives are distinguished according to their functions in the sentence. Arabic syntax is considerably different from that of western languages such as English and French. Arabic syntactic order is tremendously flexible; in other terms, there is no single canonical structure like SVO in English (E-shishiny, 1990; Safi-stagni, 1992). In fact, there are three basic types of sentences: first, the nominal sentence where there are only nouns or a noun (subject) which always precedes a verb. Second, the verbal sentence which requires the verb to precede the noun (subject) in addition to grammatical constructions with special structures which are sometimes referred to as vocative sentences (E-shishiny, 2003). However, in a formal description of Arabic syntax in the Government and Binding framework, Hammo, Moubaiddin, Obeid, and Tuffaha (2014) assumed that the nominal sentence SVO is the canonical Arabic sentence since it contains a hidden verb (is), which is a specificity of the Arabic language. For example, the sentence محمد طبيب has no explicit verb; it literally corresponds to the English phrase "Muhammad doctor", however the hidden verb ‘to be’ makes it a full sentence in English; thus it is translated as "Muhammad is a doctor". Besides, one of the most important features of Arabic is that it is a language of declension. Shortly said, Arabic is an intricate language with complex grammatical specificities that sometimes have no corresponding counterparts in other languages. This might be some of the reasons why it is described with the word miracle.

1.6.3 Arabic Morpho-Syntax in Children with Down Syndrome:

To this date, there are very few studies covering the morpho-syntactic deficits in children with DS in Arabic language. Most importantly, the present study may probably be the first one that deals with these deficits from the generative framework. Nonetheless, a few studies, in Algeria in particular and in the Arab world in general, attempted to record these

impairments in Arabic-speaking children with DS. Accordingly, a study conducted on grammatical number inflection in children and young adults with DS in Jordan reported challenges and restricted understanding of the appropriate number inflection among the subjects (Mashaqba, Abu Sa'aleek, Huneety, & Al-Shboul, 2020). In fact, Mashaqba and colleagues (2020) observed an inaccurate and persistent use of the plural and the dual forms; the subjects recurrently used the singular form in the place of the plural and dual ones. Consequently, the most prevalent impairments were observed in the dual forms. In fact, the researchers assumed that this is due to the fact that the singular form is the default number and the latter is simpler to acquire in Arabic while the dual is the most complex and delayed form (2020, pp. 5-6). The overuse of the singular form may be the result of the omission of inflectional morphemes, which are crucial in forming the plural and the dual forms.

Moreover, another study conducted on Arabic-speaking children with DS in Algeria reported significant morpho-syntactic deficits such as the misplacement of phonemes and morphemes within words like لفلف instead of فلفل (phonological and morphological loops), difficulties with word order in sentences along with deficits in the comprehension of sentences (Nasri, 2022, pp. 31-32). Furthermore, Nasri (2022) observed the omission of function words in the majority of subjects (Nasri, 2022, p. 43, p. 45, p. 49). Besides, the use of uncoordinated telegraphic utterances was also common (Nasri, 2022, p. 43, p. 44, p. 48, p. 49).

Furthermore, Nasri's observations aligned with the study of Djellat and Benaouata (2020), which was also conducted in Algeria. Eventually, the latter reported a more detailed number of morpho-syntactic deficits such as gender-number agreements in verbs and subjects along with adjectives and the nouns they describe. In addition, the conjugation of verbs is almost non-existent since the subjects repeatedly used the infinitive in the place of finite verbs. This may be due to the fact that they do not discern the distinction existing between

verb tenses and moods. Besides, the omission of particles, mainly prepositions, conjunctions and determiners, pronouns, and articles, was recurrent in the subjects' agrammatic representations (Djellat & Benaouata, 2020, pp. 186-187).

Aditionally, Abu Khadra (2013) reported in her study that Lebanon Arabic-speaking subjects with Down syndrome had difficulties naming action verbs in sentences, mainly those containing inflectional morphemes, unless they are provided with pictures of human beings depicting the actions. In addition, in the study of Friedmann (2002) using the Tree-Pruning Hypothesis, it was reported that the Arabic speaking agrammatic subjects displayed similar difficulties that were captured in the Hebrew and English-speaking ones in the construction of wh-questions. However, Friedmann pointed out that the Arabic speaking subjects manifested no deficits with yes/no questions. Furthermore, other impairments were also displayed by DS subjects; the latter include the poverty of lexical storage which might be a result of the morpho-syntactic deficits. In addition, difficulties with pronunciation were reported; the latter concern the production of ش ,س ,ف, and ز which are confounded by the subjects and finally the children with DS exhibited deficits with the use of complex sentences, abstract words, and poor conversational skills (Nasri, 2020, p. 50; Djellat and Benaouata, 2020).

In short, the aforementioned findings of previous studies seem to indicate that agrammatism might be also manifested in Arabic. It is important to note that the aforesaid challenges may be more recurrent in Arabic speaking patients with Down syndrome due to the elevated number of constraints that were previously described; for example, the use of the dual form causes more obstacles in addition to the remarkably outstanding interhemispheric neural network connectivity that Arabic language requires (Wei et al., 2023). Furthermore, the agreements between subjects and adjectives, the existence of both prefixes and suffixes in verb conjugation, the constraints in case agreements along with the dominance of broken

plurals over sound plurals might increase the morpho-syntactic challenges in Arabic speaking children with DS.

1.7 Conclusion:

Altogether, this chapter attempted to give a theoretical overview of the main features of individuals with Down syndrome focusing on the deficits affecting their morpho-syntactic abilities. In order to undertake such an enterprise, the generative approach to language development was taken as an important underpinning and morpho-syntax served as the core linguistic variable. Additionally, the variously cited studies in the present chapter contributed to giving insights about how the deficits affecting the morpho-syntactic representations are exhibited in individuals with Down syndrome in a number of languages such as English, German, and Hebrew. Moreover, attention was attributed to the genetic anomaly found in people with Down Syndrome, which seems to be associated with a range of impairments affecting these individuals' neurological and cognitive abilities which, in turn, might occasion reverberations on these individuals' morpho-syntactic skills. Consequently, certain studies reported that these repercussions might manifest symptoms of agrammatism Broca's aphasia in the spontaneous speech production and comprehension along with the written production of individuals with Down syndrome. Furthermore, while some approaches to morpho-syntactic deficits assumed that the aforementioned symptoms seem to affect morpho-syntax globally, others proposed that the impairments may afflict specific morpho-syntactic components in Down syndrome subjects. It is noteworthy to highlight that the studies cited throughout this theoretical overview tend to indicate that morpho-syntactic deficits remain an under-explored subject in Arabic speaking patients with Down syndrome, especially the ones undertaken in the generative framework. Consequently, the upcoming chapter will impart a more practical exploration of the above mentioned morpho-syntactic impairments in Arabic speaking children with Down syndrome.

Chapter Two: Research Methods and Design

2.1 Introduction:

For any idea to discern the light of viability, it must go through some well-defined systematic steps following a logical advancement. The same notion goes for the topic at hand which fastidiously discusses the effect of Agrammatic Broca's Aphasia on the Arabic morpho-syntactic structure of Down syndrome children in Tlemcen. This chapter tackles the methodological aspects of the aforementioned talking point along with the ethical regards escorting the feasibility of the research. In other words , this chapter pursues the underlying intricate theories, methods and procedures which all together form the underpinning of the research. Furthermore, it scrutinises the application of felicitous ethical principles which have a peculiar resonance due to the thorough nature of the research process.

2.2 Ethical Consideration

Ethical considerations geared up the course of carrying out this research. In conducting the first data collection phase, a request was made by the researcher, the supervisors of this work and the head of the English department to the Academy of Education in order to have access to the two selected schools in Tlemcen (see Appendix A). This latter was supported by an invitation letter from AWIT association for Down syndrome children (see appendix B). Roughly one month later, the authorisation was granted to the researcher which included full access to the schools until the 26th of May (see Appendix C). It was at that time that the data collection phase could finally start by preparing the information sheets and the consent forms for the interviews (see Appendix D and E). Ergo, a formal visit was made to AWIT association where a thorough conversation was held between the pedagogical responsible of the association and the researcher. At first, a focused group discussion was recommended in which the teachers were meant to gather and contribute their knowledge and expertise. However, the pedagogical responsible clarified the non-possibility of the FGD for all teachers cannot leave their workplaces. Hence, the researcher opted for plan B which was

already prepared and suggested conducting individual interviews. The pedagogical responsible being a gatekeeper and a cultural insider, called the teachers at the two schools and informed them of the coming visit of the researcher. This latter was of great help in the flow of the field work since it made the researcher gain the trust of the teachers even before meeting them. Once at the schools, the teachers were already expecting the visit of the researcher who was warmly welcomed. After stopping by the director's office and presenting the aforementioned authorisation along with all needed papers, the access was granted to the researcher who headed directly to Down syndrome classes. The information sheet along with the consent form were thoroughly discussed and explained and the teachers were ready to help. Ergo, the teachers acted like gatekeepers and presented the researcher with a plethora of tips on how to approach the pupils. After finishing the first data collection phase, the teachers were informed of the coming data collection phases and their opinions were solicited on the appropriate time for them to be conducted. Therefore, all the said phases were scheduled depending on the pupils' timetable. On top of that, an online semi-structured interview was conducted online via Google meet with an expert in molecular genetics and neurology. The specialist was provided with a comprehensive information sheet containing all the necessary details (see appendix F), accompanied by a consent form duly signed by her (see appendix G). Moreover The data is diligently stored in dedicated repositories within the database, demonstrating a meticulous approach to data management (see Appendix H). This formal statement emphasises the importance placed on safeguarding and organising the collected data, ensuring its accessibility and integrity for future analysis.

2.3 Research Methodology and Design:

According to Kvale & Steiner, "Method originally meant the way to the goal. With no goal stated, it is difficult to show the way to it." (2009, p. 191). Accordingly, with the goal of this research being firmly established, this study follows a combination of inductive and

deductive reasoning with an exploratory, single instrumental and holistic case study that includes a mixed method approach. The utilisation of inductive reasoning allowed for the exploration and discovery of new insights and patterns within the data. Moreover, by being fully immersed in the specific context of individuals with Down syndrome and agrammatic Broca's aphasia, unique linguistic phenomena could be identified and underlying themes and patterns could be uncovered. In parallel, deductive reasoning was applied to establish connections between existing theoretical frameworks and the research findings. Furthermore, the exploratory nature of the study design allowed for flexibility and openness to unexpected findings, ensuring a comprehensive exploration of the research topic. Additionally, a mixed method approach was employed, integrating qualitative and quantitative data collection and analysis techniques. This combination allowed for the triangulation of data and the enhancement of the reliability and validity of the findings. Withal, qualitative methods, including interviews and observations, provided rich and contextualised insights into the lived experiences of individuals with Down syndrome whereas quantitative methods, including standardised assessments and linguistic analysis, provided objective measures to support and complement the qualitative findings. Therefore, the adoption of this multifaceted methodology enabled the researcher to capture the complexity and multidimensional nature of the topic at hand. According to Creswell, researchers can use inductive reasoning to explore and generate theories or themes from qualitative data, and then use deductive reasoning to test these theories or hypotheses using quantitative data (2014). Moreover, in this study, a deliberate choice was made to utilise a non-probability sampling technique. This decision was driven by a multitude of factors that align with the specific research objectives.

2.3.1 The Sampling Technique:

Given the discreet nature of the sample population and following the fact that they represent a minority in the society, this study follows an exponential discriminative snowball

sampling in which not all referrals are included in the sample (Nikolopoulou, 2022). The researcher used the help of a pedagogical staff at the university of Tlemcen who offered multiple referrals and organisations including both Autism and Down syndrome associations. These latter were assiduously screened and not all of them were selected to participate in the sample. The aforementioned selection was done on the basis of a critical case sampling which is a type of purposive sampling mostly used for exploratory qualitative research where a single case can be decisive in explaining the studied phenomenon by making logical generalisations (Yin, 2017).

According to Bryan (2008),

> Purposive sampling is a non-probability form of sampling. The researcher does not seek to sample research participants on a random basis. The goal of purposive sampling is to sample cases/participants in a strategic way, so that those sampled are relevant to the research questions that are being posed. (P. 418)

Accordingly, the primary participants of this study underwent a rigorous selection process that considered their genetic profile and age range. Special care was taken to ensure that only participants without additional diseases or comorbidities were included in the study. On top of that, the researcher specifically selected pupils aged 11 to 17 for the study due to the psychologist's belief that children under 11 would not yield sufficient data since they are still in the early stages of learning based on the notion of mental age that was equally claimed by the geneticist. This meticulous approach aimed to create a sample that accurately represents the population of interest and minimises confounding factors. Additionally, all secondary participants revolving around the said initial sample are eminently connected to the studied population providing a data triangulation. Expert-based sampling technique was used to carefully select the secondary participants including the teachers, the psychologist along

with the geneticist. This latter helped with corroborating the findings by adding a subsidiary layer of validity and reliability (Creswell, 2014).

2.3.2 Setting, Participants and Procedures:

This study was held in the province of Tlemcen at the two primary schools of Alabili and Khalil Abdeslam and at the association of AWIT. It was conducted during the second semester of the academic year 2022/2023 as a part of a master's degree in Language Sciences at the University of Tlemcen.

The population of the study touches primarily Down syndrome children in addition to their teachers, a psychologist and an expert in molecular genetics and neurology. Creswell argues that the involvement of experts as secondary participants helps to challenge and critically analyse the research findings, methodologies, and interpretations through the enhancement of the quality and validity of the research findings (2014). Therefore, a total of 3 teachers from the two schools along with the pedagogical responsible of AWIT who is a psychologist, contributed to the completion of a semi-structured interview being the first data collection instrument after which a data saturation was observed. This latter refers to the point in qualitative research where collecting additional data does not yield any new or meaningful information. In this case, no new themes, insights, or patterns were emerging from the data (Creswell, 2014). Moreover, a total of 16 pupils out of 26 contributed to the fulfilment of a test that was administered to them at the two schools. Previous research studies have consistently utilised a similar sample size, providing robust evidence for the generalisability of the findings in relation to genetic factors (Penke and Wimmer, 2020; Ring and Clahsen, 2005). Furthermore, an entirety of 2 classes at Alabili primary school were observed with the first class covering 7 pupils with the age range of 12-15 studying at the 4th year with three teachers in class. The teacher of Arabic is a master holder of French who had 6 years with them. Furthermore, the second class covers 11 pupils with the age range of 14-17 studying in

the 3rd year with three teachers in class. The teacher of Arabic has a bachelor in Islamic Religion and had 6 years with them whereas the teacher of Mathematics had 23 years with them. The decision to conclude the data collection after two observation sessions was driven by the recognition of data saturation. Moreover, the last instrument included a specialist in molecular genetics and neurology who was interviewed online through Google meet. This approach is particularly useful in interdisciplinary research or when studying a complex topic like the one at hand which requires expert input.

2.3.3 Research Instruments:

Following a logical reasoning, it was mandatory to count for all the minute details of the data collection phase in order to reach the finest results. Therefore, the instrument's selection was meticulously made by orchestrating a systematic progression wherein each instrument lays the foundation for the emergence of the subsequent one. Ergo, given the exploratory nature of the research and following a participant-centred approach, a face to face semi-structured interview with 5 main questions and their sub questions was conducted to help in exploring the under-researched topic at hand (see Appendix I). According to Patton, the flexibility provided by semi-structured interviews allows for the adaptation of the questions based on the participants' responses along with the emerging themes (2015). This latter elucidated the challenges experienced by children with Down syndrome from the perspective of their educators. This includes the issues that they face both at syntactic and morphological levels. Moreover, the pedagogical responsible of AWIT association was also interviewed. Being a psychologist and having a holistic overlook on the functionality of teaching at the schools, he added an important glance at the studied phenomenon. In light of the gathered information and the previous research, the second instrument was accordingly formed and prepared in the quest for the validity and accuracy of the collected data. This latter resulted in the creation of a test that covers all the 6 themes extracted from the first data

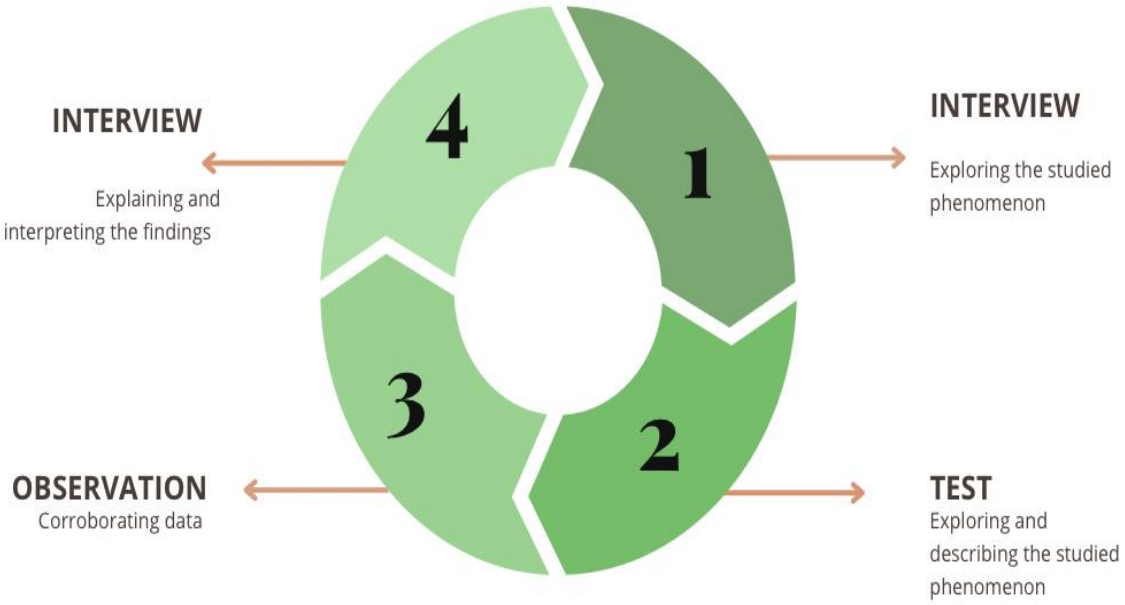
collected in a set of 9 versatile exercises covering the effect of agrammatic Broca's aphasia on the morpho-syntactic structure of Arabic (see Appendix J). The said 9 exercises were based on the technique of non-translational elicitation varying from transformational elicitation to sentence completion, substitution in addition to transformational and paradigmatic elicitation. Additionally, Thorndike and Thorndike-Christ intensified the fact that tests provide a systematic and efficient way to assess various constructs, which is particularly valuable in identifying relative strengths and weaknesses among individuals. (2019)

As an elongation to the test's aim with the focus being on the written comprehension of the pupils, an overt, semi-structured and non-participant observation was done to count for the spontaneous speech production deficiencies (see Appendix K). This latter helps with asserting the test's results at both levels, comprehension and production. On top of that, Hennik, Hutter and Bailey claimed that, "Semi-structured observation allows for the collection of rich, qualitative data, while providing some degree of flexibility and spontaneity in the observation process" (2020, p. 152) which accord with the research objectives. Furthermore, for the sake of data interpretation, a fourth instrument was added to provide data triangulation with the aid of an expert in molecular genetics. Ergo, a semi-structured interview was conducted to account for the elucidation of the main findings of the research with a set of 19 questions (see Appendix L). The questions were designed based on the previous collected data and they were exclusively concerned with the genetic implications of language disorders in Down syndrome. The interview guide included 6 sections arranged from general to specific questions. The first section seeks for a better understanding of the importance of the genome in the creation of the different organs with a special emphasis on the brain. The second section asks for a comparison between people with Down syndrome and ordinary people with an emphasis on the role of the genetic anomaly in DS and its effect on the neurological circuits. The third section is concerned with the effect of the genetic anomaly on cognition and

biological defects whereas the fourth section deals with the effects of the genetic anomaly on the linguistic deficits in DS. In the fifth section, the specialist was asked to provide a comment on the results of the previously collected data about language deficits observed in the sample and the sixth and final section asks about new tendencies in the genetic implications of language disorders in DS.

Figure 6

Research Instruments Rationality



Note: This figure exemplifies the rationality underlying the selection of research instruments, as well as the justification for their specific sequence. The research journey commences with interviews, which serve as a means to delve into the phenomenon through the invaluable insights of teachers and pedagogical staff. This latter proved instrumental in furnishing the requisite knowledge for the development of the second research instrument, facilitating its preparation in a methodical manner. Furthermore, a test was created on the light of the gathered themes from the interviews with a considerable attention to all the codes and categories obtained from the analysis of this latter. The observation was then added to help

with the corroboration of the collected data in the speech production of the pupils. Moreover, the observation played a major role in assessing spontaneous speech production deficiencies. Ultimately, a semi-structured interview was included to help with the explanation and interpretation of the findings by an expert in molecular genetics and neurology.

2.4 Data Analysis and Interpretation:

Bourdieu's perspective on the analysis phase challenges the notion of a detached and neutral approach to data gathering and analysis. Instead, he emphasises the active involvement of the researcher in shaping the analysis process,

> I do not believe that it is useful to turn to the innumerable so-called "methodological" writings on interview techniques . . . At any rate it does not seem to me that they do justice to what has always been done—and known—by researchers, who have the most respect for their object and who are the most attentive to the almost infinitely subtle strategies that social agents deploy in the ordinary conduct of their lives . . . the adequate scientific expression of this practice is to be found neither in the prescriptions of a methodology more often scientistic than scientific, nor in the anti scientific caveats of the advocates of mystic union. (1999, p. 607)

This last underscores the vital role of the researcher in shaping the course of the methodology in accordance with the fostering of reflexivity and critical self-awareness in the interpretation of data. Following the same rationality of the research instruments selection, the comprehensive examination of the findings derived from the initial data collection was undertaken with utmost diligence and precision, with the explicit objective of setting the stage for the development and refinement of the subsequent research instrument. The aforementioned logical framework was consistently adhered to during the phases of data analysis and interpretation, exemplifying a rigorous and systematic approach in the pursuit of accurate and meaningful insights.

2.4.1 Piloting the Interviews:

The consent form along with the information sheet were scrupulously discussed with the participants individually. On top of that, the interview guide was presented with every question being thoroughly addressed. This latter gave the teachers an additional layer of trust and confidence and abetted them in getting prepared for the real interviews. Some teachers requested a copy of the guide and more time to consider each question. Furthermore, during the interview session, a noteworthy occurrence took place as one of the teachers adeptly documented the utmost vital information on a physical medium, thereby offering invaluable assistance in capturing and retaining key insights from the discussion. The aforementioned point showcases the importance of the piloting phase in getting the most of the participants.

2.4.2 Interview Analysis and Interpretation:

Undertaking an interview as an art includes major components such as creativity, improvisation, and breaking the rules. Accordingly, in interviews, there are no established or universally accepted methods and no straightforward path to uncover the true meaning of what is being said. Rather, the interpretation and understanding of interview data rely heavily on the researcher's experience and expertise, highlighting the craftsmanship involved in this process (Kvale & Steiner, 2009). Similarly, when it comes to analysing textual data, there are no standardised methods that can match the vast array of techniques available for statistical analysis. Therefore, in the analysis of the first data collected, the focus was on meaning analysis going through three phases (see appendix O). The first phase was the verbatim transcription of four interviews which resulted in a total of 16 pages, 9902 words written letter by letter and safely stored in a special repertoire in the database (see appendix M).

The second phase was coding the meaning using a hybrid approach with deductive coding which uses previous findings and inductive coding which helps in exploring under-researched topics which resulted in a total of 76 codes (see appendix N).

The Third phase was meaning condensation where a thematic analysis was followed to extract the themes needed for building the second instrument. This latter resulted in 12 categories covering the 76 codes and a total of 6 themes.

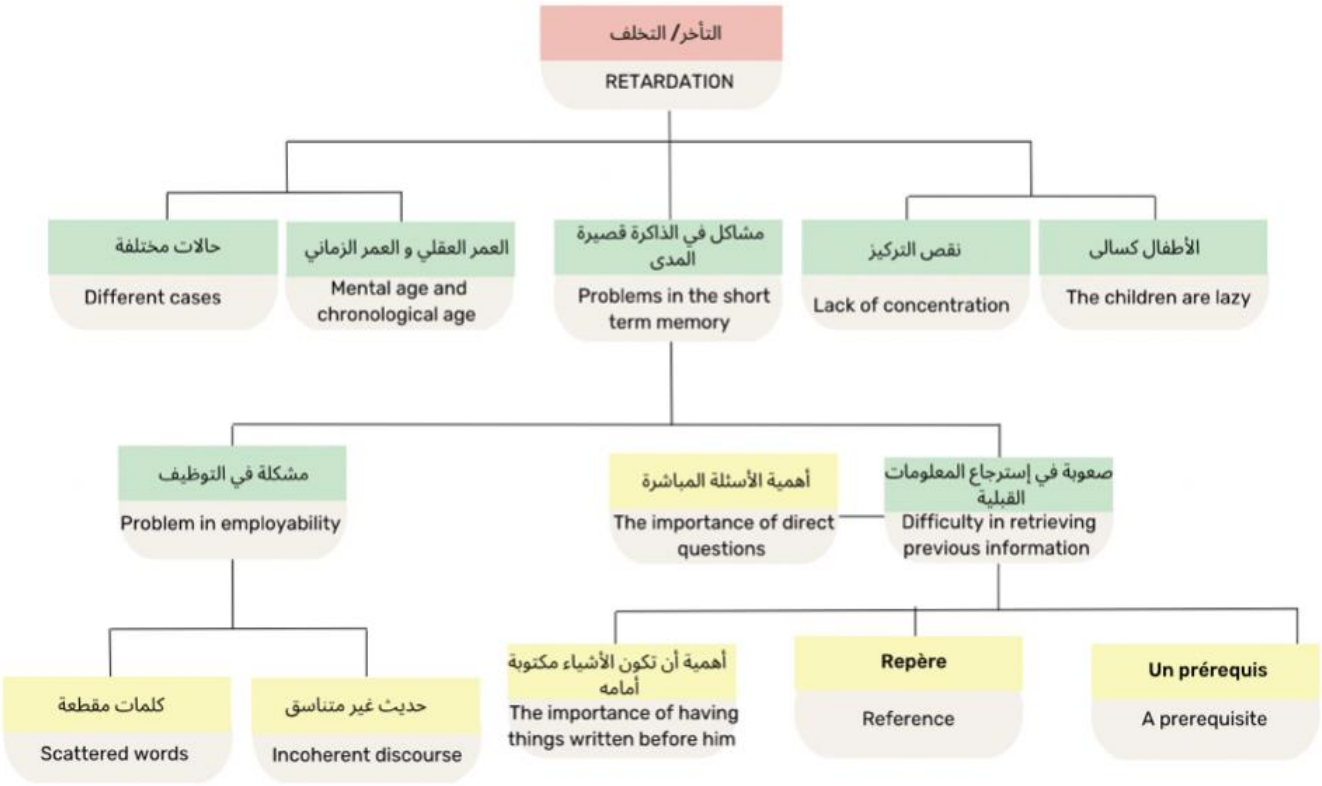
2.4.2.1 Meaning Condensation:

The process of condensing the rich meaning derived from the data analysis yielded a comprehensive set of six different themes that effectively encompassed both syntactic and morphological impairments represented in twelve categories.

As displayed in figure 7, mental retardation is one of the most tackled points in the interviews being responsible for a plethora of malfunctions related to language use. The psychologist emphasised the difference between the two notions of mental and chronological age saying that in innumerable times the children are less in age than what their age number suggests. Moreover, DS children were said to have problems with short term memory which result in both difficulties in retrieving previous information and problems of language employability. These latter give rise to incoherent discourse and scattered words usage. Furthermore, the psychologist intensified the lazy nature of the children saying that they tend to replace using language with gestures.

Figure 7

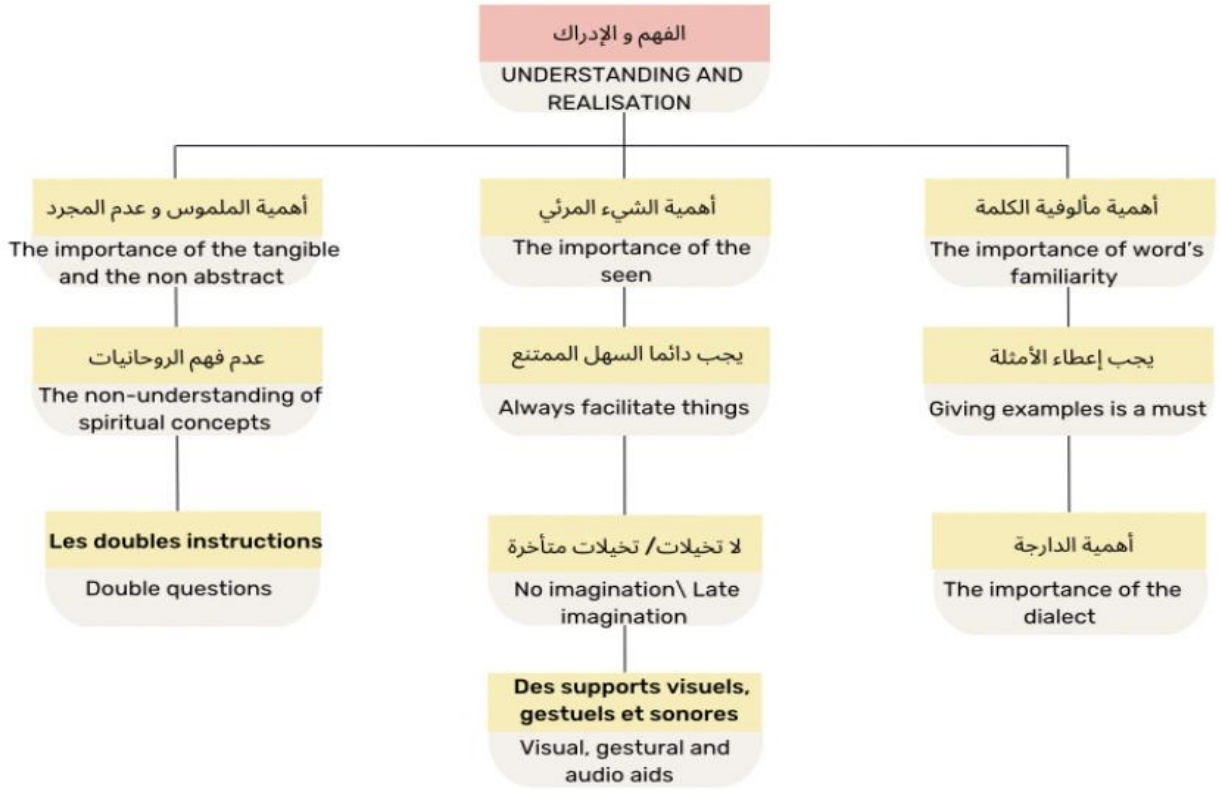
Meaning Condensation Categories: Retardation



Moreover, DS children seem to face significant problems with understanding and realising abstract, obscured and spiritual concepts (see figure 8). This latter led the teachers to adopt certain methods like for instance the use of gestures, images, sounds and tools to help the children overcome their difficulties. Moreover, the use of the dialect is highly important in the teaching process along with the use of simple examples. According to the teachers, DS children have a very poor lexical repertoire that constrained them to the use of familiar and simple terms.

Figure 8

Meaning Condensation Categories: Understanding and Realisation



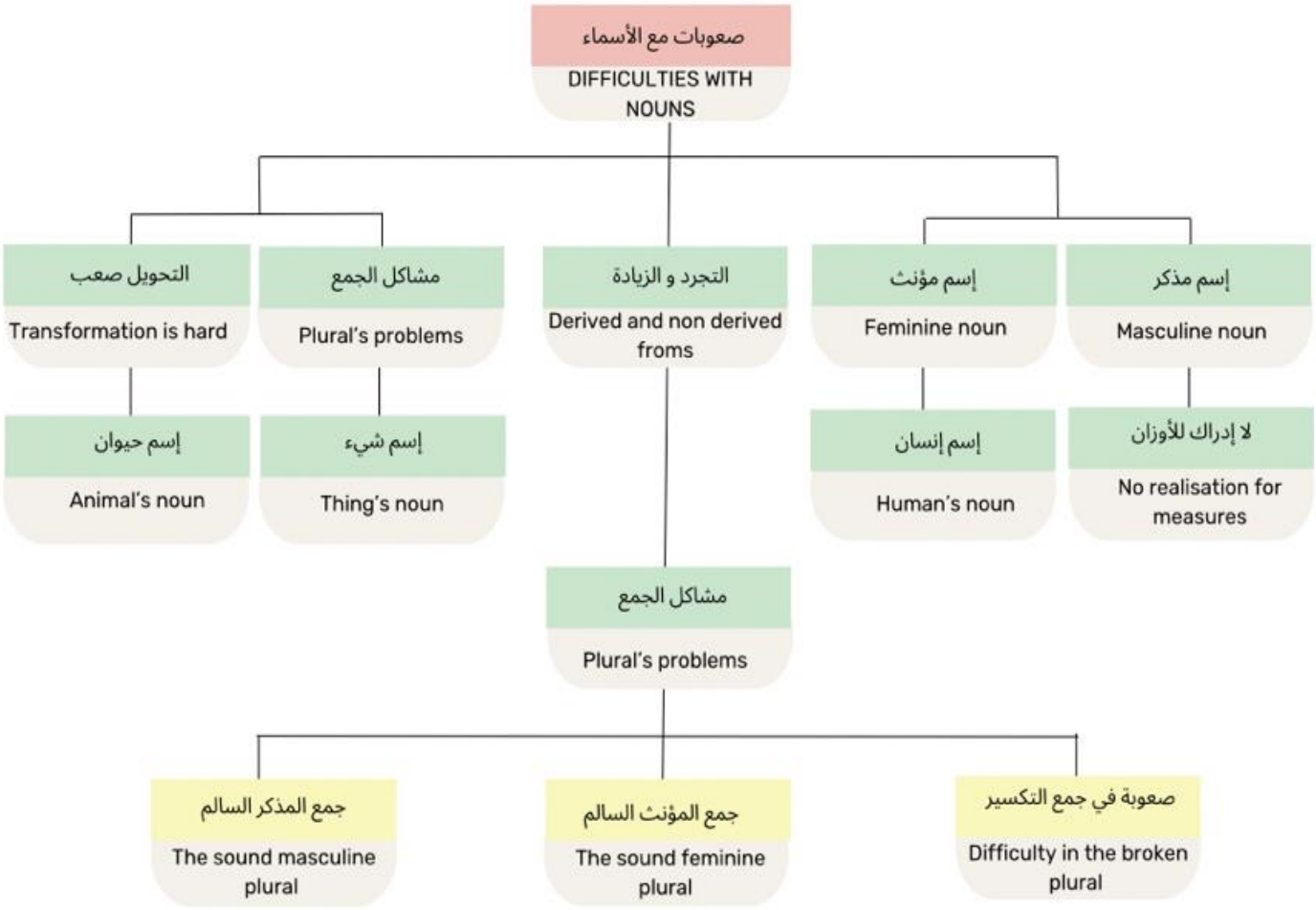
Note: this figure demonstrates the problems of understanding and realisation faced by DS children along with their needs and desideratum.

According to their teachers, DS children have an apparent problem with noun classification (see figure 9). Furthermore, the teachers explained that the children are always guided by rules that they memorise with no real understanding. This latter was said to cause problems of overgeneralisation especially with irregular cases. Moreover, the children were claimed to have ostensible problems with understanding the meaning of nouns and their referents. This later was said to be intense especially with unfamiliar nouns. Additionally, the

teachers expounded that children with Down syndrome exhibit a propensity for retaining inflectional morphemes through the utilisation of supplementary cues such as gestures.

Figure 9

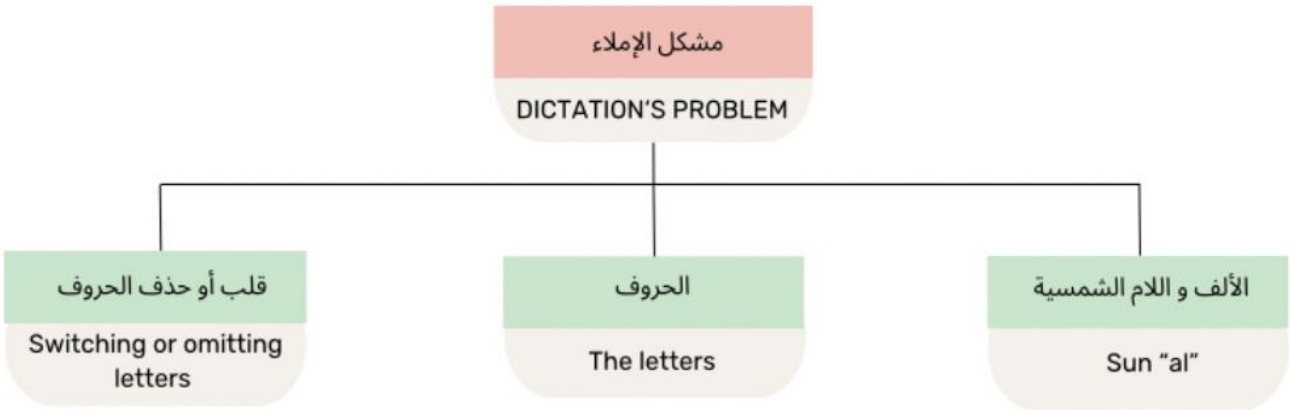
Meaning Condensation Categories: Difficulties with Nouns



According to the interviewees, it is apparent that DS children encounter a notable hurdle in accurately recalling the specific order of letters within words when tasked with composing sentences. Additionally, they face a notable issue with silent letters which they tend to omit in their writing. The aforementioned points led the teachers to dictate the words letter by letter repetitively to help the pupils in the writing process. This dictation was said to be always escorted by gestures and visual aids (see figure 10).

Figure 10

Meaning Condensation Categories: Dictation Problem



Furthermore, an apparent strenuousness was noticed in reading sessions where DS children struggle to read words in sentences (see figure 11). According to their teachers, the pupils tend to perform unneeded and successive poses between letters. Moreover, they need to be given some time before they can embark on reading. Additionally, it was articulated by the teachers that the pupils with DS are unable to read a complete text in its entirety; rather, they rely on a modified and concise rendition prepared by their educators. This revelation serves as an illuminating insight into the inadequacies of the existing syllabus program, which fails to adequately address the specific needs and challenges faced by pupils with Down syndrome. This observation underscores the necessity for curriculum revisions and tailored approaches to better accommodate the educational requirements of these pupils.

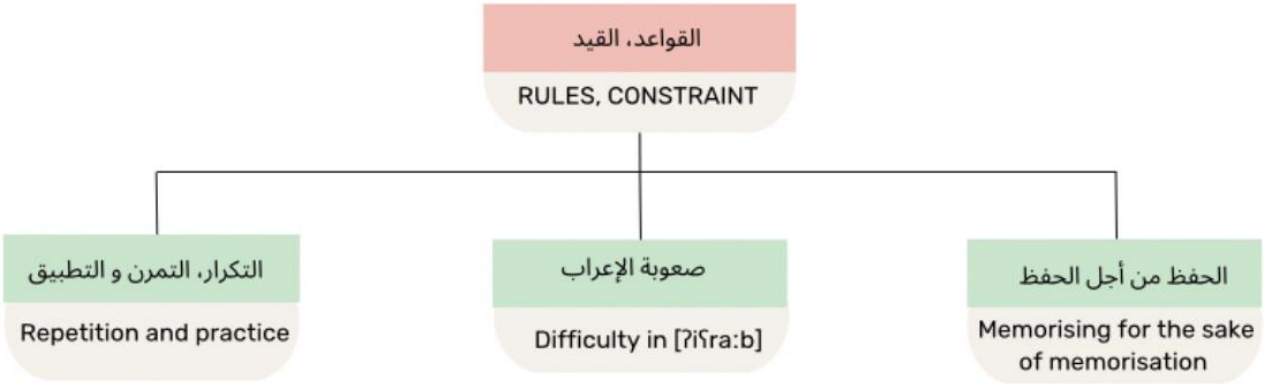
Figure 11

Meaning Condensation Categories: Difficulty in Reading

Additionally, the teachers emphasised the point of rules and constraints claiming that DS children tend to memorise the rules with no real understanding saying that "They memorise just to memorise" (see figure 12). This latter forced the teachers to adopt a sagacity of practice and repetition inside the classroom where language rules are repeated and practised with the aid of gestures and aiding tools.

Figure 12

Meaning Condensation Categories: Rules & Constraints

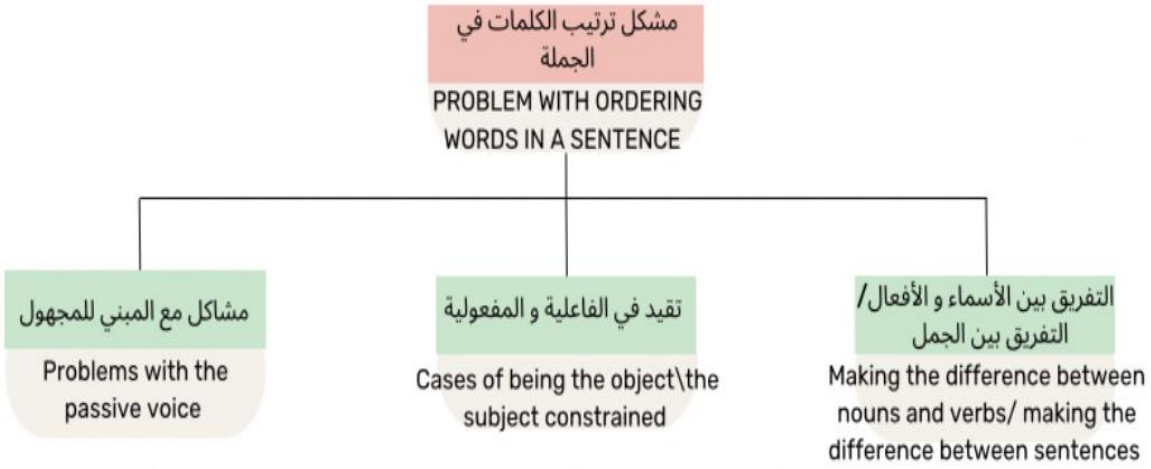


In addition to the problem of ordering letters in words, DS children face another problem of ordering words in sentences (see figure 13). This latter reflects a syntactic problem

especially with making the difference between nouns and verbs. Additionally, teachers claimed that the pupils face an immense problem with understanding and using the passive voice. Moreover, pupils were said to have issues with cases of being the object/subject in sentences.

Figure 13

Meaning Condensation Categories: Word Order in Sentences



As expressed by the teachers, DS children grapple with profound challenges when confronted with the task of verb conjugation. This formal disclosure sheds light on the onerous obstacles that DS children encounter in their efforts to navigate the complexities of verb conjugation in Arabic (see figure 14). Furthermore, the teachers explained that the pupils memorise the rules with no understanding of the word classification. The pupils do not realise that what they are conjugating is a verb and that it requires an action. Consequently, DS children encounter difficulties in comprehending the concept of past tense as it pertains to actions that have transpired. This latter indicates the inability of the pupils to see the action in front of them minimising the level of understanding. Moreover, they face problems with present tense conjugation since it requires the insertion of more inflectional morphemes. The

teachers also intensified the use of tone and gestures in the differentiation between the different tenses.

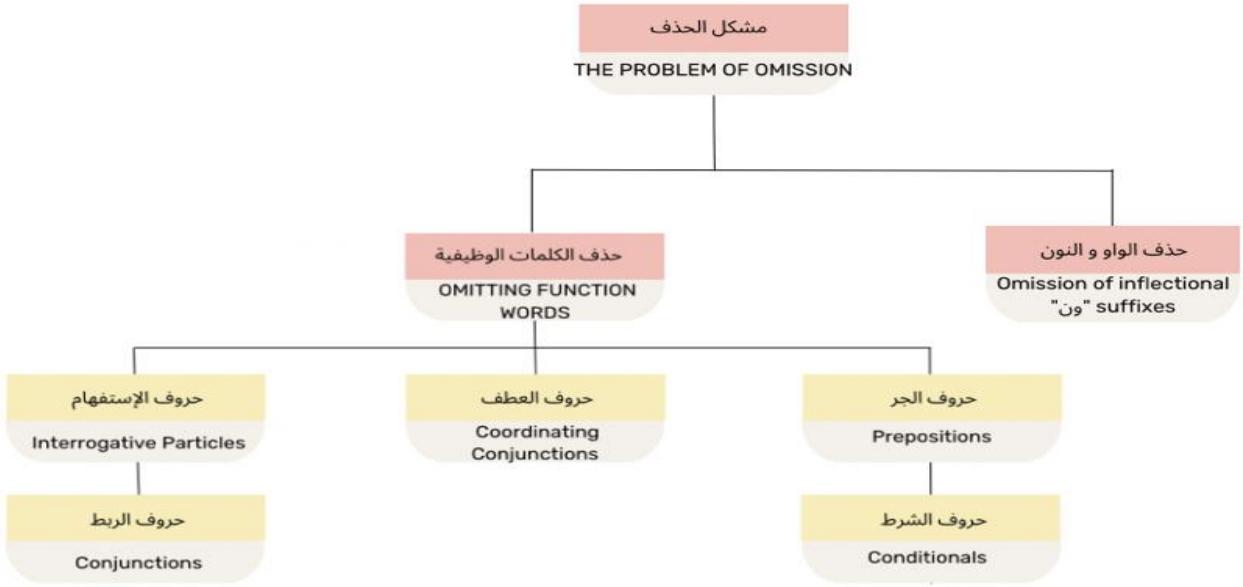
Figure 14

Meaning Condensation Categories: Verbs Rules and Meaning

One of the prominent problems that DS children face is the omission of function words and inflectional suffixes (see figure 15). The teachers explained that all function words including conjunctions, prepositions and particles are not used by the pupils both in the dialect and in the standard form. Moreover, the teachers claimed that the pupils do not understand the meaning of the function words nor their syntactic functionalities. Moreover, it was observed that the pupils exhibit notable difficulties with inflectional suffixes, often resorting to memorisation accompanied by gestures and aids without a genuine comprehension of their underlying meaning. This underscores the challenges faced by the pupils in comprehending and applying inflectional suffixes, relying primarily on rote memorisation rather than a deeper understanding.

Figure 15

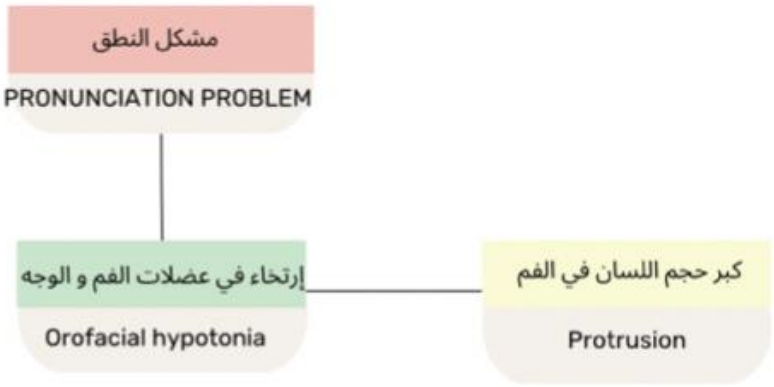
Meaning Condensation Categories: The Problem of Omission



According to the psychologist, DS children suffer from a pronunciation problem due to an orofacial hypotonia that leads to protrusion (see figure 16). The psychologist provided an explanation stating that despite receiving assistance from a speech therapist, the children persist in experiencing this difficulty. This formal explanation emphasises the ongoing nature of the problem and highlights that even with professional intervention, the issue remains unresolved for the children in question.

Figure 16

Meaning Condensation Categories: Pronunciation Problems

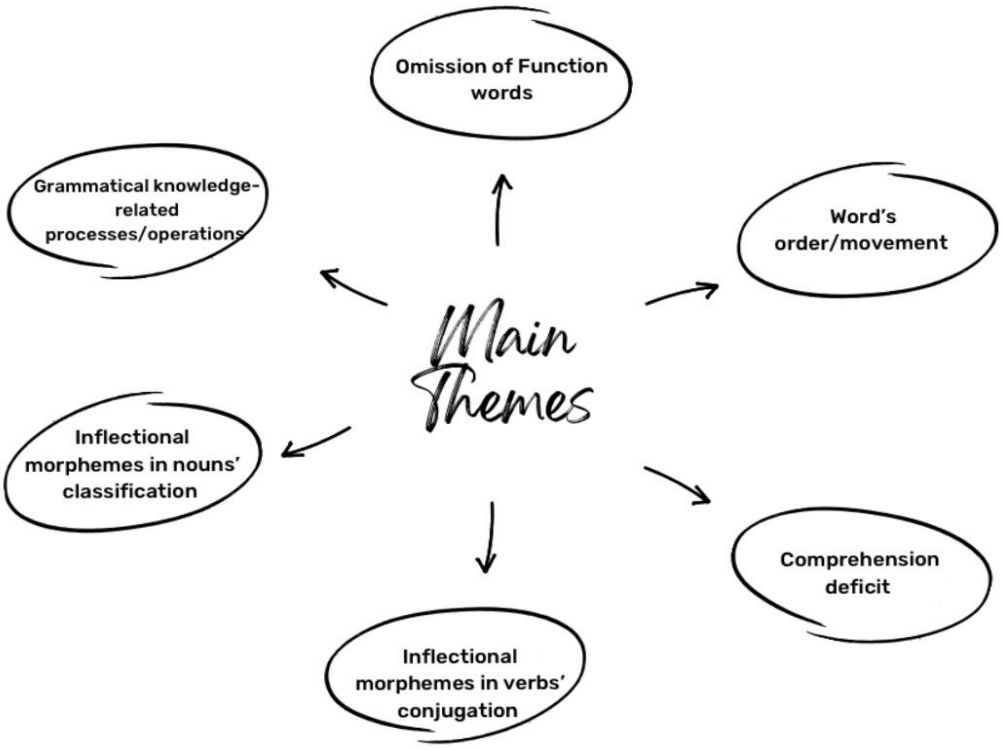


2.4.2.2 Thematic Analysis:

The aforementioned categories led to the emergence of 6 outstanding themes. These themes count for the main problem areas discussed in the interviews (see figure 17). These thematic elements were employed in the development of the second data collection instrument, employing a formal approach to ensure their integration into the research methodology. The test was created based on these 6 main issues in a trial of reaching a well defined exploration and description.

Figure 17

The Main Themes



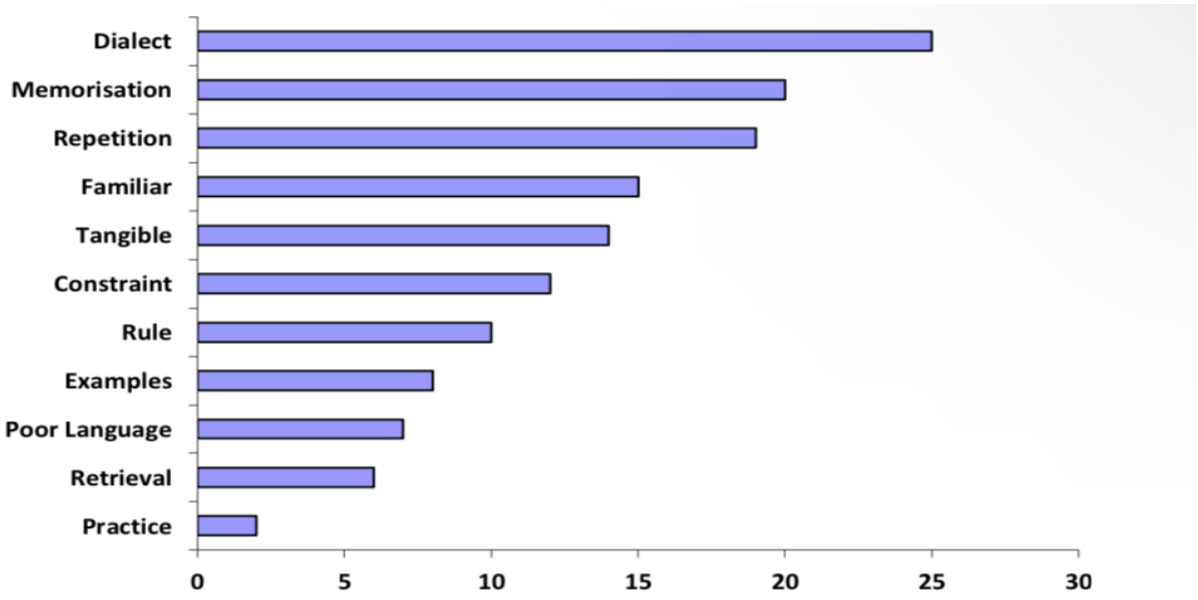
In relation to the quantitative data, a dedicated software tool was specifically developed to facilitate the automated tallying of the most frequently occurring words within the transcriptions. This approach was adopted to streamline the analysis process and derive

valuable insights from the abundance of textual data. All data is safely stored in a special repertoire for data analysis in the database.

Figure 18 demonstrates the importance of the dialect in simplifying and clarifying language lessons. The teachers tackled the overwhelming use of dialectal Arabic in delivering their lessons for its familiar and easy going nature. Moreover, “memorisation” is the second most frequent word along with “repetition” which are the most used techniques in the learning process. Moreover, the terms “familiar” and “tangible” serve as indicators of the limited lexical repertoire and impoverished understanding prevalent among children with Down syndrome. This last observation underscores the constrained nature of their lexical category and highlights the inherent difficulties they face in comprehending and utilising language effectively.

Figure 18

The Most Frequent Words



2.4.3 Piloting the Test:

The test was carefully discussed with the teachers at the two schools and their opinions were taken into consideration in the amelioration of the test design. Furthermore, the designs of previous tests and examinations administered at the two schools played a significant role in informing the necessary modifications to the current test. This formal acknowledgment underscores the valuable insights gained from the examination of past testing materials, facilitating the refinement and enhancement of the current assessment instrument.

2.4.4 Test Analysis and Interpretation:

In analysing the test results, the focus was on the quantitative data obtained along with some qualitative readings. The data is carefully saved in a special repertoire in the database (see appendix P). Moreover, Creswell highlighted the importance of comparative analysis in exploring patterns and relationships within non-probability samples by emphasising the fact that this last can be a valuable tool for generating insights and understanding the relationships between variables even in the absence of randomisation (2018). Therefore, the researcher sought the help of an IT engineer who developed and programmed a specialised software expressly designed to facilitate the analysis of the collected data with the use of cross-tabulation which involves examining requests made to a database using Structured Query Language (SQL) (see appendix Q). This latter is a powerful and standardised programming language explicitly developed for managing and manipulating relational databases as the primary language utilised in database management systems (DBMS) for a wide range of operations including pivot (Molinaro, 2005). The use of the aforementioned advanced tools highlights the proactive approach taken to leverage technology in order to enhance the depth and precision of data analysis. Moreover, the analysis entails a diligent scrutiny of the test results on a per-exercise basis, exemplifying a systematic approach to dissecting and

comprehending the performance of pupils in each exercise (see appendix R). This formal description underscores the thoroughness and attention to detail applied in the examination of test outcomes, ensuring a comprehensive understanding of the strengths and weaknesses exhibited by the participants in relation to each exercise. Moreover, Visual Basic (VB), a programming language known for its comprehensive coverage of data access, querying, data binding, working with datasets, and database programming techniques (Petroutsos, 2000), was effectively utilised in retrieving relevant data from the database. Additionally, VB's strings were programmed by the IT engineer to be used in spotting certain words and syntactic patterns within the retrieved data (see Appendix X). Furthermore, it is worth mentioning that a rigorous explanation was given to the pupils individually when administering the test.

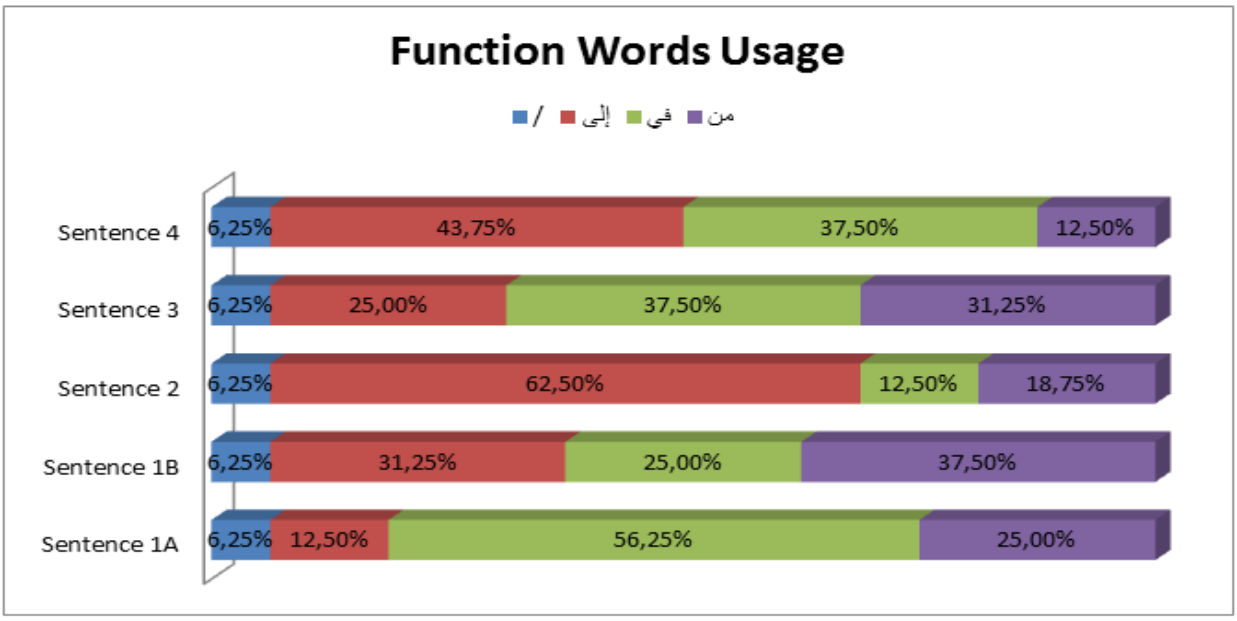
2.4.4.1 Testing the Theme of Function Words Omission:

In the aftermath of conducting a cross-analysis tabulation across the diverse variables, the outcomes distinctly reveal a deviant pattern in the usage of scattered function words (see figure 19). This formal assessment underscores the discernible deviation and irregularity detected in the employment of function words throughout the dataset, offering valuable insights into potential linguistic disparities or anomalies in the language usage exhibited by the children under scrutiny. In the first blank of the first sentence, 56,25% used the particle "في" which is the correct answer, however 37,50% used the wrong particles leaving a frequency of 6,25% of no answer. In the second blank of the first sentence —which follows the same context, only 31,25% used the particle "إلى"which is the correct answer with the frequency of error reaching 62,50% leaving 6,25% of no answer. In the second sentence, only 18,75% used the particle "من" which is the correct answer with the particle "إلى" reaching a frequency of 62,50%. In the third sentence, only 37,50% opted for the particle "في" which is the accurate answer with a rate of 56,25% of error. In the fourth sentence, 43,75% used the particle "إلى" which is the correct answer with the frequency of errors reaching 50%.

Moreover, some answers contained the initial letters of the particles instead of the full words . During the test, the pupils were irritated when asked to choose the correct function words to the extent that some of them claimed the sentences to be accurate without adding any particles. It was noted by the researcher that some pupils kept on repeating the sentences with probing faces in an endeavour to indicate that the sentences are indeed complete.

Figure 19

Function Words Omission



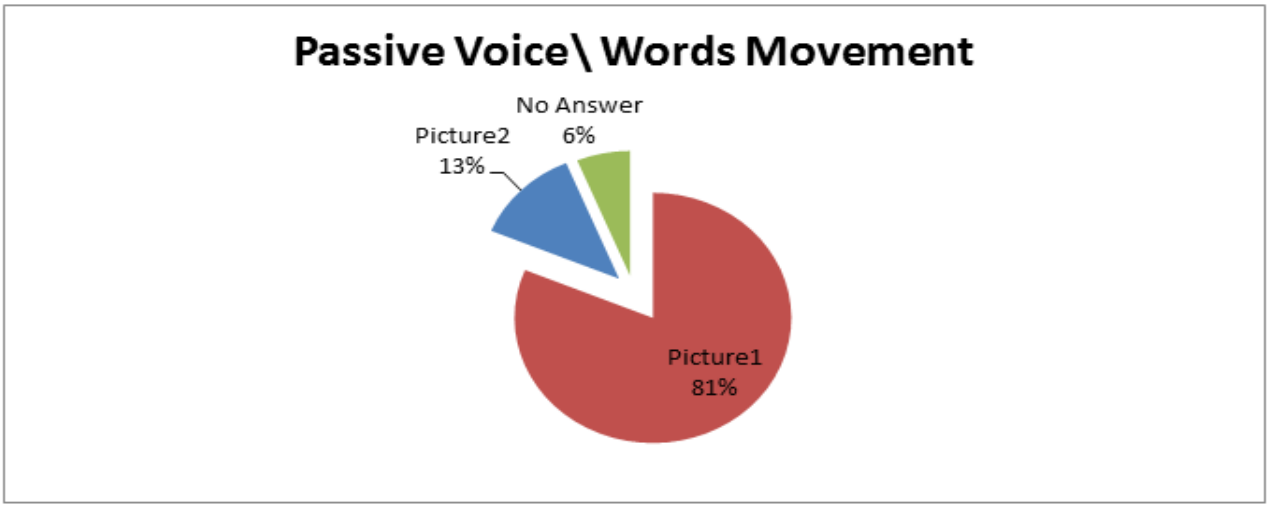
2.4.4.2 Testing the Theme of Words Order/Movement:

The obtained results manifest an apparent deficit in the comprehension and utilisation of the passive voice (see figure 20). This formal observation emphasises the notable deficiency observed in participants' ability to understand and employ passive voice structures, underscoring a specific area of challenge within their language proficiency. Only 13% of the pupils selected the second picture which is the accurate representation of the given sentence leaving a percentage of 81% for the first picture and 6% for no answer. These results exemplify a false comprehension regarding the identification of both the doer and the receiver

of the action. This formal observation highlights the misconception observed among participants, indicating a flawed understanding of the roles and entities involved in the action being described. Moreover, it showcases the linear processing of the structure of the sentence with the doer being always first and the receiver being last. In this exercise, the sentence "لُمِسَت الأخت من طرف أخيها" which translates to "the sister was touched by her brother" resulted in 81% of the responses incorrectly attributing the girl as the doer of the action, based on her position at the beginning of the sentence, and perceiving the boy as the receiver of the action due to his placement at the end of the sentence.

Figure 20

Words Order/Movement

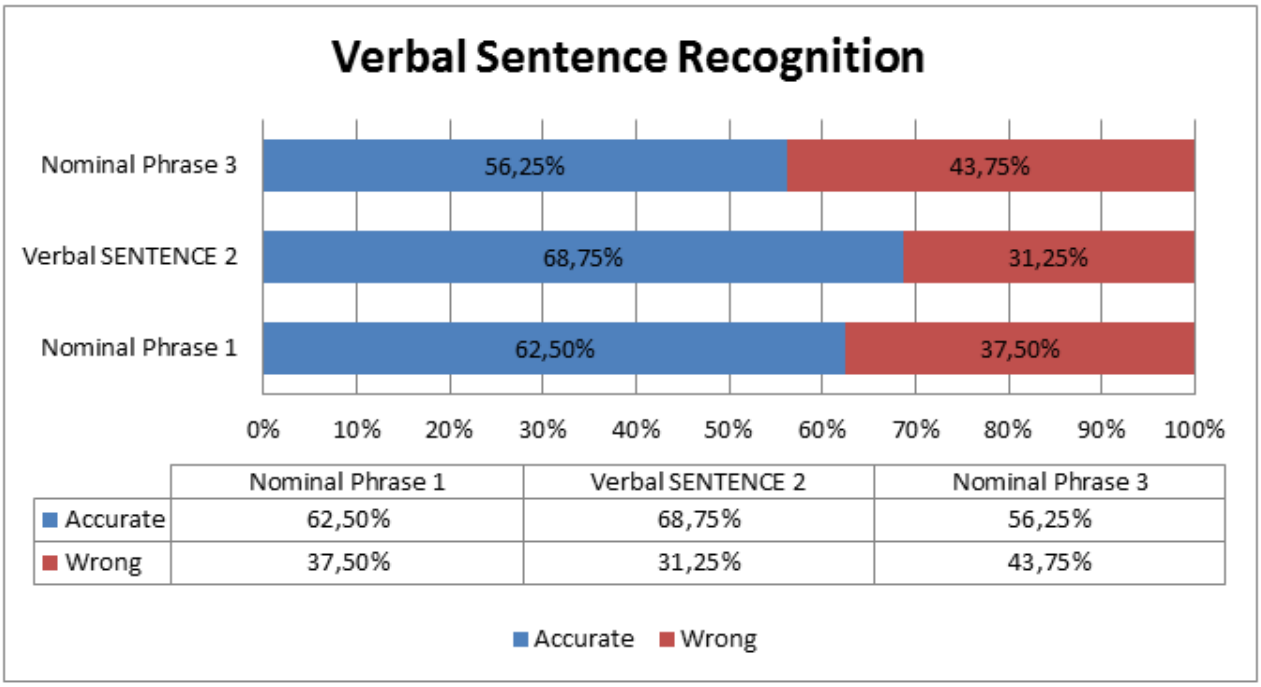


The results further reveal a substantial deficit in the comprehension of verbal sentences (see figure 21). This formal observation underscores the significant challenges observed among participants in understanding and interpreting sentences that involve action or verbal elements. The findings highlight a notable gap in their comprehension abilities within this specific linguistic domain. In the first question with the inversion of subject-verb form, 62,50% did not select the nominal phrase leaving a frequency of 37,50% of wrong selection. In the second question with the familiar form of verb-subject, 68,75% selected the

sentence. In the third question with no verb, 43,75% selected the phrase. Furthermore, the majority of answers included a selection of words— particles, nouns and verbs— instead of full sentences. Additionally, some answers incorporated the selection of the word "الفعلية" from the question. Also some answers included dividing the sentence with two circles.

Figure 21

Words Order/Movement and Grammatical Knowledge-related Processes/Operations



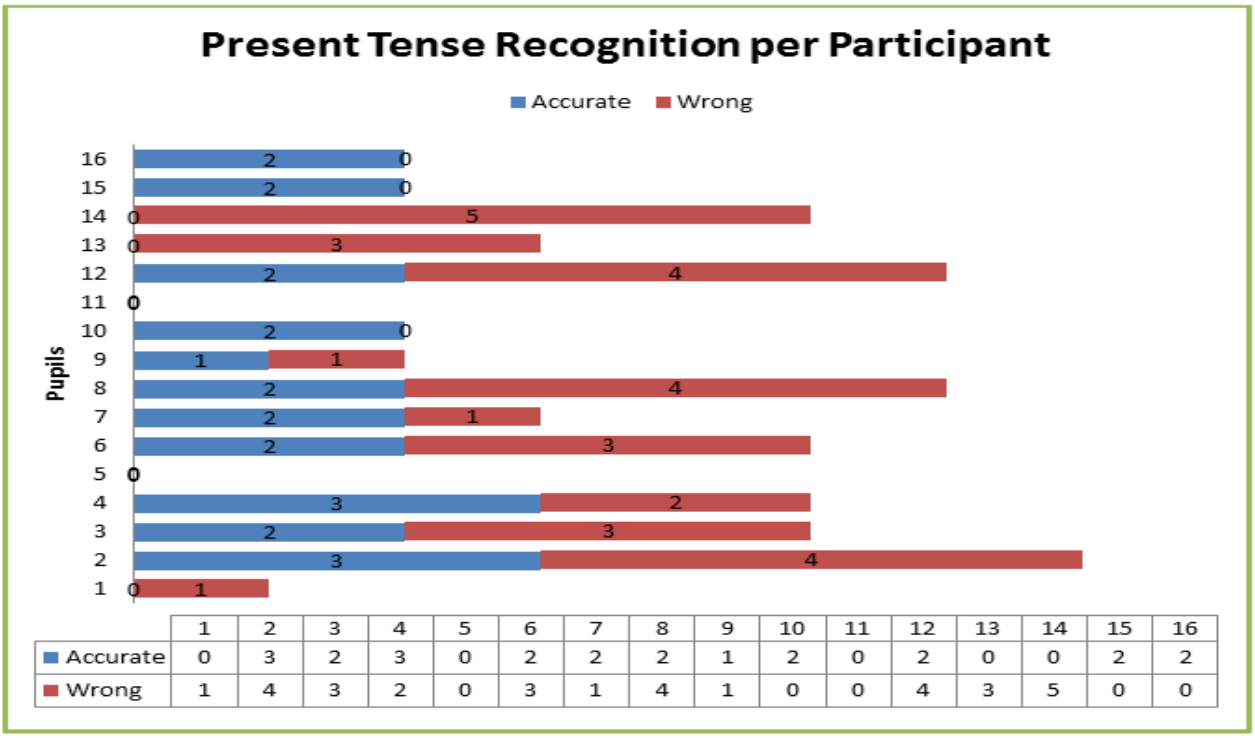
2.4.4.3 Testing the Themes of Inflectional Morphemes in Verb Conjugation

The results of the present tense recognition demonstrate a comprehension deficit of the different syntactic categories along with a deficit in comprehending inflectional morphemes (see figure 22). Furthermore, they display a comprehension deficit of tenses. In this exercise there are three accurate answers— present tense verbs. However, as evident from the data presented, the frequency of accurate answers compared to the frequency of errors vividly illustrates the existence of the aforementioned deficit. This formal statement emphasises the disparity between correct and erroneous responses, providing quantitative evidence that

further supports the identification of a comprehension deficit in relation to verbal sentences. The best Instance of this case is the second pupil who selected the 3 accurate answers; however, he also selected 4 wrong words. Furthermore, some answers include the selection of the words "الفعل" and "المضارع" from the question and the selection of the question itself.

Figure 22

Inflectional Morphemes in Verb Conjugation and Grammatical Knowledge-related Processes/Operations.



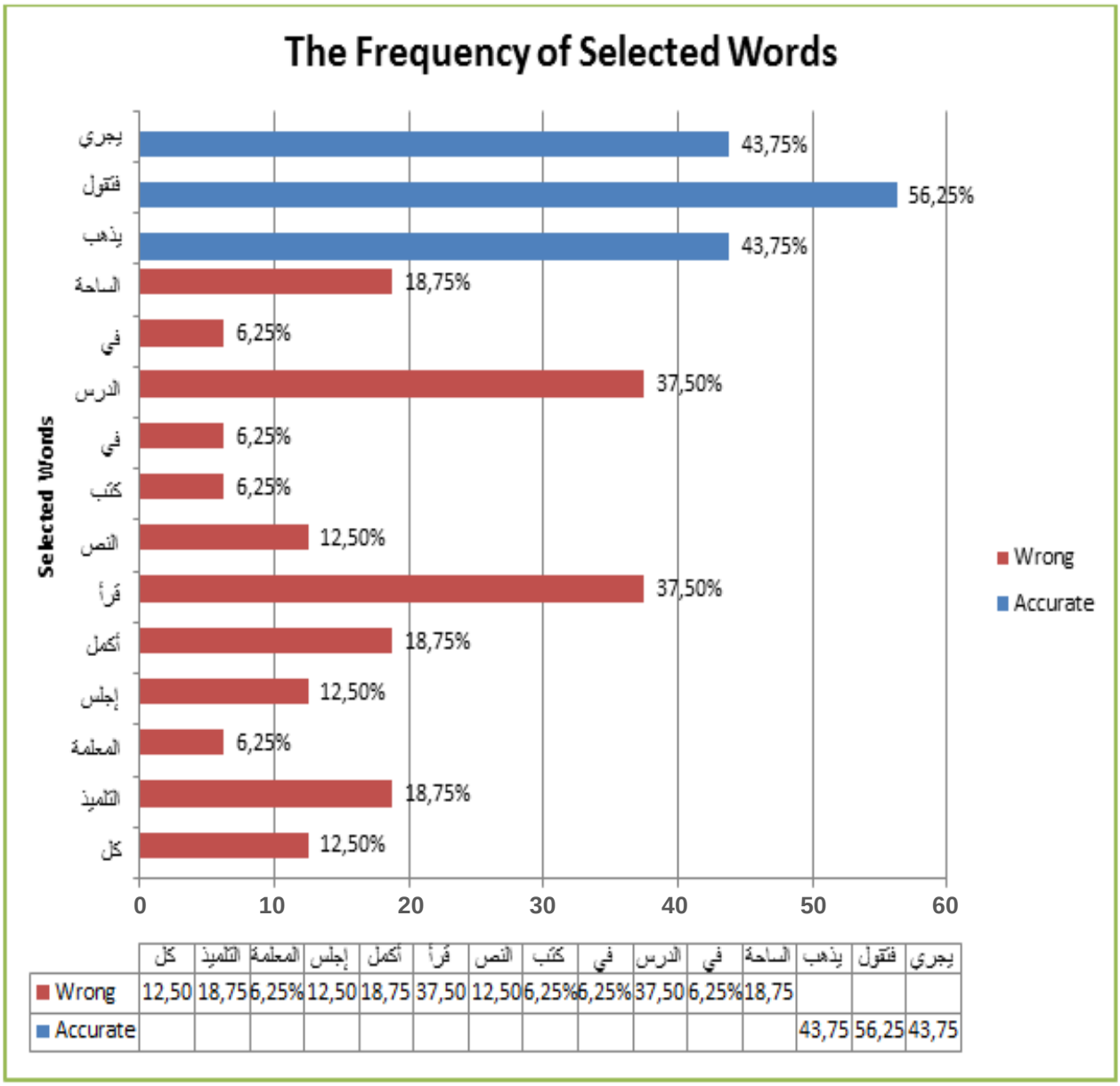
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Accurate	0	3	2	3	0	2	2	2	1	2	0	2	0	0	2	2
Wrong	1	4	3	2	0	3	1	4	1	0	0	4	3	5	0	0

The frequency analysis of selected words clearly demonstrates a comprehension deficit in syntactic categories (see figure 23). This formal observation emphasises the noticeable discrepancy in the frequency of specific words associated with different syntactic roles, indicating challenges in the participants' understanding and utilisation of these grammatical structures. The findings highlight a distinct deficit in comprehending and applying syntactic categories within the language proficiency of the individuals under investigation. A total of 12 wrong words were selected varying from nouns to particles to

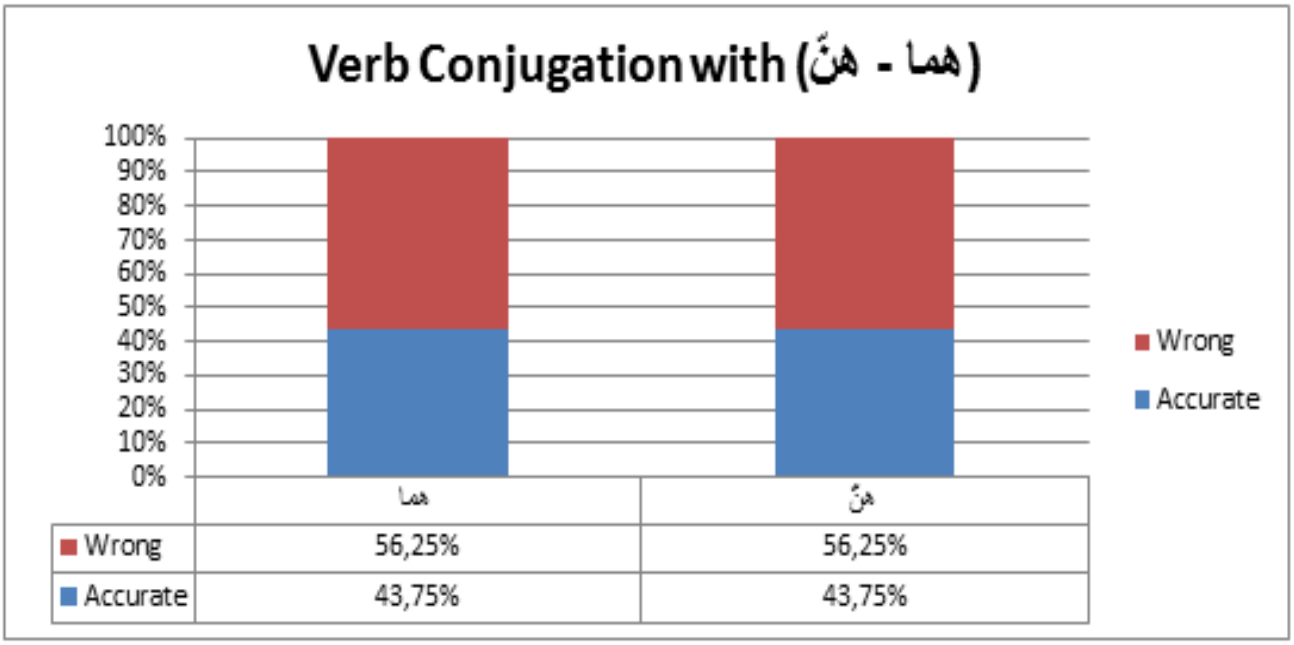
verbs in the past tense and verbs in the imperative form. The two most selected wrong words are "الدرس" — which is a noun— with a frequency of 37,50% and "قرأ" which is a verb in the past tense— with a frequency of 37,50%. Moreover, the words "أكمل" and "إجلس" —which are verbs in the imperative form— and the words "التلميذ", "النص", "الساحة" and "المعلمة" — which are nouns. Additionally, the particle "في" was selected in two different contexts and the particle "كل" with a frequency of 12,50%.

Figure 23

The Frequency of Selected Words



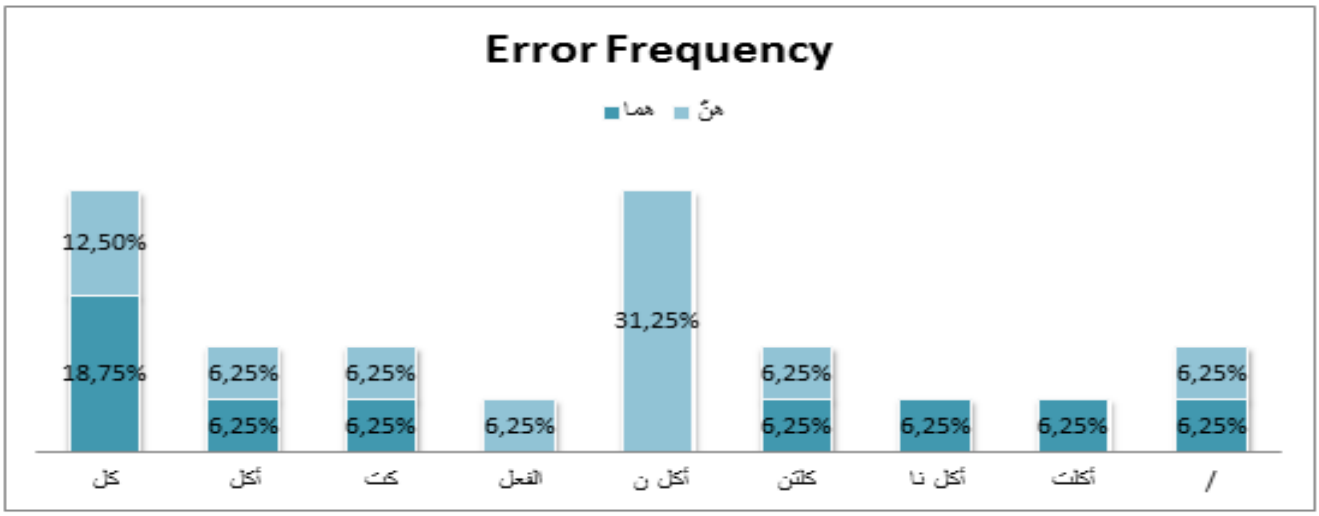
Inflectional Morphemes in Verb Conjugation



On top of that, the results demonstrate different errors with "أكل ن" being the most frequent one in "هنّ" with 31,25% and "كل" being the most frequent in "هما" with 18,75%. This formal analysis highlights the specific errors that commonly occur within the mentioned sentences, providing insights into the prevalent mistakes made by participants during the task (see figure 25).

Figure 25

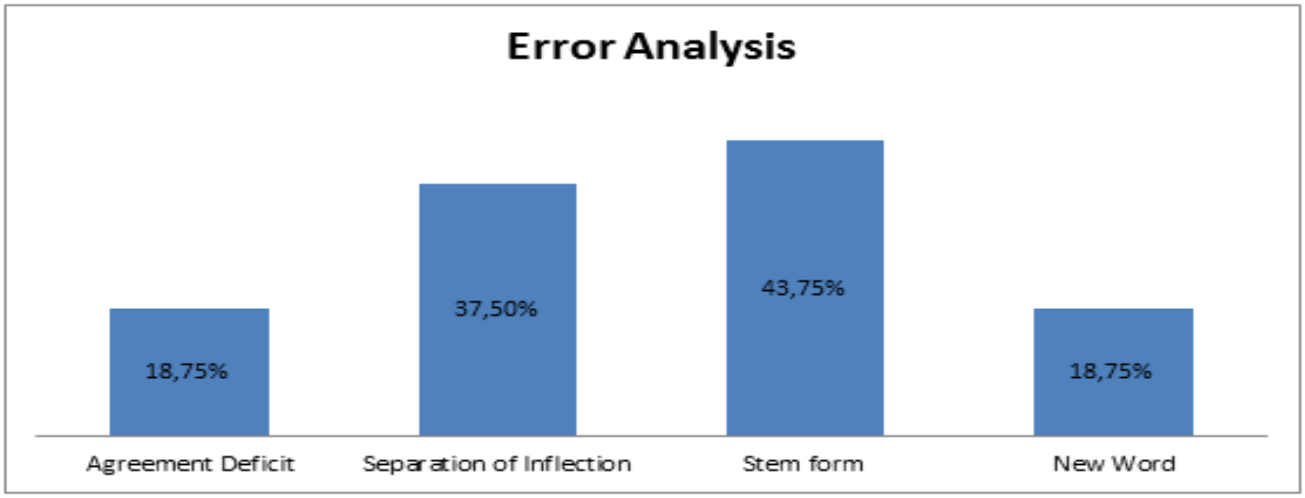
Error Frequency



Therefore, the most prevalent type of error observed is related to the stem form, followed by errors involving the separation of inflection (see figure 26). This formal analysis highlights the recurring nature of mistakes associated with the base or root form of words, along with errors pertaining to the correct placement or attachment of inflectional elements.

Figure 26

Error Analysis

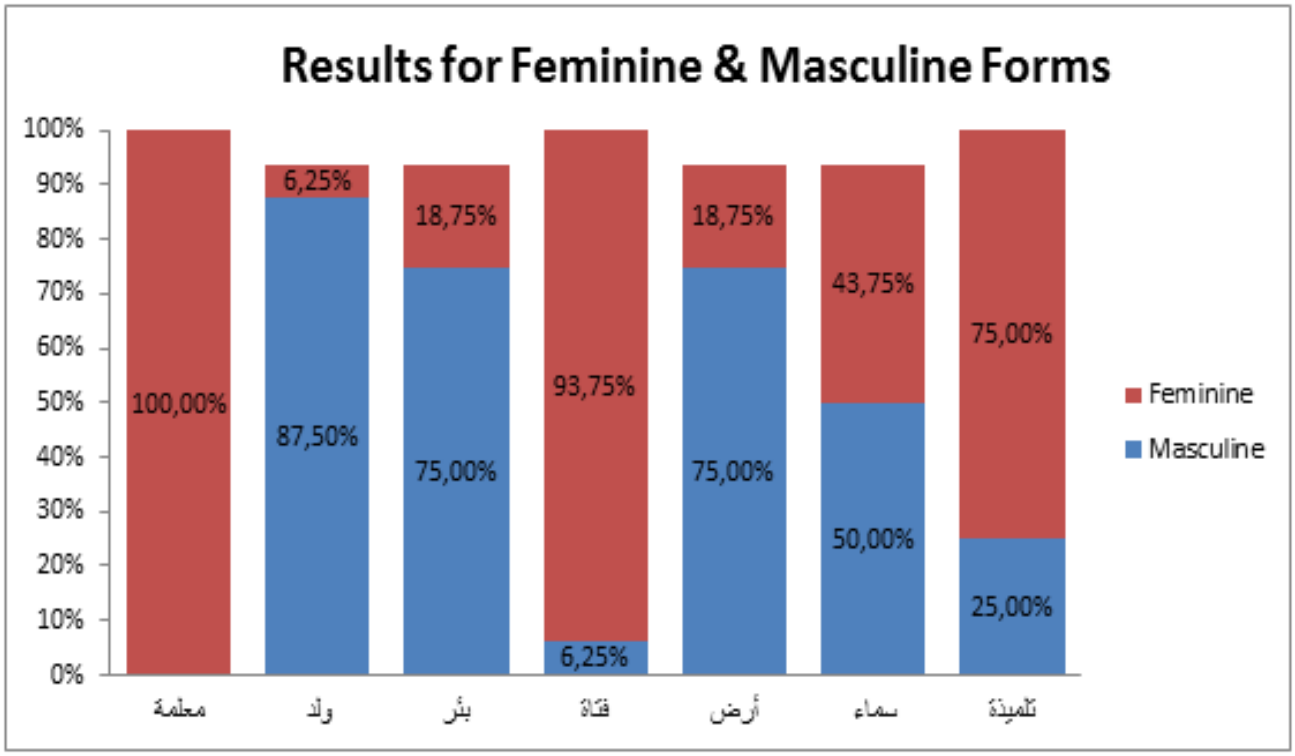


2.4.4.4 Testing the Theme of Inflectional Morphemes in Nouns Classification:

The results demonstrate a notable deficit in correctly identifying the feminine gender in words that lack explicit feminine signs at the end (see figure 27). This formal observation highlights the specific challenge faced by participants in correctly attributing the feminine category to words that do not exhibit conventional feminine markers showing that the pupils memorise the gender of the word with the presence of the sign rather than understanding it.

Figure 27

Inflectional Morphemes in Nouns Classification: Feminine &Masculine Forms

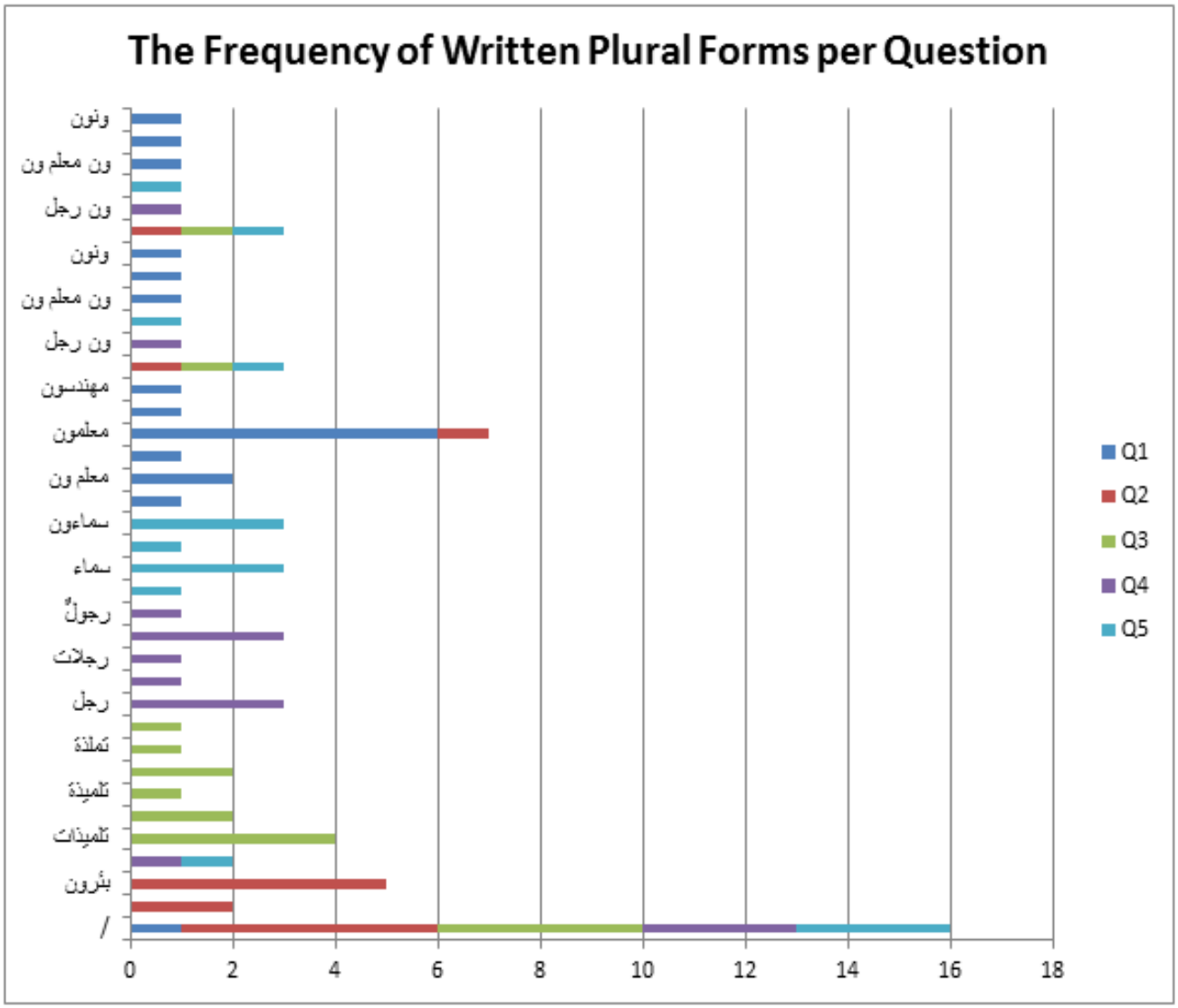


Following the cross-analysis tabulation of the different variables, the results display an apparent deficit in plural forms transformation (see figure 28). Moreover, the pupils expressed considerable difficulty and found the exercise to be challenging during the test administration, to the extent that some of them became visibly irritated and declined to complete the remaining portion of the exercise. This formal observation emphasises the significant level of

frustration and resistance experienced by certain individuals when faced with the task, indicating the intensity of the challenge presented by the exercise for these particular pupils.

Figure 28

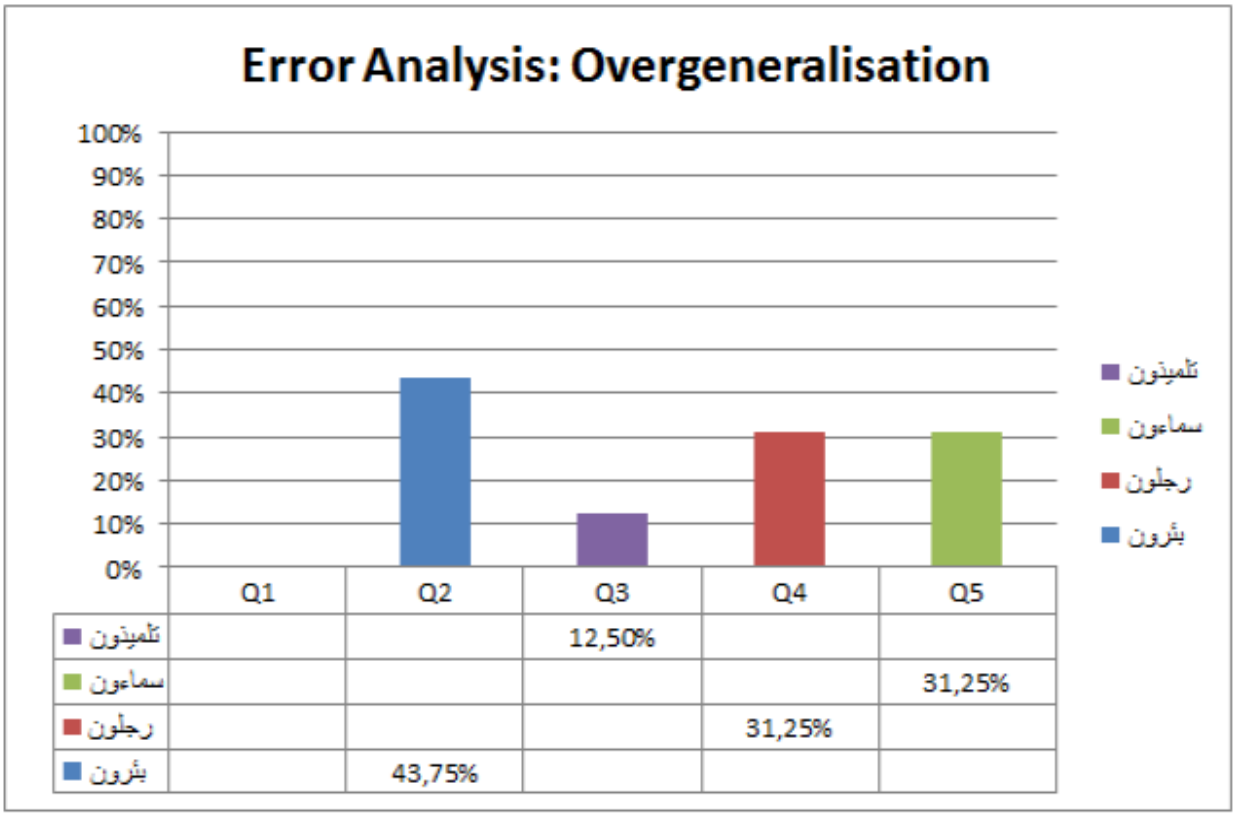
Inflectional Morphemes in Nouns Classification: Plural Forms



Following the cross-analysis tabulation of the different variables, the results indicate a prominent tendency to overgeneralise the sound masculine plural rule, extending it to both sound feminine plurals and broken plurals (see figure 29). This formal observation highlights the conspicuous pattern of applying the masculine plural pattern inappropriately to other plural forms.

Figure 29

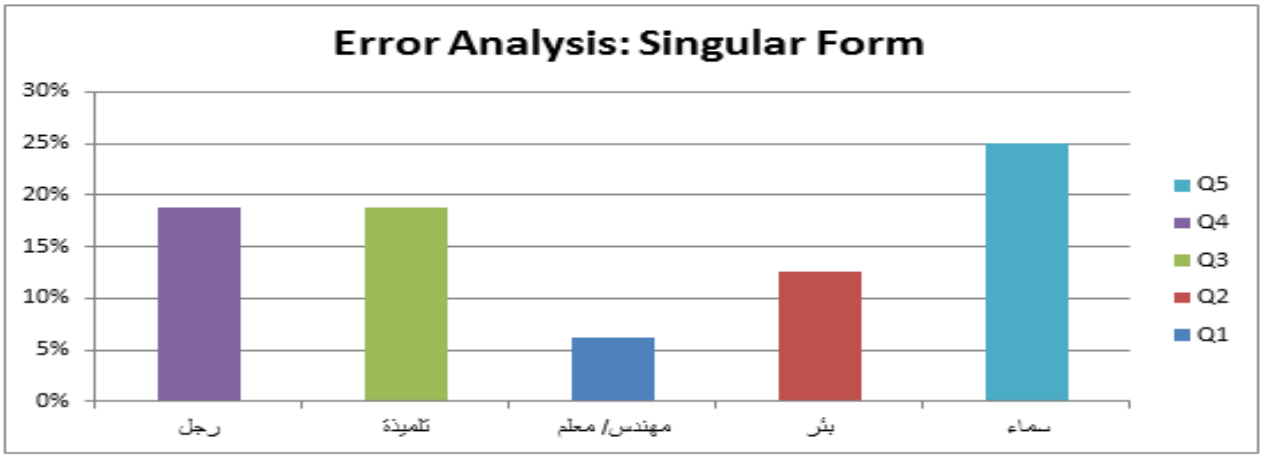
Error Analysis: Overgeneralisation



Withal, following the cross-analysis tabulation of the different variables, the results reveal a notable tendency to utilise singular forms as an alternative to plural forms, seemingly with the intention of avoiding or eliminating the usage of inflectional morphemes (see figure 30). This formal observation highlights the ostensible pattern of opting for singular forms instead of employing appropriate plural forms, suggesting a preference for simplicity and a potential avoidance of more complex grammatical structures. The findings shed light on the participants' linguistic strategies and indicate a potential deficit in the accurate application of plural inflectional morphemes.

Figure 30

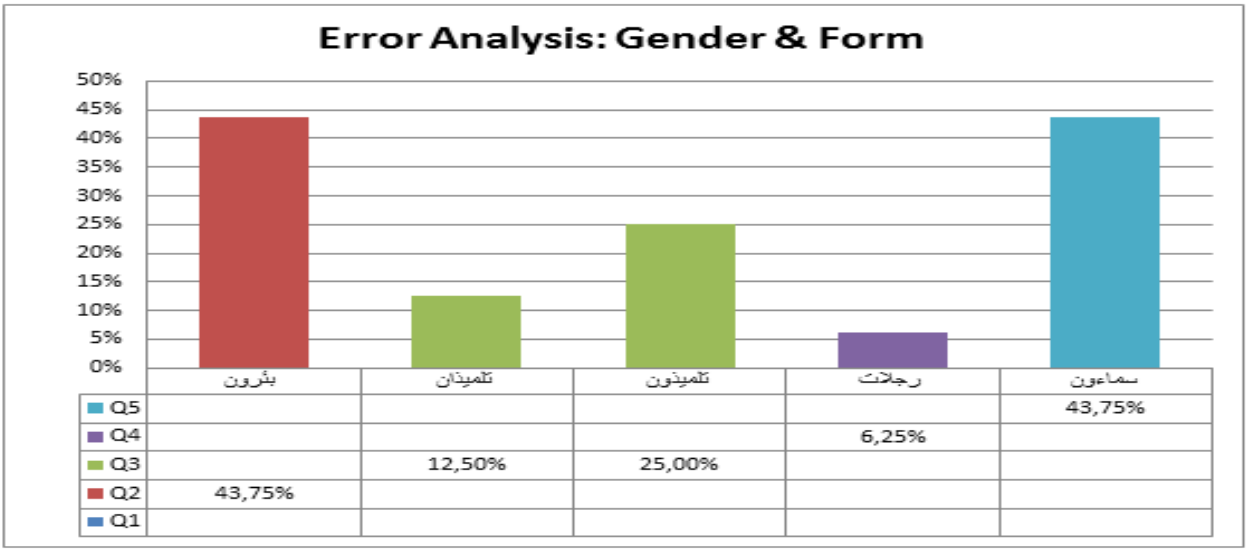
Error Analysis: Singular Form



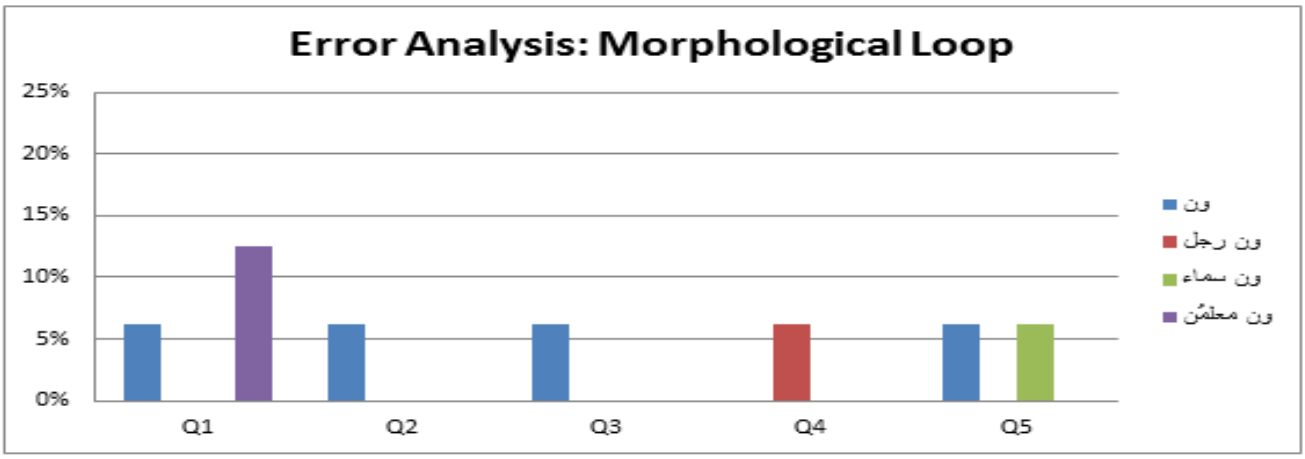
Upon conducting a cross-analysis tabulation of the various variables, the findings reveal a noticeable discrepancy in gender and plural transformation (see figure 31). Gender deviation is explicitly seen in the broken plural forms of "سماءون" and "بئرون" which are feminine nouns with masculine inflections. The same can be said for the word "تلميذون" which was written in the question in the feminine form. Moreover, the form is also deviated in the word "تلميذان " which is in the dual form.

Figure 31

Error Analysis: Gender & Form



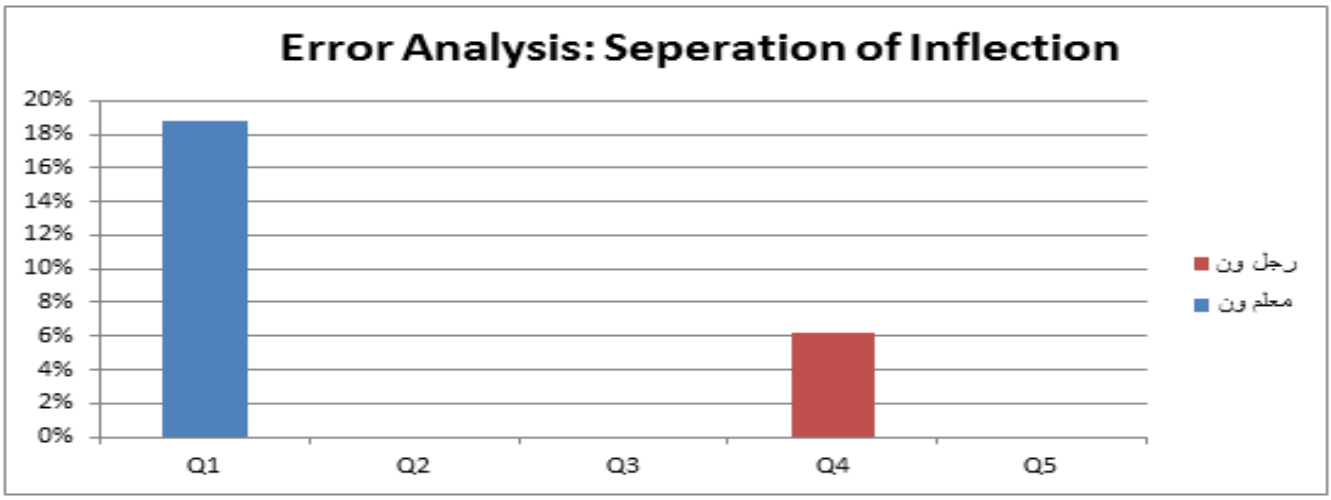
Error Analysis : Morphological Loop



Upon conducting a cross-analysis tabulation, the results reveal a distinct separation of plural inflectional morphemes from the nouns (see figure 33). The aforementioned separation is predominantly observed in questions one and four.

Figure 33

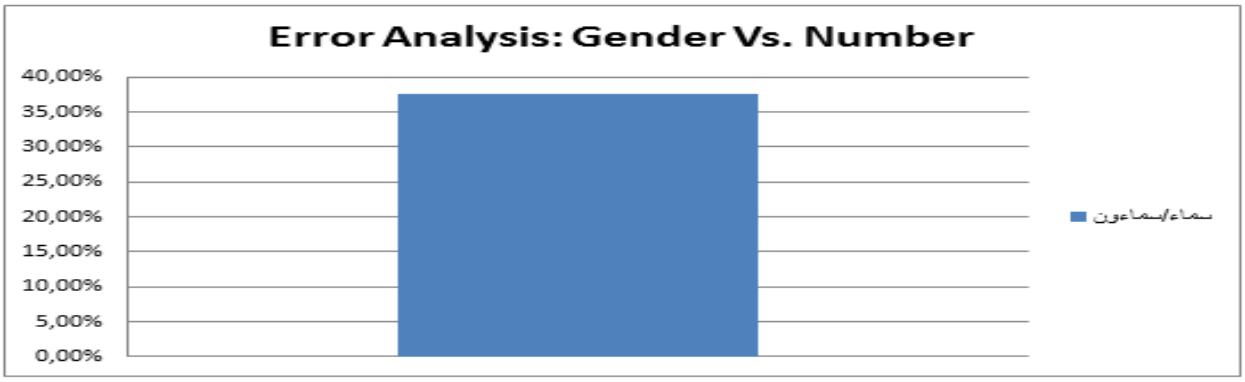
Error Analysis: Separation of Inflection



Upon contrasting the results of the two exercises, it becomes evident that there is a deficiency in the comprehension of gender (see figure 34). The same pupils who choose the word "سماء" to be feminine added masculine inflectional morphemes to indicate the plural form "سماءون" with a frequency of 37%.

Figure 34

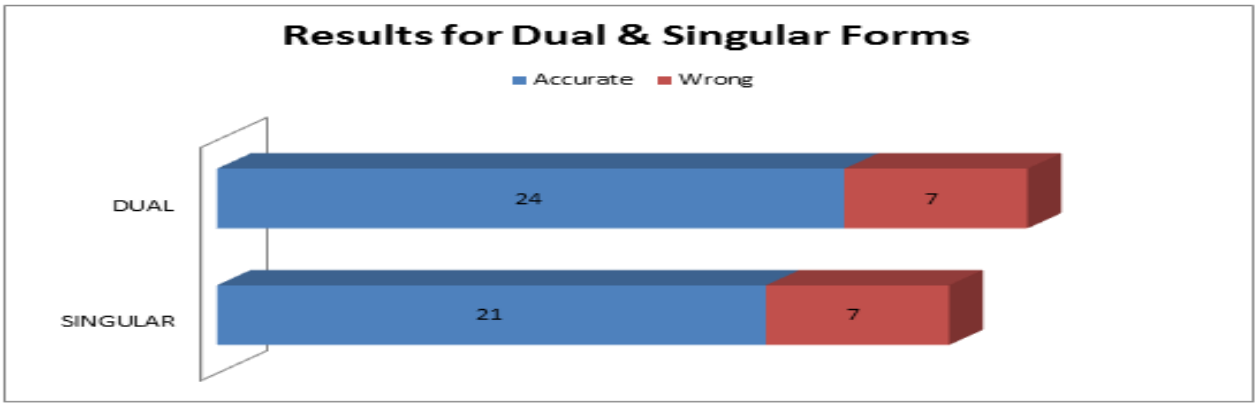
Error Analysis: Gender Vs. Number



Additionally, the results exhibit a small margin of error in dual and singular forms (see figure 35). Some pupils displayed an omission of some phonemes in the written form along with the addition of "ال" in some words especially in the word "تلميذ" . In addition to that, some answers included words that were not given in the exercise. Furthermore, the results demonstrate a higher accuracy score associated with the usage of the dual form.

Figure 35

Dual and Singular Forms

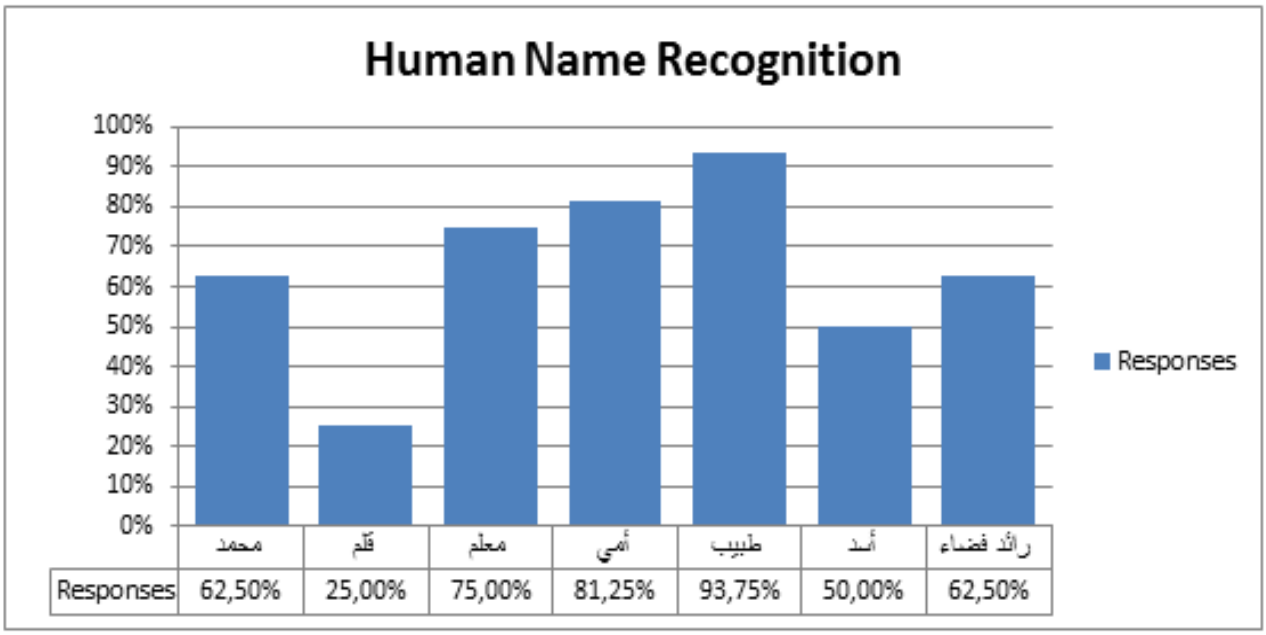


2.4.4.5 Testing the Theme of Comprehension Deficit:

Figure 36 demonstrates a comprehension deficit in recognising human names. This latter is displayed in the erroneous selection of the word "أسد" (a lion) with a frequency of 50% and "قلم" (a pen) with a frequency of 25%. Moreover, some answers include the selection of the word "فضاء" (space) instead of the whole compound noun " رائد فضاء" (astronaut).

Figure 36

Human Name Recognition



2.4.5 Piloting the Observation:

Before undertaking the official sessions of observation, a piloting phase was conducted to count for the same themes discussed earlier. The piloting phase was done at the two schools including all the classes. This latter allowed for a better understanding of the studied phenomenon along with a better preparation of the observation grid.

2.4.6 Observation Analysis and Interpretation:

The analysis of the observation is based on the aforementioned themes in the spontaneous speech production of DS pupils and all collected data is saved in a special repertoire in the database (see appendix S). The observation took place after holidays and all the themes were carefully observed in two different classes. Moreover, Both classes were full

of colourful pictures of letters, days of the week, numbers, seasons, and syntactic rules. In addition, the items present included a mirror, a printer, a microwave, and a fridge. Moreover, the pupils displayed a warm reception, expressing their welcome through embraces and cheerful countenances. They were enthusiastic and started opening conversations with the researcher by telling stories about their last activities. Regarding their behaviour inside the classroom, the majority were lazy, tired, reluctant and easily distracted. The pupils also displayed innumerable pauses between letters when reading.

2.4.6.1 Observing Function Words Omission:

During the observation session, an apparent omission of function words was observed. The pupils were constantly deleting function words both in the dialect as well as the standard form of Arabic. In the second session, the teacher displayed a picture on the board and asked the pupils to name the animals present in the picture. When answering, the pupils rarely used coordinating conjunctions like the word "و" which signifies "and". It is worth mentioning that this particle which is transcribed as /wa/ is a bilabial sound which makes it one of the easiest sounds to pronounce since it does not require the use of the tongue and hence it is not affected by protrusion. However, DS pupils still omit it in their spontaneous speech. Furthermore, other particles like "في", "إلى", "مع" were also observed to be excluded from their speech. For instance, when they were asked by the teacher to state what they have brought with them for lunch they formed phrases like " موز خبز عصير" which signifies "banana bread jus" with no conjunctions. Additionally, when asked to narrate their last activities, answers like " أنا أمي السوق" which signifies "me mom mall" and " أنا الصيف البحر" which designates "me summer beach" were observed where function words were not used.

2.4.6.2 Observing Words Order/Movement:

The pupils exhibited ostensible difficulty when dealing with passive voice sentences. Moreover, when the pupils were presented with direct questions regarding the agent and the

recipient of the action within the sentence displayed on the board, they were able to provide accurate responses. However, they encountered difficulties in comprehending and employing passive voice sentences verbally.

Additionally, The pupils faced difficulties with " الصفة والموصوف" (the adjective and the noun being described) and that is due to the fact that it is hard for them to go back to "الموصوف" (the noun being described) and also in view of the fact that they mix between "به الفاعل والمفعول" (the doer and the object of the action) and the adjective and the noun being described. This occurrence can be attributed to the similarity in word order between these elements within a sentence.

2.4.6.3 Observing Inflectional Morphemes in Verb Conjugation:

The results of the observation showcase that DS pupils suffer from apparent issues with inflectional morphemes when conjugating verbs orally. During the first session of observation, the teacher asked the students to conjugate verbs with different pronouns. It was apparent that the pupils have an eminent difficulty with subject-verb agreement. Only one pupil found that the "أ" in "أراجع" becomes "ت" with "أنت" and that was with the help of the teacher. Moreover, one of the pupils used " دروسنا" (our lessons) instead of "دروسك" (your lessons) with "أنت" (you). Additionally, one of the pupils said that "أنا" should be "نا" instead of "أنت". Another pupil said that "أ" in "أراجع" should be changed to "ن" with "أنت". Furthermore, most of the students were silent and reluctant when asked to replace the pronoun "أنا" (I) with "أنت" (you). Moreover, they exhibited a comprehension deficit of tenses. Only two pupils were able to discern that the verb in "أنا أراجع دروسي" is in the present tense. Additionally, one of the pupils said "تقفز" with a feminine inflectional morpheme referring to the lion which is a masculine noun.

2.4.6.4 Observing Inflectional Morphemes in Nouns Classification:

The pupils displayed observable issues with inflectional morphemes in nouns classification orally. When they were asked if the proper noun“ شكري” is a noun or a verb, they were all silent and hesitated to answer except for one pupil. Moreover, one of the pupils considered the adjective “نشيط” (energetic) to be a verb whereas the rest of the pupils struggled to remember the lesson of adjectives. Additionally, One pupil used the adjective “كبير” (big) to describe his female friend despite the fact that the teacher used the adjective “صغيرة” (small) with the feminine inflectional morpheme to provoke them to find “كبيرة”. Similarly, one of the pupils used the word animal (حيوان) to refer to a group of animals (حيوانات). Besides, one of the pupils selected the noun “ قصة” (a story) when asked to circle the adjective in a sentence and another student claimed the noun “غذاء” (nutrition) to be an adjective. Furthermore, One of the pupils read the adjective“طويل” as “طويلة” in “ جدتي شعرها طويل” showing an ostensible noun-adjective agreement issue.

2.4.6.5 Observing Comprehension Deficit:

During the observation, the pupils demonstrated a comprehension deficit both at the syntactic and the morphological levels. This latter was also discerned in their oral speech production. During the teacher’s efforts to review previously covered material with the pupils upon their return from the holidays, it became apparent that the pupils encountered challenges in recalling the knowledge they had previously acquired. Additionally, most of them were reluctant to read, showing an apparent difficulty with reading. Withal, they did not know how to make pauses between words properly. The same can be said about the unneeded pauses between letters like in the word “ش ج ا ع”. As for “I’rāb”, they tend to remember it with gestures like the accusative sign with hands above their heads and the nominative sign by moving their hands in a round shape next to their mouths. Furthermore, the pupils employed non-verbal gestures to indicate question instructions such as using hand movements to create circular motions in the air. Moreover, during the oral production session, one pupil

erroneously asserted that the lion lives in the house, in addition to that there was a collective hesitation among the pupils when asked whether the lion is a wild or a domestic animal. Furthermore, when talking about the circus, the pupil who recently went to it was participating and she was enthusiastic about it, whereas the rest of the pupils were reluctant. Besides, the teacher read the text with the aid of gestures, pictures and tools and she was constantly explaining new words by performing the action of the word. For instance, the action "ينط = يقفز" (to jump) which pushed the pupils to start participating and imitating the action. The teacher also explained the word "ضخم"(huge) with opening her hands and with simple words like "كبير و سمين". The teacher also explained words like "مخيلة" (imagination) and "مقعد" (seat) with gestures, antonyms, simple terms and dialectal Arabic. Moreover, the teacher was constantly repeating the new words along with their explanations.

Additionally, the pupils exhibited an apparent difficulty with their short-term memory. When the teacher removed the picture from the board and requested one of the pupils to recall all the animals depicted in the picture, the pupil hesitated and expressed that she forgot. Furthermore, when the pupils were asked to write what they saw in the picture, the teacher was dictating the words letter by letter repetitively so that they could manage to write them down. Additionally, they used gestures to remember how letters are written, like the letter "ت" with hands when it is in the middle of a word.

2.4.6.6 Observing Grammatical Related Processes/Operations:

The pupils were observed to use scattered words with no grammatical structures. For instance, they did not use full sentences when describing the picture, instead they used

scattered words like in "كرة،كرة" ,"بماذا يلعب الفيل؟". Additionally, when asked about what the lion was doing, a pupil said "seat" (مقعد) to explain that the lion was sitting on a chair.

2.4.7 Interview Analysis and Interpretation:

The interview underwent a qualitative analysis which involved a structured approach comprising three primary steps. In the initial phase, a thorough word-for-word transcription of the recording was conducted, yielding a comprehensive document spanning 27 pages and comprising a total of 11,473 words. This transcription was securely stored within the aforementioned specialised database (see appendix U).

The second phase consisted of a hybrid meaning coding which resulted in a number of 65 codes (see appendix W). Finally, in the last phase, the gathered codes were classified into 7 categories following a meaning condensation process which led to a thematic analysis that gathered four central themes tightly related to the final research hypothesis (see appendix V).

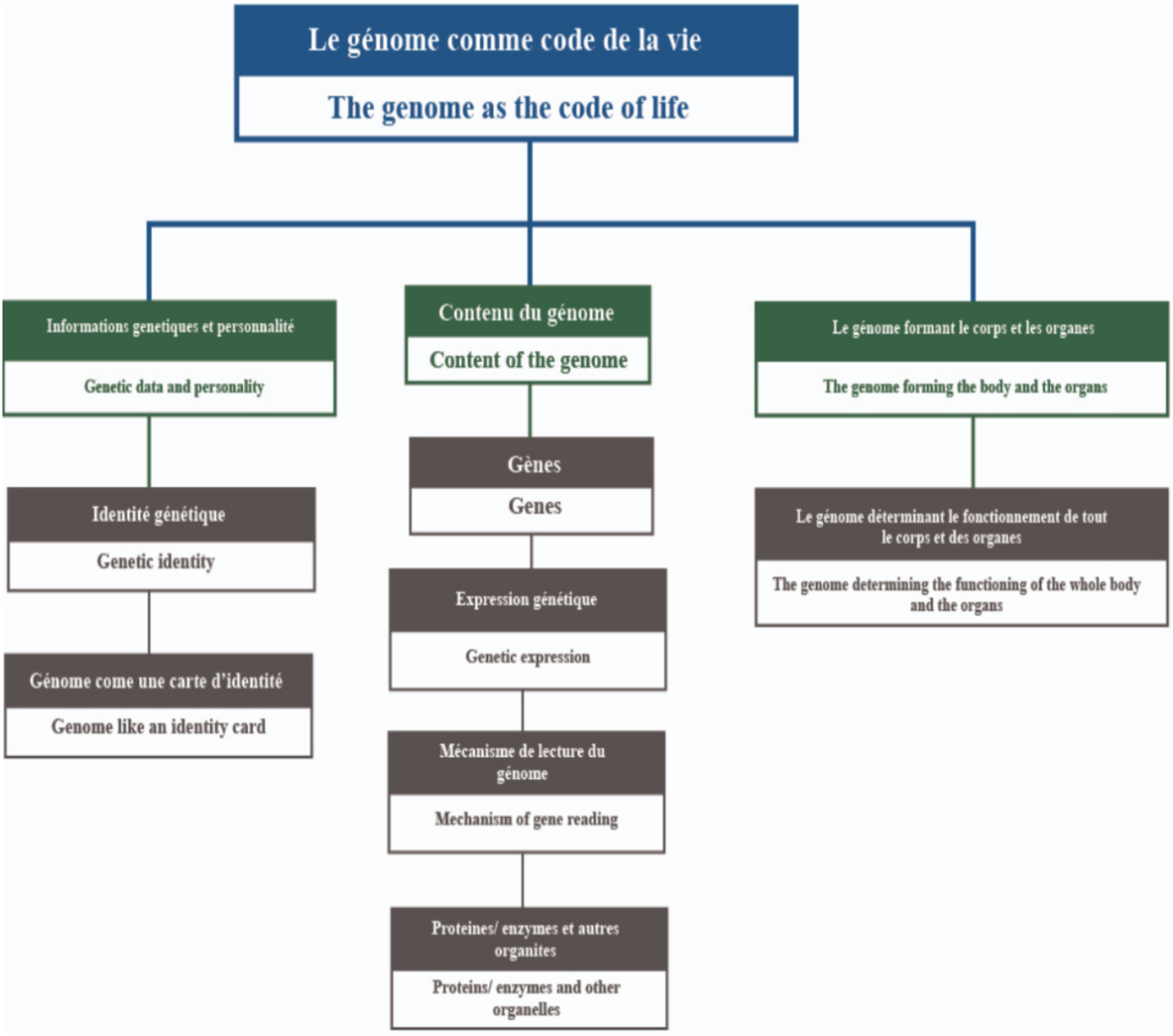
2.4.7.1 Meaning Condensation:

According to the specialist, the genome represents an intricately interwoven system that underlies the development of the human body, encompassing the formation of organs as well as the manifestation of individual traits such as physical appearance and personality (see figure 37). In a profound sense, the genome can be aptly described as the fundamental "code of life" that intricately weaves together the intricate tapestry of human existence. It serves as the und"rlying blueprint that guides the development of the physical embodiment, shaping not only the organs and bodily systems but also moulding the very essence of the individuality, encompassing the distinctive features, outward appearance, and intricate nuances of personality. In addition to that, the geneticist explained that the genome also determines how the body and its organs function whether it be biologically, psychologically or cognitively. Furthermore, the specialist explained that the genome consists of genes that are more or less

expressive according to the organ they regulate and that their understanding requires certain "gene reading mechanisms" such as proteins, enzymes and plethora of other organelles.

Figure 37

Meaning Condensation Categories : The Genome is the Code of Life

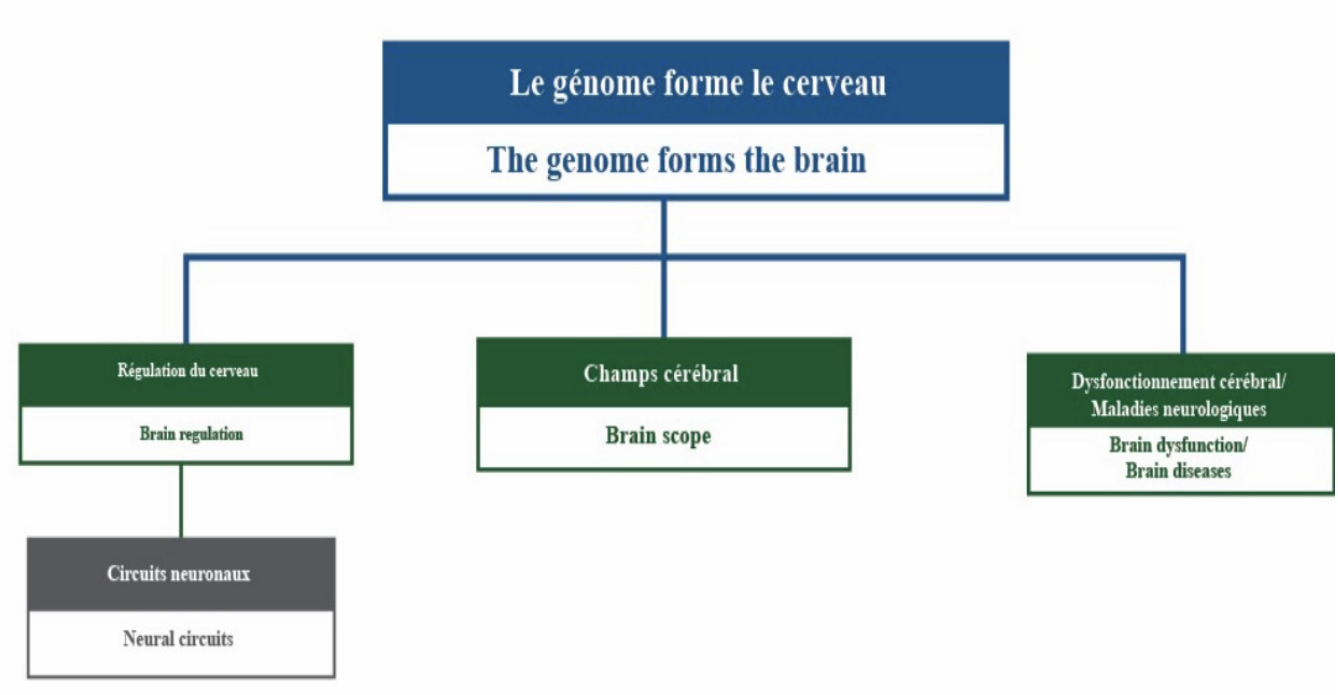


The interviewee eloquently elucidated the pivotal role of the genome in orchestrating the intricate formation of every bodily organ, notably including the remarkable intricacies of

the brain (see figure 38). With its regulatory prowess, the genome governs not only the functional aspects of the brain but also safeguards its intricate development, facilitating the growth of vital neural circuits essential for cognitive processes and overall neurological maturation. In addition to that, the brain scope covers beyond the traditionally referred parts; it also includes the spinal cord and a tremendous number of neural branches which play outstanding roles in keeping the brain function at its best and ensuring the transmission of information through neural transmitters or neural circuits. The geneticist adamantly emphasised the indispensable role of neurotransmitters and other hormones as integral components of the brain's intricate regulatory system. It was underscored that these vital elements are responsible for eliciting the profound range of human sensations, from the shivers of cold to the searing pangs of pain. Without their delicate interplay, the delicate chemistry within the brain risks disruption and imbalance, potentially perturbing the intricate equilibrium essential for optimal cognitive and emotional functioning.

Figure 38

Meaning Condensation Categories: The Genome Forms the Brain

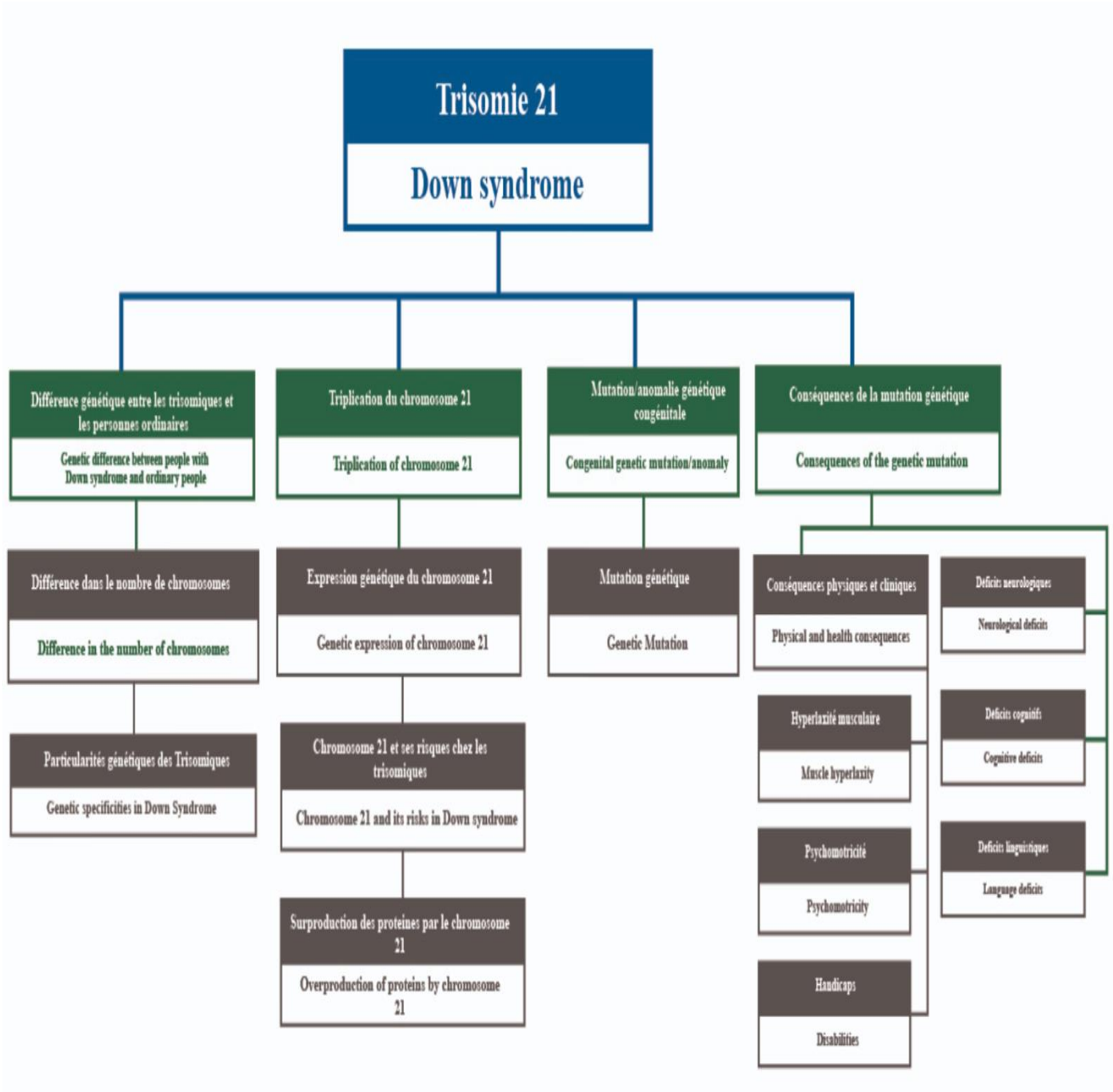


According to the specialist, the genetic anomaly, characterised by the triplication of the chromosome 21 is what makes individuals with Down syndrome different from ordinary people. The specialist drew attention to the profound ramifications of the genetic abnormality expressed within chromosome 21 which can be manifested in an array of health challenges (see figure 39). These encompass not only the potential for heart disease, muscle hyper-laxity, and hormonal deficits but also extend to encompass a wide spectrum of cognitive and neurological impairments. These intricate deficits are comprehensively explored in the upcoming figures, offering a comprehensive understanding of their far-reaching implications and their intricate interplay with overall health and vitality. Hence, it becomes evident that the repercussions of the genetic mutation in Down syndrome significantly impede their language proficiency, as these consequences exert a substantial influence on the essential organs and neurocognitive factors involved in the manifestation of language. The far-reaching impact encompasses the intricate interplay of physiological structures and cognitive processes crucial

for language development, underscoring the challenges faced by individuals with DS in achieving optimal linguistic abilities.

Figure 39

Meaning Condensation Categories: Down syndrome



The geneticist postulated that the anomalies observed within the brain of individuals with Down syndrome are unequivocally attributed to a congenital genetic mutation. This assumption, underpinned by scientific reasoning, supports the understanding that the observed deviations in brain structure and function in DS are a direct consequence of the inherent genetic alteration present from birth (see figure 40). Among these anomalies are the symptoms of a congenital Broca's aphasia which the specialist confirms to be indeed innate or congenital as noticeable in her statement: "In their case, [referring to individuals with Down syndrome] it is not caused by a brain injury, it is congenital. It is, indeed, [the triplication of] their chromosome 21 that caused this aphasia.". As the specialist espoused, these anomalies exert a global impact on the brain, extending far beyond the confines of a singular region. Their pervasive influence pervades the entirety of the brain, intricately altering its structure and functionality on a comprehensive scale. However, the expert added that the congenital Broca's aphasia might not be uniform in all patients since there are individual specificities.

Furthermore, an abnormal synaptic activity or deficit in neural circuits was pointed out by the interviewee. Taking into account the role of the brain in the production of language— its processing and its comprehension— it might be fair to suggest that the anomalies— resulting from the genetic mutation— play a significant role in the linguistic deficits in DS most specifically in grammatical knowledge processing. Besides, she betoned that brain injuries or other abnormalities like that of Down syndrome can affect the neuronal development and at worst, "that can stop the development of the neurones and the brain may stop working properly". Delving deeper into the subject, the interviewee went on to postulate that these brain-related issues can significantly impede memory abilities. The disturbances within the inter-synaptic connectivities, as cited by the expert, form the basis for this assertion. Moreover, the interviewee drew parallels with other conditions such as Alzheimer's

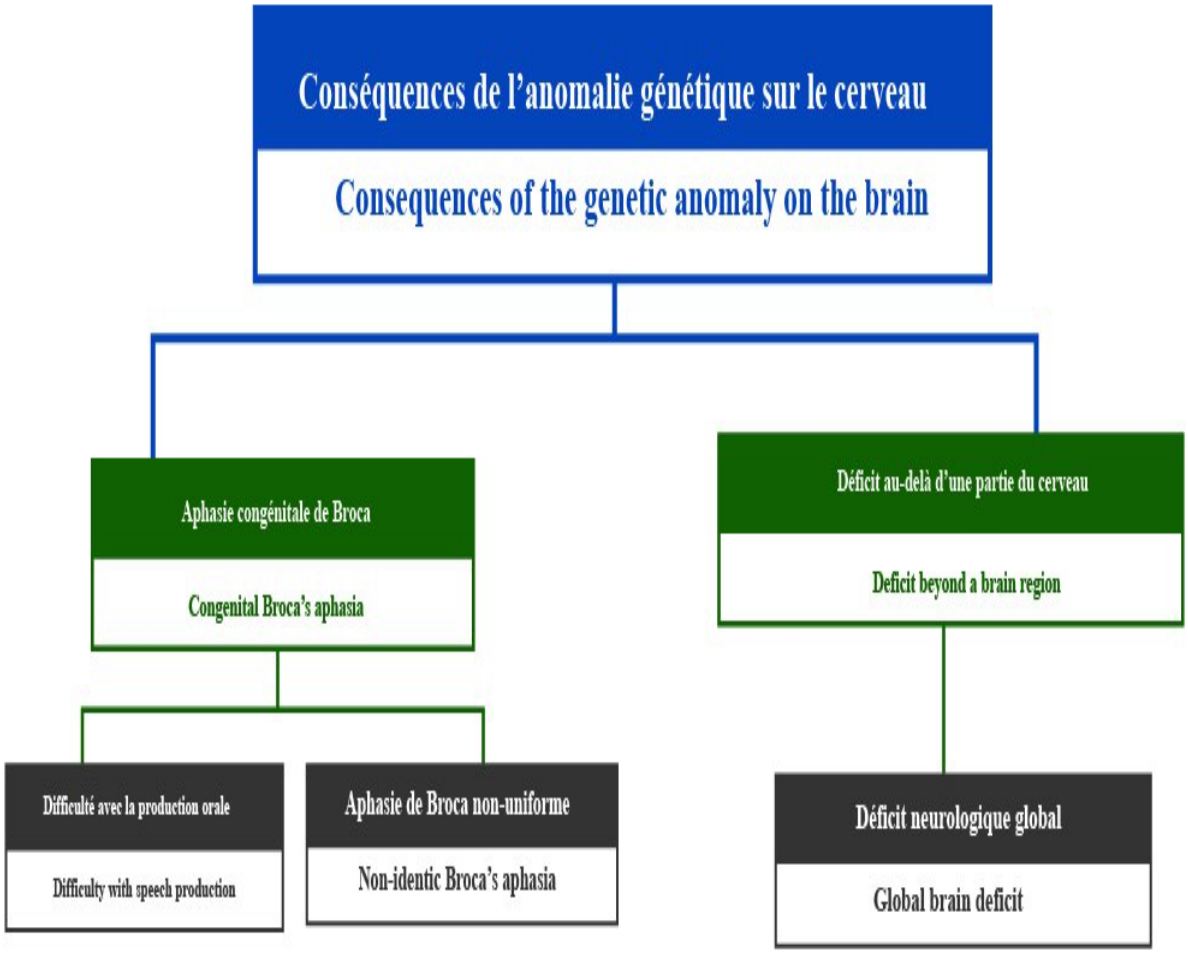
and Parkinson's diseases, wherein similar symptoms are observed, further highlighting the pervasive impact of these disturbances on memory function.

Additionally, the specialist expounded upon the intrinsic correlation between the brain abnormalities witnessed in individuals with Down syndrome and the notable delays apparent in their cognitive abilities. With unwavering conviction, the specialist proclaimed, "This will necessitate a considerable amount of additional time and heightened stimulations for the brain to operate optimally, despite its functional capacity." This profound statement serves as a testament to the far-reaching consequences of the brain abnormalities, elucidating the immense challenges individuals with DS encounter in their cognitive processing speed and overall cognitive development. On top of that, these impairments may play a pivotal role in the presentation of congenital Broca's aphasia that is primarily affecting the left hemisphere of the brain which is closely associated with language processing. The manifestation of this language disorder, characterised by difficulties in speech production and expression, can be attributed to the affected brain region. However, it is essential to recognise that synaptic activities involved in language processing permeate the entire brain rather than being confined to a singular area. Thus, the widespread disturbances caused by the observed impairments likely exert a profound influence on the emergence and manifestation of congenital Broca's aphasia, contributing to the language deficits experienced by individuals with Down syndrome. Lastly, the doctor reiterated the significance of conducting further explorations due to the global nature of brain abnormalities stemming from the genetic anomaly. It was emphasised that additional investigations are imperative to uncover other types of aphasia beyond Broca's aphasia. This arises from the understanding that the pervasive impact of the genetic anomaly on the brain warrants an exhaustive exploration of potential aphasic manifestations. By delving deeper into these uncharted territories, researchers can broaden

their comprehension of the diverse array of language impairments present in individuals with Down syndrome.

Figure 40

Meaning Condensation Categories: Consequences of the Genetic Anomaly on the Brain

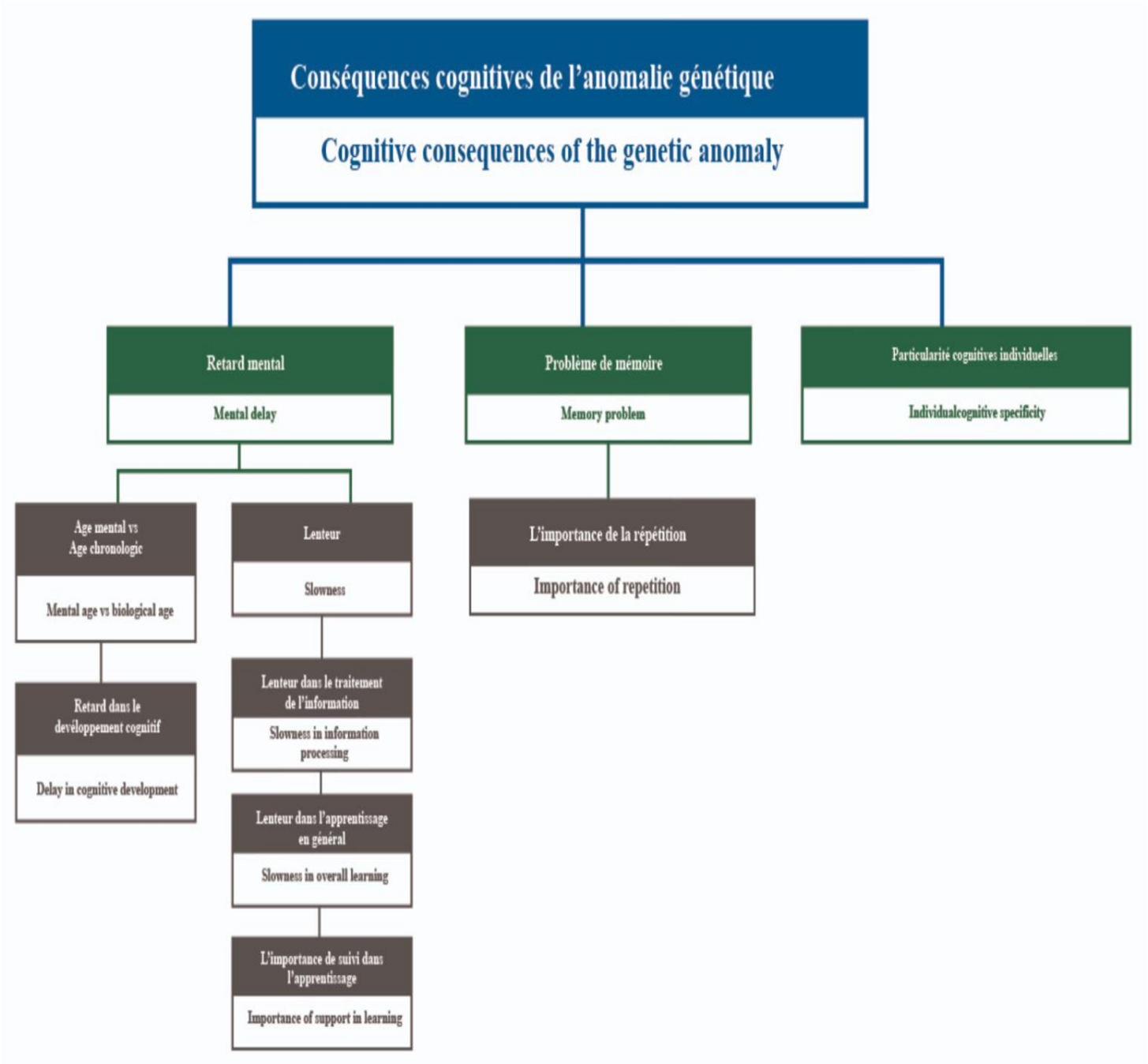


One aspect on which the specialist placed unwavering emphasis is the presence of a "mental delay" in individuals with Down syndrome which exerts a decelerating effect on their cognitive development (see figure 41). This delay encompasses a broader spectrum of learning, encompassing both general educational progress and, notably, language development. As the specialist articulated, "Thus, the educational attainment of a five-year-old child with Down syndrome may closely resemble the babbling stage of language

development observed in typically developing two or three-year-old children.". In essence, this highlights the discernible disparity between the mental age and the biological age of a child with DS, underscoring the need to consider this fundamental distinction when assessing their developmental trajectory. The specialist posits that this delay is an additional repercussion stemming from the genetic anomaly inherent in Down syndrome. It is postulated that the presence of the genetic anomaly contributes to the observed cognitive deceleration, resulting in the developmental disparity experienced by individuals with DS. By attributing this delay to the underlying genetic anomaly, the specialist sheds light on the intricate interplay between genetic factors and the cognitive trajectory in DS, further deepening the understanding of the condition. In addition to that, the geneticist pointed out that the deficits in the long-term, short-term and working memories are also another sign of the cognitive impairment. As an illustrative example, it is suggested that the challenges observed in short-term memory among children with Down syndrome could account for their need for frequent repetition. Likewise, the sluggishness in language processing experienced by these individuals may be intricately linked to deficits in the working memory. By making this insightful connection, it becomes evident that the impaired short-term memory and working memory capabilities within the cognitive profile of individuals with DS contribute to their unique learning needs and the pace at which they absorb and process linguistic information.

Figure 41

Meaning Condensation Categories: Cognitive Consequences of the Genetic Anomaly

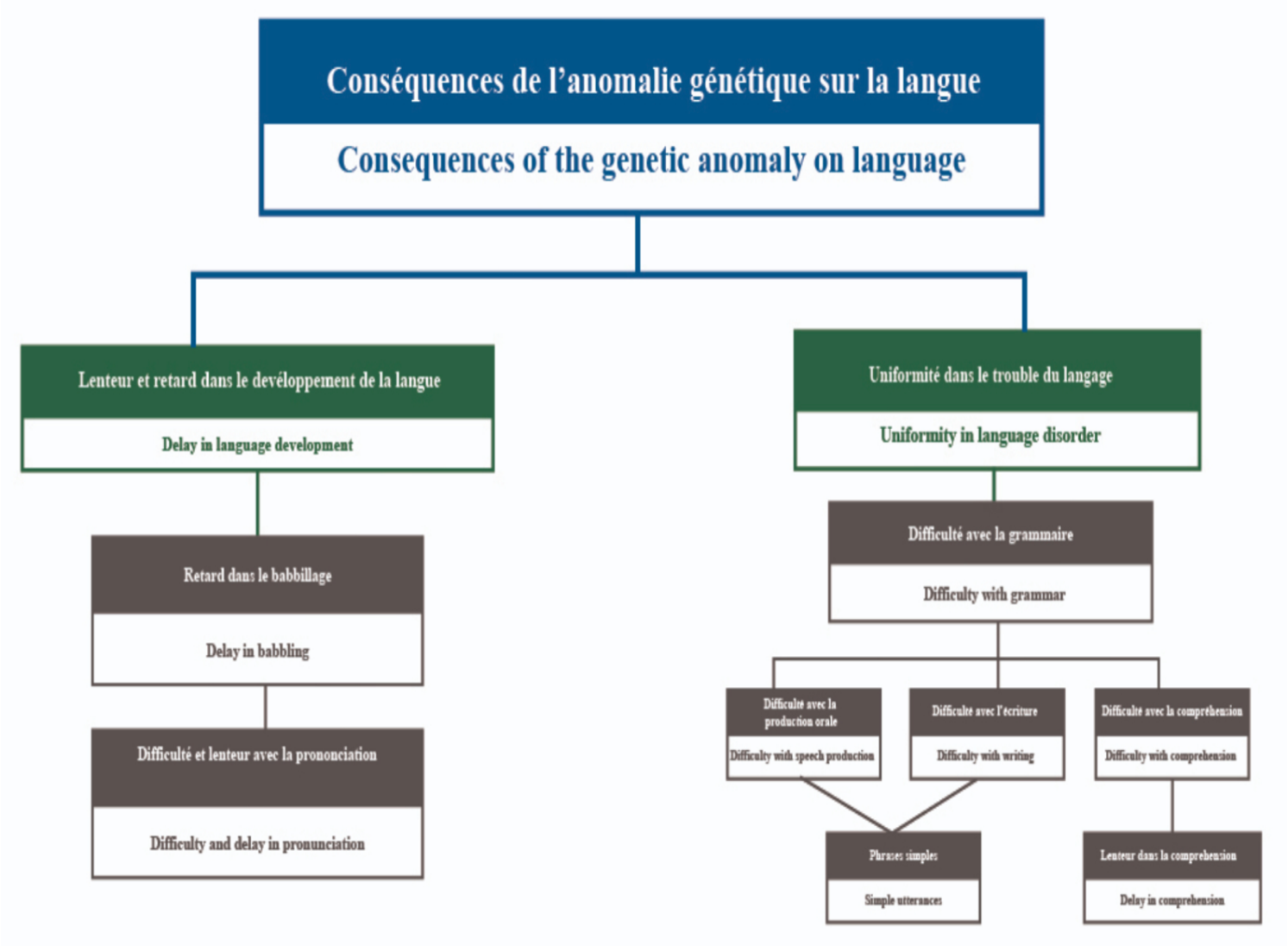


Regarding the language deficits observed in individuals with Down syndrome, the specialist affirmed that these impairments are indeed attributable to the underlying genetic anomaly (see figure 42). The convergence of these deficits across various languages further supports this assertion. As the specialist succinctly stated, “It is unequivocally due to their

anomaly". This resolute statement underscores the direct link between the genetic anomaly and the pervasive language difficulties experienced by individuals with DS. Furthermore, the expert affirmed that the delay in language development, coupled with the challenges pertaining to language production, including writing, and the comprehension of complex syntactic structures such as passives, along with deficits in grammar, particularly affecting inflectional morphology, are all additional consequences arising from the underlying genetic anomaly in Down syndrome. This might be related, according to the geneticist, to the constant use of simple and short utterances.

Figure 42

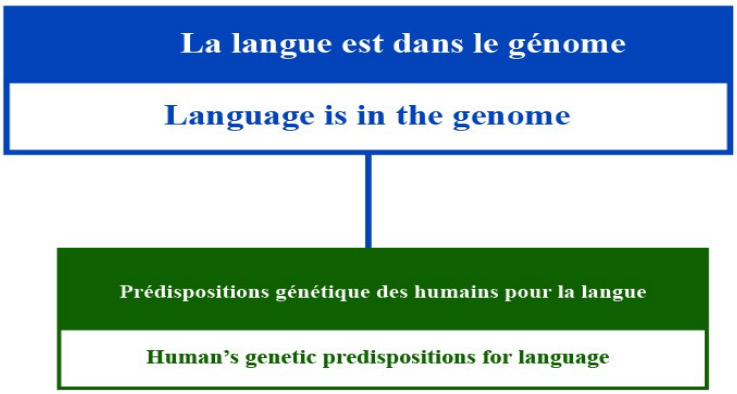
Meaning Condensation Categories: Consequences of the Genetic Anomaly on Language



When questioned regarding the possibility of hypothesising the inclusion of the language faculty within the genome, the geneticist responded with a thought-provoking assertion: "Language may indeed be a significant part of the genetic system". This insightful remark emphasises the geneticist's recognition of the potential influence of our genetic makeup on the intricate nuances of language (see figure 43). In support of this statement, the specialist offered a compelling perspective. The expert affirmed that every human being possesses inherent genetic predispositions for language acquisition from the moment of birth. Furthermore, the interviewee acknowledged that external factors also play a crucial role in shaping and nurturing these genetic predispositions. However, in the case of Down syndrome, the genetic anomaly disrupts the delicate equilibrium of these inherent genetic predispositions for language. As the specialist suggested, the presence of the genetic anomaly in DS introduces disturbances to these fundamental genetic foundations, hindering the typical development and expression of language abilities. This profound insight underscores the intricate interplay between genetics, external influences, and the nature of language acquisition, shedding light on the specific challenges faced by individuals with DS in their linguistic journey.

Figure 43

Meaning Condensation Categories: Language is in the Genome

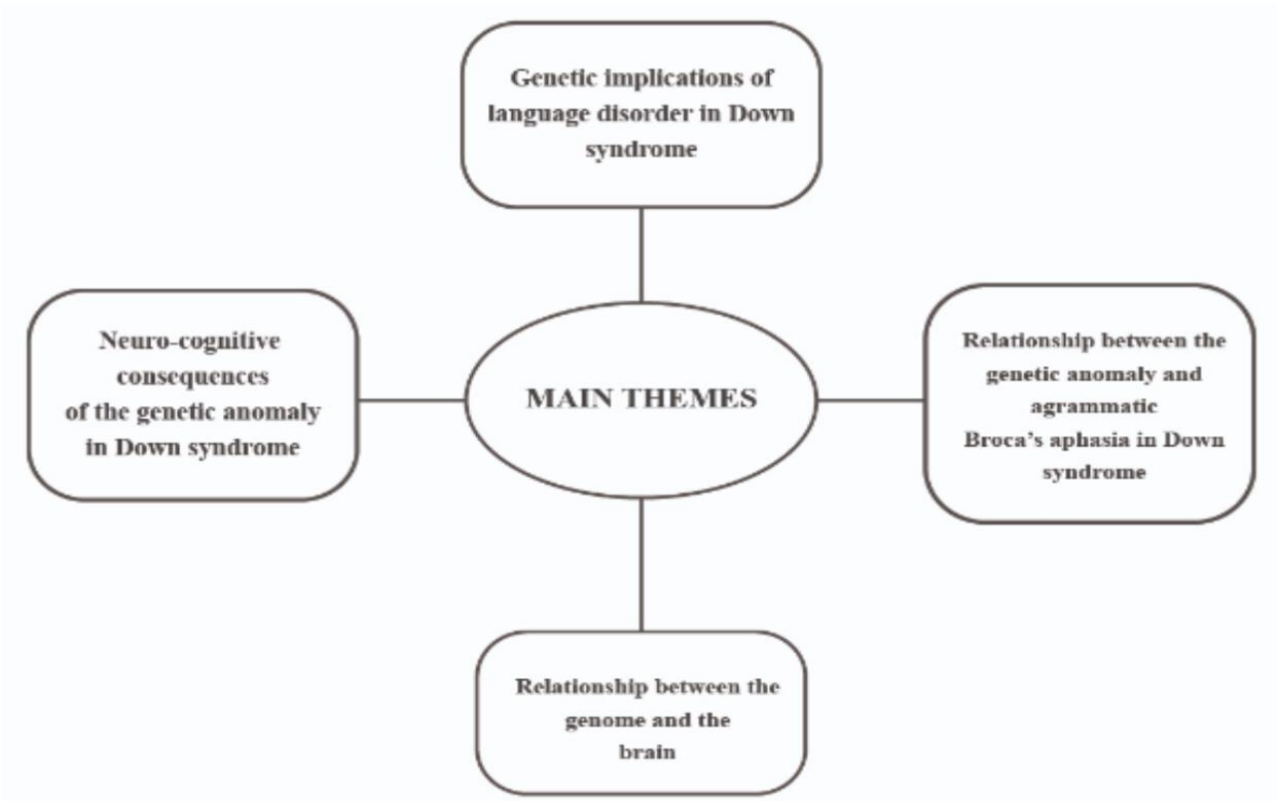


2.4.7.2 Thematic Analysis:

The meticulous thematic analysis conducted following the delineated categories yielded four paramount themes (see figure 44). These themes serve as a vivid portrayal, capturing the profound genetic implications intertwined within the linguistic manifestations observed in individuals with Down syndrome, as extensively discussed throughout the interview. Thus, their significance cannot be understated, as they play a pivotal role in substantiating the final hypothesis put forth by the present study. By illuminating the intricate relationship between genetics and linguistic outcomes in DS, these central themes contribute invaluable insights that bolster the overarching research hypothesis.

Figure 44

Main Themes



2.5 Discussion of the Main Results:

Upon the completion of the data analysis and interpretation phase, it can be formally stated that the collected data demonstrate conformity to all utilised instruments and corroborate the earlier findings of other research.

2.5.1 The Agrammatic Representations of Children with Down Syndrome Prevail in Arabic:

In the light of the data collected, it is safe to confirm that the agrammatic representations of Broca's aphasia prevail in Algerian DS children. Proceeding from the assertions made by the teachers during the interviews, it can be postulated that DS pupils encounter a myriad of complications pertaining to the morpho-syntactic aspects. Therefore, the assumptions made by the psychologist regarding the fact that down syndrome children suffer from issues with their short term memory proved to be right. Moreover, the results of the most frequent words in the interviews (see figure 18) conform to the results obtained from the test (see section 2.4.4.4) in which the terms "memorisation" and "repetition" prevailed as the most repeated words. Furthermore, some pupils gave accurate answers orally but wrote defected answers in the test. Additionally, it is pertinent to highlight that the pupils with DS demonstrated a discernible pattern in their responses, specifically within the realm of the morphological loop. Notably, they encountered challenges in recalling the precise positioning of morphemes within the given words. (see figure 32). This latter was also discerned during the observation sessions (see section 2.4.6.5) where the teacher was observed to dictate the words letter by letter repetitively and with the help of gestures that act as references on how a letter should be written. In addition to that, the pupils demonstrated a conspicuous difficulty when called upon to verbally reproduce the animals depicted in the picture subsequent to its removal by the teacher. The aforementioned deformity is linked to a decline in the capacity of the hippocampus and the temporal lobes (Pinter et al., 2001). Hence, visual aids are

noticeably used in the learning process (Kay-Raining Bird et al., 2004). Moreover, this decline seems to provoke problems in retrieving previous information in addition to problems in employability. Both of which are highly linked to impairments in the working memory (Baddeley, 2007; Buckely and Le Prévost, 2002). On top of that, the pupils were observed to face apparent challenges when remembering previously acquired knowledge (see section 2.4.6.5). This latter conforms to results obtained from the test in addition to the fact that the researcher had to explain the exercises for the pupils individually. This problem of information retrieval was explained by Flórez to be related to the long term memory which accordingly decreases the ability of pupils in remembering stored words (1999). This struggle in recalling words was tackled by the teachers in the interviews where it was linked to the poor Arabic linguistic repertoire of the pupils (see figure 11). It was also linked to their poor ability in providing synonyms and antonyms in addition to their restricted comprehension of non-familiar and abstract words like spiritual concepts (see figure 8). This last concord with the test results that demonstrate a comprehension deficit in recognising human names(see figure 36). Additionally, the test results conform to the observation findings in that the same deficit was observed (see section 2.4.6.5). The teacher was repetitively observed to use gestures, tools and even the dialect in explaining new and unfamiliar terms. This conforms to previously stated conclusions that DS children face challenges with abstract terms both at the level of comprehension and usage (Lorusso et al., 2017). On top of that, it was also observed that DS children display an apparent poverty of Arabic lexical storage (Djellat and Benaouata, 2020; Nasri, 2020: 50). This apparent poverty is more evident in Arabic for the contradictory notion that DS children pertaining to Arabic— which is widely acknowledged for its vast vocabulary and linguistic depth thanks to derivation, still face a shortage in their lexical stock.

Moreover, DS children are proved to have illustrious issues with inflectional morphemes in nouns classification in Arabic. This later was first stated by the teachers during

the interviews (see figure 9) where they claimed that the pupils face problems with the feminine, masculine and plural forms. This was in accordance with the test results (see section 2.4.4.4) where a discerned deficit in feminine forms was exhibited especially in words with no feminine sign at the end (see figure 27). Additionally, the same deficit was noticed during the observation sessions where the pupils used masculine adjectives to describe feminine nouns (see section 2.4.6.4). This can be linked to their difficulties with bound inflectional morphemes which they fail to comprehend (Comblain and Thibault, 2009; Laws and Bishop, 2003; Menn and Obler, 1990a). Moreover, and as stated earlier, DS pupils are said to have apparent difficulties with plural forms. This latter was found in the test results where the pupils were asked to transform singular nouns into plural form. The results exhibited ostensible problems of overgeneralisation especially with broken plural forms (see figure 29) and the separation of inflectional morphemes (see figure 33) in addition to an impairment with gender and form (see figure 31). This last was also seen in the observation session where pupils were observed to omit inflectional morphemes in plural nouns (see section 2.4.6.4). The same deficit was also observed by Mashaqba and his colleagues where DS children opted for singular forms instead of plural ones (2020). On top of that, the pupils showcased a deficit in comprehending human nouns. This was first stated by the teachers who claimed that the children are not aware of the different meanings of nouns and what they refer to (see figure 9). This was also found in the test results where the children exhibited the aforementioned problem (see figure 36). All the above mentioned points intensify the fact that DS pupils are merely remembering rules that are overgeneralised. This was stated by the teachers who claimed that DS children memorise the rules with no understanding of their meanings (see figure 12) the thing that was equally observed in their classes (see section 2.4.6).

Furthermore, DS pupils are found to have eminent issues with inflectional morphemes in verbs conjugation and understanding. Data gathered from the teachers stated that the pupils

struggle with tenses and their inflectional morphemes. Additionally, They are said to have problems in understanding that the word which they are conjugating falls under a specific category called verbs. Therefore, they fail in realising that this verb requires an action, more intensively in the past tense. This last was also discerned by Abu Khadra who claimed that Arabic-speaking subjects with DS have difficulties in naming action verbs, mainly those with inflectional morphemes (2013). On top of that, the teachers claimed that the pupils are constrained by mere rules which they memorise with the aid of gestures (see figure 14). This led the terms “rule” and “constraint” to be one of the most frequent words in the interviews (see figure 18). All the aforementioned issues conform to the test results where the pupils failed to recognise the present tense verbs (see figure 22). Additionally, the pupils selected fallacious words ranging from different categories including nouns and particles (see figure 23). Furthermore, when asked to conjugate a verb with two pronouns, they exhibited an apparent issue with the inflectional morphemes related to the past tense. (see figure 24). The most frequent error types of this latter were the stem form and the separation of inflections followed by subject-verb agreement problems (see figure 26). This last problem was equally observed during their sessions where the pupils were unable to conjugate verbs accurately, the thing that defies the principles of government (Chomsky, 1995). The same problem of gender-number agreement deficits in verbs was noticed among Algerian DS subjects (Djellat and Benaouata, 2020). As for the stem form, it is said that DS children tend to use verbs in the infinite form (Friedmann, 2002; Grodzinsky, 2000; Penke and Wimmer, 2020) the thing that was also observed by Djellat and Benaouata where Algerian subjects used the infinitive form (2020). Moreover, the pupils displayed a comprehension deficit of tenses (see section 2.4.6.3). This latter aligns with the TPH hypothesis that is based on data gathered from Hebrew speaking agrammatic aphasics who presented an impaired tense inflection (Friedman and

Grodzinky, 1997). Additionally, many studies on German, Hebrew and Greek ended up showcasing the same findings (see section 1.5.1).

Furthermore, it is noteworthy to highlight that DS pupils unequivocally encounter substantial challenges when it comes to comprehending and effectively employing the passive voice in the Arabic language. The teachers explained during the interviews that the pupils have significant problems with ordering words in sentences which project their deficiencies in differentiating syntactic categories (see figure 13). Moreover, the psychologist and the teachers stated that DS children have a colossal problem with understanding and using passive voice both in their production and comprehension. This latter was also discerned in sentences with verb movement and other non-canonical structures linked to binding (Frizelle et al., 2019; Grodzinsky, Gavarró and Dotti, 2013; Penke and Wimmer, 2020). The above-mentioned issues concord with the test results in which the pupils exhibited inaccurate understanding of the doer and the receiver of the action which showcases their linear thinking (see section 2.4.4.2). This linear strategy was observed to come against the theta principle of Chomsky (1986, 1995). This was equally observed in their spontaneous speech production where the pupils were unable to understand the accurate meaning of the sentences despite their ability to answer direct questions on the doer and the receiver of the action. It is important to underscore that the observed challenges experienced by DS pupils in comprehending and employing the passive voice in Arabic were exclusively mitigated through the presence of written sentences provided alongside the instructional material. This last was equally perceived in a study by Prahl and Schuele where DS children displayed a poorer understanding of read short passages which suggest that listening comprehension is more like an obstacle to reading comprehension (2022). Furthermore, other researchers like Mauner, Fromkin and Cornell hypothesised that the said comprehension deficit is linked to an impairment in the inauguration of the structural relationships between the moved elements

and their traces (1993). Additionally, during the observation, the pupils demonstrated a confusion between the different parts of speech which have the same syntactic order (see section 2.4.6.2). According to Grodzinsky, the movement of the object from its position is linked to Broca's aphasia where the trace with the constituent is deleted (1984, 2000). Ergo, the stated agrammatism is linked to TDH where the pupils are observed to activate the linear default strategy in assigning roles in sentences (see section 1.5.3.3).

Withal, one of the most discerned issues that Arabic DS pupils face is the omission of function words. The teachers along with the psychologist stated that function words, including conjunctions and prepositions are being omitted by the pupils both in the standard form and in the dialect (see figure 15). The said omission was also noticed in Nasri's study where the majority of Algerian DS subjects dropped function words in their production (2022). Furthermore, The interviewees' claims conform to the test results in which an ostensible deficiency was observed. The results showcased a deviated usage of scattered function words (see section 2.4.4.1). Moreover, during the test, the pupils exhibited an irritated behaviour caused by their confusion about the role of the function words claiming the sentences to be complete without them. Additionally, during the observation, the pupils displayed an omission of function words both in the dialect and in the standard form of Arabic. On top of that, they rarely used coordinating conjunctions and their speech was rather incoherent with the use of scattered words and with no grammatical structure (see section 2.4.6.1). This latter was also observed by a plethora of researchers who claimed that this omission resulted in a speech full of telegraphic uncoordinated utterances with the mere use of lexical words (Buckley, 1993; Comblain and Thibault, 2009; Eadie et al., 2002; Menn and Obler, 1990a). Thus, indicating a deficit in the X-Bar principle (see figure 3) which is characterised by the impossibility of projecting functional words. Furthermore, during the observation sessions, the use of the above mentioned scattered words led to an apparent reduction in the sentence

length (see section 2.4.6.6). This last was also observed by a number of researchers who claimed that this has a tremendous impact on limiting DS subjects' communication (Acharya and Wroten, 2022; Buckley, 1993; Menn and Obler, 1990a; Rondal and Comblain, 1996; Tager-Flusberg et al., 1990). Additionally, Caplan's theory on the Lexical-Node hypothesis claims that agrammatic Broca's aphasics cannot produce syntactically correct structures for they rely only on lexical items (1985, 2006). What is even more enthralling is the assumption of Ouhalla that agrammatic aphasics are indeed unable to access their storage of functional categories which is supposed to be an innate ability (1993).

Based on the preceding discussion and the accumulated findings, it is evident beyond dispute that the Arabic language possesses an unequalled capacity for effectively projecting the aforementioned issues, surpassing any other language in this regard. The comprehensive analysis of the matter at hand reveals that Arabic, with its distinct linguistic attributes, excels in articulating and encapsulating the complexities and nuances of DS subjects in a manner that is unparalleled by any other linguistic medium. This latter is for its complex morpho-syntactic structure (see section 1.6.1 and 1.6.2) in addition to the fact that it is characterised with declension which is not the case of isolating languages. Furthermore, the aforementioned specificities are pervasive throughout various facets of Arabic grammar encompassing conjugation patterns and case declensions (see section 1.2.1). Arabic conjugation stands as a testament to the language's grammatical intricacy and precision. The system of verb conjugation in Arabic entails a comprehensive array of patterns and affixes that reflect not only tense but also voice, mood, and person. This inclusive conjugation system allows for a remarkably nuanced expression of verbal actions and states, capturing subtle nuances that may remain elusive in other languages. Moreover, Arabic's system of cases further illustrates its linguistic sophistication and expressive power. Arabic nouns, pronouns, and adjectives are inflected for case, which serves to indicate their grammatical roles and relationships within a

sentence. Additionally, the three primary cases, namely nominative, accusative, and genitive, enable the language to convey not only syntactic information but also semantic nuances, such as definiteness, possession, and specification.

2.5.2 The Agrammatic Representations of Children with Down Syndrome Defy the Core Principles of Universal Grammar:

Carrying on the data discussed in the previous section, the agrammatic representations exhibited by DS pupils defy the core principles of Universal Grammar. UG includes specific principles and parameters synchronising the use of internalised language constituents including verbs, nouns, function words along with morpho-syntactic rules such as inflectional and derivational morphemes. In addition to that, the rich lexical repertoire is equally a part of UG. (Cook and Newson, 1996; Chomsky, 1986; Guasti, 2002; Ouhalla, 1994; Stromswold, 2000). According to Chomsky's nativist approach, children possess a rich language even before starting formal education (Chomsky, 2014). This latter is not the case for DS children who suffer from a very poor lexical stock. Moreover, under the umbrella of UG parameters, there are many sub-theories tackling the deep and surface structures. This last is said to be one of the eminent principles of UG in which the D-structure covers the unseen syntactic level rooted in the mental lexicon whereas the S-structure stands for the projected form of the D-structure by use of movement transformation (Cook and Newson, 1996; Chomsky, 1957; Ouhalla, 1994; Penke, 2015). Hence, the knot between the two levels serves as syntactic traces when a sentence is subjected to movement (Cook and Newson, 1996). Nevertheless, this principle is defied by DS children who have ostensible defects in the S-structure (Penke, 2015). This can be seen in the results gathered from the test (see section 2.4.4) where the pupils presented severely impaired morphosyntax. In addition to that, this latter was also discerned in their spontaneous speech production during the observation sessions (see section 2.4.6).

Furthermore, the movement theory is one of the principles of UG that are highly linked to the aforementioned principle. It encompasses the displacement of constituents leading to the building of non-canonical structures which are problematic for DS pupils (see section 1.2.1.2). A perfect instance of the movement theory is the passive voice which was observed to be impaired in the pupils' answers (see figure 20). It was also observed in their spontaneous speech production where the pupils were unable to use and to understand the passive constructions (see section 2.4.6.2). The above mentioned results exhibit the defiance of the movement theory principle by the linear strategy used by DS pupils which, in this regard, seem to come against the theta theory. Additionally, the lack of traces is the reason behind the comprehension deficit observed in DS pupils especially with non-canonical structures (Friedman, 2002; Grodzinsky, 2000; Penke, 2015; Wimmer and Penke, 2020; Witecy, Wimmer and Pinker, 2017).

Regarding the semantic relationship between parts of sentences, which is another concern of syntax (Cook and Newson, 1996), the Theta theory plays a major role in indicating who does what to whom (see section 1.2.1.4). This latter was observed to be impaired in the test results (see figure 20) along with the observation sequels where the pupils used the default linear strategy in assigning semantic relationships. This latter is intensively discerned in non-canonical structures (Wimmer and Penke, 2020).

Withal, the X-bar theory is equally an important principle of UG since it stands for the syntactic categories which project different heads that are taken from the mental lexicon (Chomsky, 1995). However, the test results showcased an apparent impairment with noun phrases (see section 2.4.4.4), verb phrases (see section 2.4.4.3) in addition to observable defects of functional heads projection (see section 2.4.4.1). This last was also observed in their speech production both in the dialect and in the standard form of Arabic. Ergo, the pupils were observed to omit prepositions and coordinating conjunctions which was claimed in

several studies to lead to an incoherent discourse (De Bleser and Bayer, 1991; Ouhalla, 1993). The aforementioned results display the DS pupils' elusion from the said principle.

Moreover, the Government theory is another crucial parameter for it indicates how the governing element influences the governed one (see section 1.2.1.5). However, the observation results displayed a problem in the adjectives and their governing nouns in Arabic (see section 2.4.6.2). In addition to that, the test results exhibited a deterioration in the subject-verb agreement (see figure 26) which falls under the Case theory that is concerned with tense inflections in verbs. Moreover, the omission of the inflectional morphemes in nouns classification and in verbs conjunction are two of the main themes of this research that were also observed by other researchers to be highly impaired in individuals with Down syndrome (Grodzinsky, 1984; Laws and Bishop, 2003; Menn and Obler, 1990a; Penke, 2008, 2015).

Within the framework of Universal Grammar, the Pro-drop or Null Subjects parameter represents a fundamental constraint that accounts for grammatical variations across languages. It simply determines whether a language tolerates the dropping of the subject (see section 1.2.1.6). In Arabic, it is possible to hide the subject in certain situations while keeping the syntactic and the semantic structures of the sentence. This latter denotes that in Arabic, DS children face more challenges in verb conjugation (see section 2.4.4.3). This explains the big number of inflectional morphemes escorting verbs in Arabic which is not the case in other languages, for Arabic is a declinable language. In other words, the subject is hidden but it showcases itself through the inflectional morphemes which indicate case, number and gender.

Furthermore, DS pupils flout the arguments stated by Chomsky and his followers in their quest to defend UG. One of the main arguments is the poverty of stimulus along with the negative evidence which both cover the ability of children to acquire complex grammatical structures and linguistic knowledge from a humble exposure to incomplete input

(see section 1.2.1). In addition to that, it highlights the importance of feedback and corrective information that the children receive. Nevertheless, DS pupils defy this argument for they have a very limited grammatical knowledge (see section 2.5.1). According to Chomsky, children appear to possess an innate ability to recognise agrammatic patterns (1995). However, as stated in the previous section, DS pupils are unable to spot grammatical mistakes since they have the distinction of being the initial perpetrators of them. Therefore, this indicates that DS children lost this innate, subconscious ability tackled under the term Universal Grammar. Conversely, the universality is unwaveringly present in the agrammatic representations of Down syndrome children. Observing the same difficulties and issues present in other languages like English, German or Hebrew in Arabic is supporting the assertion that there is, in fact, one single underlying system of all human languages (Chomsky, 2008). This latter can be subject to alteration in stating that the universal agrammatic representations of children with DS is indeed, another proof of the Universality of grammar.

2.5.3 The Anomaly in the Genome is Responsible for Language Disorders in Down Syndrome Children:

Based on the two previous sections, it became eminent that Arabic subjects with DS demonstrate comparable anomalies in the morpho-syntactic structure, mirroring those observed in other languages. Namely, English (Laws and Bishop, 2003; Menn and Obler, 1990a), French (Comblain and Thibault, 2009), Hebrew (Grodzinsky, 1984), Malayalam (Nandhu et al., 2015), Japanese (Koizumi et al., 2020) and Brazilian Portuguese (Fortuno-Tavares et al., 2015). These anomalies defy the core tenets put forth by Chomsky which assert that innate language abilities are inherent in all children. On the contrary, they present universal agrammatic representations that deviate from the anticipated linguistic patterns. In line with Chomsky's assertion that the child's acquisition of grammar and language knowledge

is a result of the interplay between innate principles that are genetically determined and the accumulation of experiences throughout their development (Chomsky, 1980), it is evident that the deficits faced by DS children are a projection of the anomaly in their genome. Furthermore, as previously stated, the notion of universality remains intact, albeit with a shift in its trajectory. While Chomsky's framework initially emphasised the innate and universal principles guiding language development, the anomalies found in individuals with Down syndrome highlight a different aspect of universality.

Moreover, when pondering the fundamental distinction between individuals without Down syndrome and those with DS, one factor emerges as the undeniable differentiator: the genome. It is within the intricate structure of their genetic makeup that the key disparities lie. The presence of an additional copy of chromosome 21 in individuals with DS gives rise to unique characteristics and challenges that set them apart. By delving into the realm of genetics, a captivating narrative of how the genomic blueprint shapes the diverse human experiences was unravelled. The very same reason that underscores the said distinction sheds light on their universal agrammatic representations. These genetic variations contribute to the universal manifestation of agrammatic representations observed across different languages in individuals with DS. Therefore, to comprehensively address the aforementioned points and facilitate the interpretation of the accumulated data, an interview was conducted with an expert in the fields of molecular genetics and neurology. As articulated by the geneticist, the genome emerges as the code of life, dictating the intricacies of existence with varying degrees of expressivity based on the specific organ it regulates (see figure 37). Among the organs under the governance of the genome, the brain stands as an awe-inspiring executor of its instructions. This remarkable organ, intricately shaped by the genetic blueprint, orchestrates the complexities of human cognition, emotion, and behaviour. According to the specialist, the genome facilitates the growth of vital neural circuits that are essential for the cognitive

processes (see figure 38). This last finding aligns with previous research in the field, further confirming that the genome plays a pivotal role in the formation and functioning of the brain. (Bae et al., 2015; National Institute of Neurological Disorders and Strokes, 2010). Moreover, in a groundbreaking study by Duet, Chang, Cloak, and Ernst, a remarkable revelation emerged stating that the brain takes the lead as the organ with the highest quantity of gene expression among the thousands of genes constituting the human genome (2014: 1). Adding to the significance of gene expression in the brain, the genes housed within the intricate structure of deoxyribonucleic acid (DNA) are responsible for encoding vital proteins. Among these protein-coding genes, a subset plays a vital role in the early infancy stages of brain development. These genes arrange the intricate processes involved in generating new neurones and ensuring the precise orchestration of synaptic activity. (Fisher and Vernes, 2015; Robinson, 2015). In accordance with a recent study conducted at the University of Bonn, an intriguing revelation has come to light. Their research has unveiled that specific genes within the human genome play a vital role in producing proteins that serve as guardians of neuronal well-being within the brain. These remarkable proteins act as protectors, diligently ensuring the health and optimal functioning of neurones. (2021). Furthermore, the influence of genes extends to the determination of brain dimensions during its developmental stages, with a particular gene known as microcephalin playing a pivotal role (Evans et al., 2006). All the aforementioned points collectively contribute to the understanding of the neurological distinctions between typically developing children and those with genetic mutations and variations, including children with Down syndrome. These genetic factors intricately shape the formation and functioning of the brain, influencing various aspects such as neural architecture, synaptic connectivity, and gene expression patterns.

Additionally, the anomalies and variations within the genetic makeup of individuals, such as those observed in Down syndrome, give rise to unique neurological profiles and

cognitive challenges (Hasina et al., 2022). This multifaceted perspective underscores the significance of genetic influences in shaping the complex neurological landscapes of individuals and further deepens the understanding of the rich diversity of human cognition and development. Withal, the interviewee confirmed the said points and intensified the effect of the triplication on the cognitive and neurological impairments. This phenomenon becomes evident in the smaller size of the brain in individuals with Down syndrome, which can be attributed to the variations in the ASPM genome (National Institute of Neurological Disorders and Stroke, 2010). On top of that, a decrease in the volumes of the hippocampus and the temporal lobes was apparent in an MRI study conducted by Pinter and colleagues (2001: 1660). This last has a tremendous effect on memory which plays a crucial role in language processing (see section 2.5.1). Moreover, the need for repetition observed in individuals with Down syndrome was also highlighted by the expert, further reinforcing the role of genetic factors on memory (see figure 41). Additionally, the specialist intensified the presence of a "mental delay" which sheds light on the disparity between the mental age and the chronological age of DS children which stem from the genetic anomaly affecting cognitive development. Furthermore, it has been observed that children with Down syndrome experience a significant decrease of 20% to 50% in the number of neurones from birth to the age of 60 months. This reduction in neurone count contributes to a deceleration in the creation of new neurones, which occurs primarily during the prenatal period. Specifically, after 22 weeks of gestation, there is a notable decline in the rate of neurogenesis in individuals with DS compared to typically developing individuals (Schmidt-Sidoret al., 1990: 181). All the last abnormalities in the synaptic activities in DS were linked to the cognitive impairments and believed to be the result of the overproduction of proteins coded by the triplicated copy of the chromosome 21 (Benavides-Piccione et al., 2004). The expert confirmed that, indeed, the repercussions of the genetic mutation in DS impede language proficiency as they exert a

tremendous influence on the essential organs and neurocognitive factors involved in the manifestation of language (see figure 39). Moreover, Gopnik (1997) stipulated the impaired ability to build a normal grammar to be due to the genetic disorder (see section 1.3.3).

Consequently, this phenomenon directly stems from the congenital genetic mutation, which is a direct consequence of the inherent genetic alteration present from birth. This characteristic becomes apparent in the symptoms exhibited by individuals with Broca's aphasia, as outlined in section 2.5.2, which the specialist unequivocally affirms to be an innate condition. The specialist's confirmation underscores the inherent nature of Broca's aphasia, emphasising that it is present from birth and rooted in the individual's genetic makeup. Furthermore, a study conducted by Penke provided corroborating evidence that Broca's aphasia manifests in agrammatic structures in both speech and writing (2015). Hence, any anomaly associated with this organ will inevitably lead to the occurrence of aphasia (2015). This notion finds its roots in Chomsky's generative theory, wherein he postulated the existence of the Language Acquisition Device (LAD) within the brain. However, the geneticist explained that the synaptic activities involved in language processing permeate the entire brain rather than being confined to a singular area. This observation signifies that Broca's aphasia indeed exerts a significant impact on the emergence of agrammatic representations. However, it is crucial to recognise that Broca's aphasia represents only a piece of the larger puzzle. Despite the long-standing hypothesis that the left hemisphere of the brain is the specific region housing the neural circuits responsible for Universal Grammar (Stromswold, 2000; Tettamanti et al., 2002), numerous opposing studies have emerged to challenge this notion. These studies have demonstrated that language processing and representation are not confined to a singular, specific location within the brain. Instead, language-related functions and networks are distributed across multiple regions and interconnected neural circuits, involving both the left and right hemispheres as well as various

cortical and subcortical areas (Dabrowska, 2015; Fisher and Vernes, 2015). Hence, these findings collectively challenge Chomsky's proposition regarding the specific placement of the LAD within the brain. On top of that, a more recent study on 94 healthy young adults native speakers of Arabic and German using a high-resolution diffusion-weighted MRI and tractography-based network statistics of the language connectome revealed that language activity leads to the activation of both hemispheres (Wei et all., 2023). What is mind blowing is the apparent strong inter-hemispheric connectivity in the Arabic speaking participants. This discovery showcases the highly intricate morpho-syntactic structure of Arabic along with Chomsky's misplacement of the language mechanism, especially that this latter was merely hypothetical. If we consider the intricate interplay between the genome and the brain, the genome provides the foundational instructions for the development and functioning of the brain, including its language-related abilities. While the brain serves as the executive organ responsible for language processing. This claim was equally supported by the specialist who claimed that "Language may indeed be a significant part of the genetic system".

2.6 Limitations:

Throughout the course of this study, the author encountered a number of limitations that are worth noting. Firstly, obtaining the authorisation from the Academy of Tlemcen to access the schools proved to be a challenging task for it was time consuming and effort taking. Moreover, the scarcity of Arabic-language resources pertaining to the investigated subject matter put the researcher under immense pressure while delving into the under-explored topic at hand. Therefore, the researcher had to navigate through limited sources and rely heavily on electronic platforms, only to face repeated disappointments when attempting to obtain crucial documents, as no response was received from the contacted authors. Another noteworthy limitation stemmed from the scarcity of existing research studies directly investigating the association between Down syndrome and Broca's aphasia. Compounding

this limitation was the lack of specialised clinical tools specifically designed to investigate and assess Broca's aphasia in the context of Down syndrome. One of the potential tools that could have been valuable in investigating the activity of Broca's aphasia is high-resolution diffusion-weighted MRI (magnetic resonance imaging). This advanced imaging technique allows for the visualisation and assessment of white matter tracts and connectivity in the brain. By examining the integrity and activity of these neural pathways, the researcher can gain insights into the underlying mechanisms associated with Broca's aphasia. Another notable limitation arose from the presence of additional syndromes, including Autism spectrum and Diabetes, among some of the participants in the sample. This circumstance posed a challenge to conducting the intended test on the entire number of individuals, limiting the scope of the study to individuals with Down syndrome alone. Lastly, time constraints prevented the author from gathering more data and conducting additional interviews with neurologists and geneticists, which would have facilitated a broader and deeper understanding of the phenomenon under investigation.

2.7 Conclusion:

In conclusion, this research endeavours to explore the effects of agrammatic Broca's aphasia on the morphosyntactic structure of individuals with Down syndrome in Tlemcen. The primary objective of this research is to emphasise the impact of the genetic anomaly associated with Down syndrome on the structural aspects of the brain, which, in turn, leads to the manifestation of Broca's aphasia and subsequent agrammatic representations in affected individuals.

In this research endeavour, a robust methodology was employed, incorporating a combination of inductive and deductive reasoning. The study adopted an exploratory, single instrumental, and holistic case study design, complemented by a mixed method approach, to provide a comprehensive understanding of the research topic. Furthermore, this study utilised

a discriminative snowball sampling method, with a focus on critical case sampling for the primary participants. Special consideration was given to the genetic profile, age range, and absence of additional diseases or comorbidities. Secondary participants were carefully selected based on their expertise, ensuring diverse perspectives and enriching the data analysis process.

Moreover, the data collection process involved the utilisation of four instruments to gather both qualitative and quantitative data. Initially, a semi-structured interview was employed to investigate the relatively unexplored topic at hand. This interview served as a foundation for developing a test aimed at assessing the challenges experienced by children with DS in reading and writing production. Furthermore, an overt, semi-structured, and non-participant observation was conducted to capture agrammatic representations in the children's spontaneous speech production. To facilitate data interpretation and enhance the robustness of findings, a specialist with expertise in molecular genetics and neurology was engaged in a semi-structured interview, contributing valuable insights to the study. All the collected data is securely stored in dedicated repositories within the database.

Moreover, the data from the two interviews underwent a meticulous analysis process that involved meaning analysis with hybrid coding and thematic analysis techniques. This approach allowed for a comprehensive examination of the collected data, extracting meaningful insights and identifying themes. The hybrid coding approach combined deductive coding based on predetermined categories and inductive coding to capture emerging themes that were not predefined. Through this rigorous analytical process, the data was thoroughly examined, enabling a rich and nuanced understanding of the agrammatic representations displayed by DS children along with their origin. The data obtained from the test underwent a rigorous analysis process, wherein each exercise was individually examined using specialised programs developed by an IT engineer. These programs were specifically designed to

facilitate the analysis of the test data, ensuring accuracy and efficiency in the process. By employing these custom-built tools, the data analysis was conducted systematically and, including cross-tabulation of the different variables, enabling detailed insights into the performance and outcomes of the participants in each exercise.

The results obtained from the utilised instruments not only support one another but also align with previous research findings. Consequently, the hypotheses posited in this study have been confirmed. The findings provide compelling evidence that agrammatic representations are prevalent in individuals with Down Syndrome when it comes to the Arabic language. These universal agrammatic representations challenge the fundamental principles of universal grammar, indicating a departure from the expected linguistic patterns. Moreover, the study suggests a direct link between the genetic anomaly associated with DS and the manifestation of language disorders in affected children suggesting a shift in the placement of the language system from the brain to the genome. Overall, these outcomes provide valuable insights into the language difficulties experienced by DS individuals and contribute to the general understanding of the underlying genetic factors impacting language development in this population.

2.8 Recommendations:

The issue of language disorders affecting children with Down syndrome, specifically the morphosyntactic deficits observed in their agrammatic manifestations, has garnered significant attention among researchers in recent years. However, there remains a noticeable lack of resources addressing this concern in the Arabic language. Therefore, it is essential for specialists, researchers, and students in the field of language studies, both in the Arab world in general and in Algeria in particular, to devote more attention to studying language disorders in individuals with Down syndrome, particularly those related to grammatical difficulties from a generative approach.

Throughout the process of data collection and analysis, several significant themes emerged. These include the omission of function words, deficits in the production and comprehension of non-canonical and complex word order, such as the passive voice, difficulties with inflectional bound morphemes in noun classification and verb conjugation, challenges in word category recognition, and processes related to grammatical knowledge. Additionally, genetic-related themes pertaining to language disorders in Down syndrome, such as the genetic basis of agrammatic Broca's aphasia, have also surfaced. Each of these themes warrants further exploration, particularly in the context of the Arabic language, which remains relatively unexplored in terms of studying language disorders in individuals with Down syndrome. By delving deeper into these themes and conducting research specifically focused on Arabic-speaking individuals with Down syndrome, this can contribute to a more comprehensive understanding of their language difficulties. This knowledge can inform the development of targeted interventions, educational strategies, and clinical practices tailored to the specific needs of this population.

Moreover, the absence of specialised clinical tools designed specifically for the examination of Broca's aphasia in the context of Down syndrome underscored the need for further research and the development of specialised tools and methodologies to comprehensively examine the presence and characteristics of Broca's aphasia in individuals with DS. By addressing these gaps, future studies can contribute to a more robust understanding of the relationship between DS and Broca's aphasia, ultimately facilitating better diagnosis and intervention strategies for individuals with these conditions.

Furthermore, while focusing solely on individuals with DS helped to narrow the scope and provide some insights into this specific group, future studies should strive to include a more diverse sample that encompasses individuals with DS and various co-occurring syndromes. This approach would enable a comprehensive understanding of the

interplay between different syndromes and the specific manifestations of Broca's aphasia, contributing to a more nuanced understanding of language impairments in individuals with complex comorbidities. Hence, achieving a more comprehensive understanding of language disorders in individuals with Down syndrome and addressing the research and resource gaps which require collaborative efforts among researchers from various disciplines. Collaboration among geneticists, neurologists, psychologists, engineers, and linguists is crucial in gaining insights into the multifaceted nature of this topic. Collaborative efforts can lead to interdisciplinary research projects, joint publications, and shared insights that advance the shared understanding and ultimately improve the lives of individuals with DS through targeted interventions and support.

General Conclusion:

Employing a generative perspective, the focus of this study lies in understanding the impact of agrammatic Broca's aphasia on the morpho-syntactic structure of Arabic among children with Down syndrome in Tlemcen. Ergo, the primary objective is to shed light on how the genetic anomaly associated with Down syndrome affects the brain's structural aspects, leading to the manifestation of Broca's aphasia and subsequent agrammatic representations in affected individuals. Hence, the research was structured into two distinct chapters to comprehensively address the topic at hand. The first chapter delved into the theoretical underpinnings, encompassing a thorough exploration of the various facets and considerations surrounding the subject. This chapter aimed to establish a strong conceptual foundation and to provide a comprehensive understanding of the topic's complexities. Whereas, the second chapter delved into the intricate realm of research methods and design, delving into the selection of appropriate sampling techniques, meticulous data collection methods, and rigorous analysis approaches. This chapter was meticulously crafted to ensure the reliability

and validity of the findings, employing robust methodologies to gather and analyse the data in a systematic and rigorous manner.

Following a comprehensive framework, the data collected unequivocally confirms the prevalence of Arabic agrammatic representations of Broca's aphasia in Algerian children with Down syndrome. These representations are characterised by the omission of function words, difficulties with non-canonical and complex word order, issues with inflectional morphemes in nouns classification and verb conjugation, impairments in word category recognition, and struggles related to grammatical knowledge processes. Moreover, Arabic language stands out significantly in its remarkable ability to emphasise and illustrate these linguistic issues, surpassing other languages in this regard. Furthermore, the agrammatic representations displayed by children with Down syndrome challenge the fundamental principles of Universal Grammar, encompassing sub-theories such as deep and surface structures theory, movement theory, X-Bar theory, theta theory, government theory, and case theory. These findings pose a counterpoint to the arguments put forth by Chomsky and his followers in defence of Universal Grammar, including the poverty of stimulus and the role of negative evidence. Consequently, it becomes evident that children with Down syndrome lack the innate, subconscious ability associated with Universal Grammar. Intriguingly, the manifestation of agrammatic representations in individuals with Down syndrome exhibits remarkable universality across various languages, including English, French, Hebrew, Malayalam, Japanese, and Brazilian Portuguese. This shared anomaly emphasises the comparable irregularities in the morpho-syntactic structure observed in individuals with Down syndrome, irrespective of the linguistic context. When it comes to discerning between individuals without Down syndrome and those with the condition, the primary factor that sets them apart resides within their genome. The intricate structure of their genetic makeup yields distinctive characteristics and presents unique challenges. The presence of an additional copy of chromosome 21 in individuals with

Down syndrome contributes to the universal presence of the said agrammatic representations observed across different languages. Moreover, the brain, as the executor of genetic instructions, assumes a pivotal role in these manifestations. Anomalies and genetic variations, as witnessed in Down syndrome, give rise to distinctive neurological profiles and cognitive challenges inherent in Broca's aphasia. Consequently, it becomes apparent that Broca's aphasia is an inherent characteristic present from birth, deeply rooted in the genetic composition of affected individuals. However, it is crucial to acknowledge that Broca's aphasia represents only a fragment of the broader intricacies underlying language processing and representation. Language-related functions and networks are intricately distributed across multiple regions and interconnected neural circuits, spanning both the left and right hemispheres.

In summary, this research successfully achieves its objectives and validates the hypotheses posited. These findings not only advance the existing body of research on this topic but also foster interdisciplinary collaboration among domains such as neurology, genetics, psychology, computer sciences and linguistics. Therefore, these profound insights precipitate a transformative paradigm shift within the generative approach, opening up new horizons for the emergence of an innovative interdisciplinary field that could potentially be referred to as Neurogenomic Linguistics. This emerging field signifies a departure from traditional boundaries, blending the realms of neuroscience, genomics, and linguistics to unravel the intricate connections between genetic factors, neural processes, and the complexities of language acquisition and processing. Such a convergence of disciplines promises to revolutionise the shared understanding of the genetic and neural underpinnings of language, paving the way for groundbreaking advancements in this burgeoning field of research.

Nevertheless, this research encountered several challenges that deserve recognition. Foremost among these was the notable dearth of Arabic-language resources specifically addressing the investigated subject matter, which placed the researcher in a daunting position while delving into this relatively unexplored domain. Additionally, a significant limitation arose from the scarcity of comprehensive research studies directly investigating the intricate connection between Down syndrome and Broca's aphasia. Moreover, exacerbating this limitation was the absence of specialised clinical tools tailored specifically for assessing and examining Broca's aphasia within the context of Down syndrome. In particular, advanced imaging techniques capable of visualising and evaluating white matter tracts and neural connectivity in the brain. Unfortunately, the unavailability of such advanced resources constrained the depth and scope of the study. Furthermore, it is essential to acknowledge that the presence of additional comorbidities such as Autism spectrum and Diabetes among certain participants in the sample necessitated the exclusion of these individuals from the intended tests, limiting the study's scope exclusively to individuals with Down syndrome. Lastly, time constraints imposed significant limitations on data gathering and the opportunity to conduct additional interviews with neurologists and geneticists. These interviews would have undoubtedly enriched the study, providing valuable expert insights and contributing to a more comprehensive understanding of the phenomenon at hand.

Furthermore, the topic at hand witnessed a growing body of research conducted in recent years. Nevertheless, it is crucial for specialists, both within the broader Arab world and more specifically in Algeria, to place increased emphasis on exploring language disorders among individuals with Down syndrome. The unique complexities of the Arabic language offer fertile ground for uncovering further intriguing discoveries in this area. Moreover, Throughout the process of collecting and analysing data, several notable themes have emerged. Each of these themes holds considerable significance and calls for deeper

investigation, particularly within the realm of the Arabic language, which remains relatively understudied regarding language impairments in individuals with Down syndrome. The insights derived from these emerging themes can serve as a valuable foundation for informing the design of targeted interventions, educational strategies, and clinical practices that are specifically tailored to address the unique needs of individuals with Down syndrome and language disorders.

To conclude, The findings of this study reinforce the notion that treating language as an isolated entity detached from its genetic foundations is an antiquated perspective. It becomes increasingly evident that language is intricately intertwined with genetics, and that a holistic understanding of language necessitates the establishment of connections across various disciplines in which the significance of interdisciplinary collaboration in language studies cannot be overstated. Moreover, the universal presence of agrammatism observed in children with Down syndrome serves as a compelling evidence for the underlying genetic basis of language. This latter further emphasises the notion that the genome itself serves as the very framework of language, with the brain acting as the executive organ responsible for its processing and expression. This aforementioned understanding calls for a paradigm shift, highlighting the need for a cohesive network that connects the different facets of language research.

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Appendices

Appendix A: Request Letter

تلمسان في 31/01/2023

الانسة ريان خضور
السيد حاسيمي سليف قيندو
طلبة ماستر 2 بجامعة أبو بكر بلقايد تلمسان
كلية الأداب واللغات الأجنبية
قسم اللغة الإنجليزية
تخصص علوم اللغة

إلى السيد مدير التربية لولاية تلمسان

الموضوع: طلب رخصة للقيام ببحث مع الجمعية الولائية لإدماج المصابين بالتريزوميا لتلمسان

لنا عظيم الشرف أن نتقدم لسيادتكم المحترمة بطلبنا هذا و المتمثل في طلب رخصة مفتوحة للقيام ببحث مع الجمعية الولائية لإدماج المصابين بالتريزوميا لتلمسان و كذا المؤسسات التعليمية التي تغطي هذه الفئة و هذا كجزء من أطروحة الماستر 2 و المعنونة تحت

'The Effects of Agrammatic Broca's Aphasia on The Morpho-Syntactic Structure: The Case of Down Syndrome Children in Tlemcen.'

والتي هي بصدد التحضير من طرف الطالبين
الانسة ريان خضور
السيد حاسيمي سليف قيندو

و المؤطرة من طرف الأساتذة
البروفيسور بلمكي أمين
الدكتورة فرقاش صارة منال

و هذا لدراسة المشاكل اللغوية التي تواجههم من نحو و صرف بهدف مساعدتهم على التغلب عليها

كما تجدون رفقة طلبنا هذا نسخة من شهادة تأطير أطروحة الماستر و التي أصدرت من طرف قسم اللغة الإنجليزية بجامعة تلمسان و كذا رسالة القبول الأولي من طرف الجمعية الولائية لإدماج المصابين بالتريزوميا لتلمسان

في انتظار قبولكم تقبلوا منا فائق التقدير و الإحترام

إمضاء الأستاذ المؤطر الرئيسي

Prof. Amine BELMEKKI
Directeur du Laboratoire
F.L.P.A.T.P
UNIVERSITÉ DE TLEMCEN

إمضاء الأستاذة مساعدة المؤطر

Dr. Sarra Menal FERKACHE
Lecturer of English
University of Tlemcen

إمضاء الطالبين

إمضاء رئيس القسم

Appendix A-1: Certificate of Master Dissertation Supervision: Rayene Khoudour

Abou Bekr Belkaid University – Tlemcen
Faculty of Letters and Languages

Department of English

Certificate of Master's Dissertation Supervision
2022/2023

Student's Name: Rayène Khoudour

Date of birth: [redacted]

Specialty: Language Sciences

Research topic:
"The Effects of Agrammatic Broca's Aphasia on the Morpho-Syntactic Structure: The Case of Down Syndrome Children in Tlemcen."

Supervisor's Name: Prof. Belmekki Amine & Dr. Ferkache Sarra Menal

Signature and stamp of the supervisor	Signature of the student	Signature and stamp of the Head of the Department/ President of the Scientific Committee
POLICY of FOREIGN LANGUAGES in ALGERIA PROFESSIONALISM in PLURI TEACHER F.L.P.A.T.P UNIVERSITE DE TLEMCEN Prof. Amine BELMEKKI Directeur du Laboratoire F.L.P.A.T.P UNIVERSITÉ DE TLEMCEN Dr. Sarra Menal FERKACHE Lecturer of English University of Tlemcen		

Appendix A-2: Certificate of Master Dissertation Supervision: Guindo Hassimi Salif

Abou Bekr Belkaid University – Tlemcen
Faculty of Letters and Languages

Department of English

Certificate of Master's Dissertation Supervision
2022/2023

Student's Name: Guindo Hassimi Salif

Date of birth: [redacted]

Specialty: Language Studies

Research topic:
The Effect of Agrammatic Broca's Aphasia on the Morpho-Syntactic Structure: The Case of Down Syndrome Children in Tlemcen

Supervisor's Name: Prof. Belmekki Amine and Dr. Ferkache Sarra Menal

Signature and stamp of the supervisor	Signature of the student	Signature and stamp of the Head of the Department/ President of the Scientific Committee
POLICY of FOREIGN LANGUAGES in ALGERIA and TEACHER PROFESSIONALISATION F.L.P.A.T.P UNIVERSITÉ DE TLEMCEN Prof. Amine BELMEKKI Directeur du Laboratoire F.L.P.A.T.P UNIVERSITÉ DE TLEMCEN Dr. Sarra Menal FERKACHE Lecturer of English University of Tlemcen		جامعة أبي بكر بلقايد تلمسان كلية الآداب واللغات قسم اللغة الانجليزية فريد داودي رئيس قسم اللغة الإنجليزية

Appendix B: AWIT Invitation Letter

الجمعية الولائية لادماج
المصابين بالتريزوميا لتلمسان
Association de Wilaya pour l'Insertion
des Trisomiques de Tlemcen

مديرية التربية
لولاية تلمسان
تاريخ الوصول
2023 فيفري 01
تحت رقم:

إلى السيد :مدير التربية لولاية تلمسان

يشرفنا أن نتقدم إلى سيادتكم بهذا الطلب لسيدة خضور ريان و السيد GUINDO HASSIMI SALFI

على الرخصة لزيارة أقسام الجمعية و ذلك في إيطار إتمام دراسة ميدانية حول الأطفال المصابين بالتريزيميا 21 المتمدرسين يدخل هذا العمل ضمن مذكرة التخرج للطور الماستر .

الرخصة تشمل مدرسة أحمد الأبيلي و خليل عبد السلام و ذلك في الفترة الممتدة من 2023 /02/05إلى 2023/02/26.

تقبلوا منا فائق الاحترام و التقدير.

ختم الجمعية

الرئيس
الحصار محمد

Bloc communal "El Amir Abdelkader" Palais "El Mechouar" Tlemcen - Algérie
Tél. : +213 (0) 43 27 51 22 / Mob. : +213 (0) 555 87 85 06

Appendix C: Authorisation Letters

الجمهورية الجزائرية الديمقراطية الشعبية

وزارة التربية الوطنية

مديرية التربية لولاية تلمسان
مصلحة التكوين و التفتيش
الرقم: 153 م.ت.ت/2023

تلمسان في: 05 فيفري 2023

مدير التربيـة

إلـى

الطالب(ة): خضور ريان

جامعة ابو بكر بلقايد – تلمسان

كلية الآداب و اللغة الانجليزية

قسم اللغة الانجليزية

الموضـوع: ب/خ القيام بدراسة ميدانية.

المرجع : جامعة ابو بكر بلقايد – تلمسان كلية الآداب و اللغة الانجليزية قسم اللغة الانجليزية التربوي .المؤرخة في 2023/01/31

بناء على الطلب المذكور في المرجع أعلاه، و في ظل احترام النظام الداخلي للمؤسسات التربوية ، نعلمكم بموافقتنا وبترخيصنا لكم للقيام بهذه الدراسة الميدانية على مستوى:

المدرسة الإبتدائية أحمد الأبيلي – تلمسان

المدرسة الإبتدائية خليل عبد السلام – تلمسان

وذلك خلال الفترة الممتدة من : 05 فيفري 2023 إلى : 26 ماي 2023

و عليه المطلوب منكم الاتصال بمديري المؤسستين المعنيتين و التنسيق معهما لإجراء هذه الدراسة.

ملاحظة: . تعتبر هذه المراسلة بمثابة ترخيص للدخول إلى المؤسسة المذكورة أعلاه .

مدير التربية

عن مدير التربية وبتفويض منه
رئيس مصلحة
التكوين والتفتيش
معاريف عبد القادر

نسخة لمفتش التعليم الابتدائي لإدارة الابتدائيات مقاطعة تلمسان

مديرية التربية لولاية تلمسان –مصلحة التكوين و التفتيش
البريد الالكتروني: Serviceformation13000@gmail.com
رقم الهاتف /الفاكس 043418908

الجمهورية الجزائرية الديمقراطية الشعبية

وزارة التربية الوطنية

مديرية التربية لولاية تلمسان
مصلحة التكوين و التفتيش
الرقم: 152/م.ت.ت/2023

تلمسان في: 05 فيفري 2023

مدير التربيـة

إلـى

الطالب(ة): قيندو حسيمي ساليف
جامعة ابو بكر بلقايد – تلمسان
كلية الآداب و اللغة الانجليزية
قسم اللغة الانجليزية

الموضوع: ب/خ القيام بدراسة ميدانية.

المرجع: جامعة ابو بكر بلقايد – تلمسان كلية الآداب و اللغة الانجليزية قسم اللغة الانجليزية التربوي .المؤرخة في 2023/01/31

بناء على الطلب المذكور في المرجع أعلاه، و في ظل احترام النظام الداخلي للمؤسسات التربوية ، نعلمكم بموافقتنا وبترخيصنا لكم للقيام بهذه الدراسة الميدانية على مستوى:

المدرسة الإبتدائية أحمد الأبيلي – تلمسان

المدرسة الإبتدائية خليل عبد السلام – تلمسان

وذلك خلال الفترة الممتدة من : 05 فيفري 2023 إلى : 26 ماي 2023

و عليه المطلوب منكم الاتصال بمديري المؤسستين المعنيتين و التنسيق معهما لإجراء هذه الدراسة.

ملاحظة: . تعتبر هذه المراسلة بمثابة ترخيص للدخول إلى المؤسسة المذكورة أعلاه .

مدير التربية

نسخة لمفتش التعليم الابتدائي لإدارة الابتدائيات مقاطعة تلمسان

عن مدير التربية وبتفويض منه
رئيس مصلحة
التكوين والتفتيش
معاريف عبد القادر

مديرية التربية لولاية تلمسان –مصلحة التكوين و التفتيش
البريد الالكتروني: Serviceformation13000@gmail.com
رقم الهاتف /الفاكس 043418908

Appendix D: Interview Information Sheet

جامعة أبو بكر بلقايد تلمسان
كلية الآداب و اللغات
قسم اللغة الإنجليزية

ورقة معلومات الدراسة للمشاركين

الطالبة خضور ريان
[redacted]
المؤطر الأستاذ البروفيسور بلمكي أمين
[redacted]
المؤطرة الدكتورة فرقاش صارة منال
[redacted]

عنوان الدراسة:

"The Effects of Agrammatic Broca's Aphasia on the Arabic Morpho-Syntactic Structure: The Case of Down Syndrome Children in Tlemcen."

"تأثير حبسة بروكا على البنية الصرفية و النحوية للغة العربية : حالة أطفال متلازمة داون في تلمسان"

يشرفني أن أدعوكم للمشاركة في مشروع بحثي جامعي، قبل أن تقرروا يرجى منكم أولا فهم سبب البحث الذي نقوم به و الجوانب التي تشملها مشاركتكم. يرجى تخصيص بعض الوقت لقراءة المعلومات التالية بعناية ومناقشتها مع الآخرين إذا كنتم ترغبون في ذلك. يمكنكم دائما سؤالنا في حالة كان هناك أي شيء غير واضح أو إذا كنتم ترغبون في مزيد من المعلومات. شكرا لكم على قراءة هذا.

ما هو الهدف من هذه الدراسة ؟

تهدف هذه الدراسة إلى معرفة الصعوبات و المشاكل النحوية و كذا الصرفية التي يعاني منها أطفال متلازمة داون في اللغة العربية خصيصا و هذا لتحديدها و مقارنتها بالصعوبات التي سبق أن دونت من قبل باحثين لغويين آخرين في لغات أخرى الشيء الذي سيمكننا من معرفة مدى تأثير الكروموزوم ٢١ على البنية الداخلية للدماغ و على وظائفه اللغوية خاصة. تهدف هاته الدراسة من كل ما سبق ذكره إلى إيجاد حلول عملية كبرامج تعليمية جديدة و كذا إلى تطوير تطبيق خاص بالمحاكاة الدماغية لمساعدة أطفال متلازمة داون من التغلب على الصعوبات السابق ذكرها. تمتد مدة هذه الدراسة إلى غاية السادس و العشرين من ماي ٢٠٢٣.

ما هو سبب إختياركم ؟

لقد تم اختياركم للمشاركة في هذه الدراسة كونكم عنصر مهم جدا من أجل السيرورة الحسنة لكافة المراحل المستقبلية للدراسة. كونكم أساتذة لغة عربية لأطفال متلازمة داون نحتاج لخبرتكم العالية و لتجاربكم الغنية داخل القسم فيما يخص النحو و الصرف خاصة فنحن نعتمد عليكم لمعرفة الصعوبات التي لاحظتموها في المسائل النحوية و الصرفية عند تلاميذكم.

هل المشاركة طوعية ؟

يعود قرار المشاركة أو عدمها في هذه الدراسة إليكم. إذا قررتم المشاركة في هذه الدراسة سيتم إعطاؤكم ورقة معلومات الدراسة هذه و سيطلب منكم إمضاء استمارة موافقة. بإمكانكم الخروج من الدراسة في غضون أسبوع من المقابلة و هذا قبل أن تبدأ فترة تحليل المعلومات من طرف الباحثين و بدون الحاجة لأي تبرير و بدون المساس بأي منافع خاصة بكم.

ما الذي تشمله المشاركة ؟

الدراسة تمتد إلى السادس و العشرين من ماي ٢٠٢٣ أما بالنسبة لمشاركتم في الدراسة فستكون مرة واحدة و لمدة نصف ساعة. المشاركة ستكون عبارة عن مقابلة في مكان مناسب لكم بهدف الإجابة عن بعض

الأسئلة بخصوص الصعوبات التي يواجهها تلاميذ متلازمة داون في اللغة العربية. سيتم تسجيل المقابلة بهدف دراسة محتواها من طرف الباحثين فقط و في سرية تامة و كل المعطيات المتحصل عليها سيتم تدميرها بعد إنشاء التطبيق و إنتهاء الدراسة.

ما هي المنافع المرجوة من المشاركة ؟

بمشاركتكم في الدراسة تساعدون في إثراء الرصيد العلمي الخاص بمتلازمة داون في الجانب اللغوي و في اللغة العربية خاصة الذي يشهد تهميش كبير في مجموع البحوث العلمية و الدراسات الجامعية في الجزائر. كذلك بمشاركتكم في الدراسة تساعدون في عملية توفير و وضع طرق جديدة التي من شأنها مساعدة هؤلاء الأطفال في التخلص من الصعوبات اللغوية التي تواجههم.

هل ستكون المعلومات في سرية تامة؟

جميع المعلومات التي نجمعها أثناء سير الدراسة ستبقى سرية تمامًا و لن يتم التعرف عليكم في أي تقارير أو منشورات كما لن يتم ذكر معلوماتكم الشخصية كأسمائكم في الدراسة أو في التسجيل.

هل سيتم تسجيل المقابلة و كيف سيتم استعمال التسجيل؟

سيتم تسجيل المقابلة بهدف تحليل محتواها من طرف الباحثين فقط و في سرية تامة و كل المعطيات المتحصل عليها سيتم تدميرها بعد إنشاء التطبيق و إنتهاء الدراسة. لن يتم استخدام التسجيل لأي سبب آخر بدون أخذ إذن مكتوب منكم و لا يسمح لأي شخص خارج الدراسة بالولوج لمحتوى التسجيل.

نقطة الإتصال للحصول على مزيد من المعلومات:

يمكنكم دائما التواصل معنا عبر البريد الإلكتروني أو أرقام الهواتف الموضحة أعلاه.

في حال قررتم المشاركة في الدراسة يمكنكم الحصول على ورقة المعلومات هذه و سيطلب منكم إمضاء إستمارة موافقة و التي بإمكانكم دائما الحصول على نسخة منها.

لكل المشاركين في الدراسة تقبلوا منا فائق عبارات الشكر والتقدير و الإمتنان العميق لعملكم المتفاني و على مجهوداتكم المبذولة من أجل نجاح هذه الدراسة.

Tlemcen University
Letters and Languages Faculty
English Language Department

Student Khoudour, Rayene
[redacted]
Supervisor Professor Belmekki, Amine
[redacted]
Supervisor Dr. Ferkache, Sarra Menal
[redacted]

INFORMATION SHEET

THE TITLE OF THE WORK:
"The Effects of Agrammatic Broca's Aphasia on the Arabic Morpho-Syntactic Structure: The Case of Down Syndrome Children in Tlemcen."

I am honoured to invite you to participate in my university research project. Before you decide, I kindly request that you first understand the purpose of the research we are conducting and the aspects that your participation would involve. Please take some time to carefully read the following information and discuss it with others if you wish to do so. You can always ask us if anything is unclear or if you would like more information. Thank you for reading this.

What is the objective of this study?

This study aims to identify the grammatical and syntactic difficulties and problems experienced by children with Down syndrome in the Arabic language. The goal is to determine and compare these difficulties with those previously documented by other linguists in other languages. This will help us understand the impact of chromosome 21 on the internal structure and linguistic functions of the brain. The study also aims to find practical solutions, such as new educational programs and the development of a brain simulation application, to help children with Down syndrome overcome the aforementioned difficulties. This study will be conducted until May 26, 2023.

Why were you chosen?

You have been selected to participate in this study because you are an important element for the smooth progress of all future stages of the study. As Arabic language teachers for children with Down syndrome, we need your high expertise and rich experiences, particularly regarding grammar and morphology. We rely on you to identify the difficulties you have noticed in grammatical and syntactic issues among your students.

Is participation voluntary?

The decision to participate or not in this study is entirely up to you. If you decide to participate, you will be given an information sheet about the study and asked to sign a consent form. You can withdraw from the study within one week of the interview, before the data analysis phase by the researchers begins, without any justification or affecting any of your personal benefits.

What does participation entail?

The study will run until May 26, 2023. As for your participation, it will only be once, for approximately half an hour. Participation will involve an interview at a convenient location, where you will be asked questions regarding the difficulties faced by children with Down syndrome in the Arabic language. The interview will be recorded solely for content analysis by the researchers, and all the collected data will be destroyed after the creation of the application and the completion of the study.

What are the expected benefits of participation?

By participating in the study, you contribute to enriching the scientific knowledge related to Down syndrome, especially in the linguistic aspect and the Arabic language, which has been significantly neglected in scientific research and university studies in Algeria. Your participation also helps in providing and developing new methods that can assist these children in overcoming their linguistic difficulties.

Will the information remain confidential?

All the information collected during the study will remain completely confidential, and you will not be identified in any reports or publications. Your personal information, such as names, will not be mentioned in the study or in the recordings.

Will the interview be recorded, and how will the recording be used?

The interview will be recorded solely for content analysis by the researchers, ensuring complete confidentiality. All the data obtained will be destroyed after the creation of the application and the completion of the study. The recording will not be used for any other purpose without obtaining written permission from you, and the access to the recording's content will not be granted to anyone outside the study.

Contact point for more information:

You can always reach us through the provided email addresses or phone numbers mentioned above. If you decide to participate in the study, you can obtain a copy of this information sheet and be asked to sign a consent form.

To all study participants, we express our sincere thanks, appreciation, and deep gratitude for your dedicated work and efforts towards the success of this study.

Appendix E: Interview Consent Form

جامعة أبو بكر بلقايد تلمسان
كلية الآداب و اللغات
قسم اللغة الإنجليزية

إستمارة الموافقة

عـنوان الـدراسـة:

"The Effects of Agrammatic Broca's Aphasia on The Arabic Morpho-Syntactic Structure: The Case of Down Syndrome Children in Tlemcen."

"تأثير حبسة بروكا على البنية الصرفية و النحوية للغة العربية : حالة أطفال متلازمة داون في تلمسان."

أسماء الباحثين:
الطالبة خضور ريان
الطالب قيندو حسيمي ساليف

١- أؤكد أنني قرأت وفهمت ورقة المعلومات المؤرخة و التي ستدرج للدراسة المذكورة أعلاه. لقد أتيحت لي الفرصة للنظر في المعلومات وطرح الأسئلة وتمت الإجابة عليها بشكل مرضي. ☐

٢- أفهم أن مشاركتي طوعية وأنني حر في الانسحاب في غضون أسبوع من المقابلة و دون إبداء أي سبب. ☐

٣- لقد قمت بتدوين رقم المشارك الخاص بي في أعلى يسار الإستمارة. هذا الرقم مهم و هو ما يحتاجه مسؤول البحث إن كنت أرغب في الإنسحاب من الدراسة مستقبلا . ☐

٤- أفهم أن نتائج هذه الدراسة يمكن نشرها و/أو تقديمها في اجتماعات أو مؤتمرات أكاديمية. أعطي إذني لبيانات مجهولة الهوية، والتي لا تحدد هويتي، ليتم نشرها بهذه الطريقة. ☐

٥- أوافق على تسجيل المقابلة بالصوت. سيتم نسخ التسجيل وتحليله لأغراض البحث. ☐

٦- أوافق على استخدام الاقتباسات الحرفية في المنشورات ؛ لن يتم ذكر اسمي ولكني أفهم أن هناك خطر من إمكانية التعرف علي. ☐

٧- أوافق على المشاركة في الدراسة المذكورة أعلاه. ☐

إسم المشارك:
التاريخ:
الإمضاء:

اسم الشخص الحاصل على الموافقة:
التاريخ:
الإمضاء:

Tlemcen University

Letters and Languages Faculty

English Language Department

Consent Form

The Title:

"The Effects of Agrammatic Broca's Aphasia on The Arabic Morpho-Syntactic Structure: The Case of Down Syndrome Children in Tlemcen."

Researchers Names:

MA.ST Rayene Khoudour

MA.ST Guindo Hassimi Salif

1- I confirm that I have read and understood the dated information sheet for the mentioned study. I have had the opportunity to review the information, ask questions, and received satisfactory answers. ☐

2- I understand that my participation is voluntary, and I am free to withdraw within a week of the .interview without providing any reason. ☐

3- I have written down my participant number at the top left of the form. This number is important .and is what the research coordinator needs if I choose to withdraw from the study in the future ☐

4- I understand that the results of this study may be published and/or presented at academic meetings or conferences. I give permission for anonymized data, which does not identify me, to be published in this manner. ☐

.5- I agree to have the interview recorded. The recording will be transcribed and analyzed for research purposes. ☐

6- I agree to the use of verbatim quotations in publications. My name will not be mentioned, but I understand that there is a risk of potential identification.

7- I agree to participate in the mentioned study.

Participant's Name:
Date:
Signature:

Name of the Person getting the consent:
Date:
Signature:

Appendix F: Interview Information Sheet

Université Abu Bekr Belkaid de Tlemcen

Faculté des Lettres et des Langues Étrangères

Départ de la langue Anglaise

CONTACTS:

Étudiant : Hassimi Salif Guindo

[redacted]

Superviseur: Prof. Belmaki Amin

[redacted]

Co-superviseuse: Dr. Ferkache Sarra Menal

[redacted]

FICHE INFORMATIVE

Titre de la recherche :

"The Effects of Agrammatic Broca's Aphasia on the Arabic Morpho-syntactic Structure: The Case of Down syndrome Children in Tlemcen"

« Les Effets de l'Aphasie de Broca sur la Structure Morpho-sybtaxique de la Langue Arabe: le Cas des Enfants atteints de Trisomie 21 à Tlemcen »

Je suis honoré de vous inviter à participer à un projet de recherche universitaire, avant de vous décider, veuillez d'abord comprendre la raison de la recherche que nous faisons et les aspects impliqués dans votre participation. Veuillez prendre le temps de lire attentivement les informations suivantes et d'en discuter avec d'autres personnes si vous le souhaitez. Vous pouvez toujours nous demander s'il y a quelque chose qui n'est pas clair ou si vous souhaitez plus d'informations. Merci d'avoir lu ceci.

Quel est le but de cette étude?

Cette étude vise à découvrir les difficultés et les problèmes grammaticaux ainsi que morphologiques subis par les enfants trisomiques en langue arabe en particulier, et ceci afin de les identifier et de les comparer avec les difficultés qui ont déjà été rapportées par d'autres chercheurs dans d'autres langues comme l'Anglais, l'Allemand ou l'Hébreu, ce qui nous permettra de connaître l'ampleur de l'impact du chromosome 21 sur la structure interne du cerveau et sur ses fonctions linguistiques en particulier. Cette étude vise à explorer et décrire ces difficultés chez les enfants en langue Arabe. La durée de cette étude s'étend jusqu'au vingt-six Mai 2023.

Quelle est la raison du choix porté en votre personne ?

Vous avez été sélectionné pour participer à cette étude car vous êtes un élément très important pour le bon déroulement de toutes les étapes futures de l'étude. En tant que spécialiste en génétique, votre expertise nous permettra de mieux comprendre les implications génétiques dans le trouble langage observés chez les enfants trisomiques.

La participation est-elle volontaire?

Oui, c'est à vous de décider si vous souhaitez participer ou non à cette étude. Si vous décidez de participer à cette étude, vous recevrez cette fiche d'information sur l'étude et on vous demandera de signer un formulaire de consentement. Vous pouvez vous retirer de l'étude dans la semaine suivant l'entretien, avant le début de la période d'analyse des données, si vous le souhaitez et sans avoir besoin d'aucune justification et sans aucun préjudice.

Qu'est-ce qui est inclus dans la participation?

L'étude s'étend jusqu'au vingt-six Mai 2023, quant à votre participant à l'étude, ce sera une fois et pour environ une trentaine de minutes. La participation sera une interview en visioconférence sur la plateforme de votre choix; toutefois nous suggérons ZOOM, pour vous afin de répondre à nos questions. L'interview sera enregistrée dans le but d'étudier son contenu uniquement par les étudiants qui mènent cette recherche et en

toute confidentialité et toutes les données obtenues seront détruites à la fin de la présente étude.

Pourquoi votre participation est-elle si importante ?

En participant à l'étude, vous contribuerez à enrichir l'équilibre des données scientifiques dans l'aspect linguistique chez les trisomiques dans la langue arabe, en particulier qui connaîune manque considérable dans l'ensemble de la recherche scientifique et des études universitaires en Algérie et dans le monde. En plus, à travers votre participation à l'étude, vous contribuez également au processus de recherche et de développement de potentielles méthodes qui aideront ces enfants à améliorer leurs capacités à communiquer.

Les données seront-elles strictement confidentielles?

Toutes les informations que nous recueillons au cours de l'étude resteront strictement confidentielles et vous ne serez identifié dans aucun rapport ou publication et vos informations personnelles ne seront pas mentionnées comme vos noms dans l'étude ou dans le formulaire de consentement.

L'interview sera-t-elle enregistrée et comment l'enregistrement sera-t-il utilisé?

L'entretien sera enregistré dans le but d'analyser son contenu uniquement par les étudiants qui mènent cette recherche et en toute confidentialité et toutes les données collectées seront détruites à la fin de l'étude. Le formulaire de consentement ne sera utilisé qu'avec votre autorisation écrite et personne en dehors de l'étude n'est autorisé à accéder à son contenu.

Point de contact pour plus d'informations:

Vous pouvez toujours nous contacter par e-mail ou aux numéros de téléphone indiqués ci-dessus.

Si vous décidez de participer à l'étude, vous pouvez recevoir cette fiche d'information et on vous demandera de signer un formulaire d'approbation, dont vous pouvez toujours obtenir une copie.

Nous vous remercions sincèrement et vous adressons notre appréciation et notre profonde gratitude pour votre travail dévoué et pour vos efforts en vue du succès de cette étude.

Abu Bekr Belkaid University of Tlemcen

Faculty of Letters and Languages

Department of English

CONTACTS:

Student: Hassimi Salif Guindo

[redacted]

Supervisor: Prof. Belmaki Amin

[redacted]

Co-supervisor: Dr. Ferkache Sarra Menal

[redacted]

INFORMATION SHEET

Research Title:

"The Effects of Agrammatic Broca's Aphasia on the Arabic Morpho-syntactic Structure: The Case of Down syndrome Children in Tlemcen"

I am honored to invite you to participate in an academic research project, before you decide, please first understand the reason for the research we are conducting and the norms involved in your participation. Please take the time to read the present information sheet carefully and discuss it with others if it is necessary. You can always contact us if there is anything that you find less clear or if you want further information. Thank you for reading carefully.

What is the purpose of this study?

This study aims to discover the grammatical and morphological difficulties and problems faced by children with Down syndrome in Arabic in particular, in order to identify them and compare them with the difficulties that have already been reported by other researchers in other languages such as English, German or Hebrew, which will permit us to know the extent of the impact of chromosome 21 on the internal structure of the brain and its linguistic functions in particular. This study aims to explore and describe the aforementioned difficulties in children with Down syndrome in Arabic. The duration of this study extends until 26th May 2023.

What is the reason for the choice made in your person?

You have been selected to participate in the present study because you constitute a tremendous element for the smooth execution of the subsequent stages of the inquiry. As a specialist in genetics, your expertise will permit us to better understand the genetic implications of the language disorders observed in children with Down syndrome.

Is the participation voluntary?

Yes, it solely depends upon you to decide whether or not you want to participate in the present study. If you decide to participate in this study, you will receive this study information sheet and you will be asked to sign a consent form. You can withdraw from the study one week following the interview, before the start of the data analysis period, if you wish and without the need for any justification and without any prejudice.

What is included in participation?

The study extends until 26th May 2023, as for your participation, it will be once and for about thirty minutes. The participation will be a videoconference interview on the platform of your choice; however we recommend ZOOM, for better technical advantages. The interview will be audio-recorded for analysis purpose involving solely its content which will be only accessible to the students conducting this research and in complete confidentiality. All data obtained will be destroyed at the end of the study.

Why is your participation so significant?

By participating in the study, you will contribute to enriching the balance of scientific data in the linguistic specificities of Down syndrome in the Arabic language, especially the latter is experiencing a considerable scarcity in all scientific inquiries and university studies in Algeria and worldwide. In addition, through your participation in the present study, you also contribute to the process of research and development of potential methods that will help the affected children improve their communication skills.

Will the collected data be strictly confidential?

All information we collect during the study will be kept strictly confidential and you will not be identified in any report or publication and your personal data, such as your name, kept confidential in the study and in the consent form.

Will the interview be recorded and how will the recording be utilised?

The interview will be audio-recorded for the analysis purpose and the latter will be exclusively accessible to the students conducting this research and in strict confidentiality and all data collected will be destroyed at the end of the inquiry. The consent form will only be used with your written permission and no one outside the study will be given access its contents.

Contact point for more information:

You can contact us anytime by e-mail or at the phone numbers listed above.

If you decide to participate in the study, you may receive this information sheet and you will be asked to sign a consent form, a copy of which you can obtain.

We sincerely thank you and express our appreciation and deep gratitude for your dedicated work and efforts towards the success of this study.

Appendix G: Interview Consent Form

Université Abu Bekr Belkaid de Tlemcen

Faculté des Lettres et des Langues Étrangères

Départ de la langue Anglaise

Noms des Étudiants :

Khoudour Rayene

Guindo Hasimi Salif

Numéro de participant

FORMULAIRE DE CONSENTEMENT

Titre de la recherche :

"The Effects of Agrammatic Broca's Aphasia on the Arabic Morpho-syntactic Structure: The Case of Down syndrome Children in Tlemcen"

« Les effets de l'aphasie de Broca sur la structure morpho-syntaxique de la langue Arabe: le cas des enfants atteints de Trisomie 21 à Tlemcen »

1. Je confirme que j'ai lu et compris la fiche d'information à la date du ☐ qui sera incluse pour l'étude ci-dessus. J'ai eu l'occasion d'examiner l'information, de poser des questions et d'y répondre de façon satisfaisante. ☐

2. Je comprends que ma participation est volontaire et que je suis libre de me retirer dans la semaine suivant l'interview sans donner de raison. ☐

3- J'ai noté mon numéro de participant/e en haut à droite du formulaire. Ce numéro est important et c'est ce dont nous utilisons pour analyser les donner ou les retirer si vous choisissiez de vous retirer de la présente étude. ☐

4. Je comprends que les résultats de cette étude peuvent être publiés et/ou présentés lors de réunions ou de conférences universitaires. J'autorise la publication de données anonymes, qui ne révèleront pas mon identité. ☐

5. J'accepte l'enregistrement audio de l'interview. L'enregistrement sera copié et analysé à des fins de recherche. ☐

6. J'accepte l'utilisation de citations textuelles extraites de mes réponses; mon nom ne sera pas mentionné mais je comprends qu'il y a un risque d'être identifié. ☐

7. J'accepte de participer à cette présente étude. ☐

Nom du/de la participant/e :…….

Date:……..

Signature:…….

Nom de l'étudiant recepteur :…….

Date:……..

Signature:…….

Abu Bekr Belkaid University of Tlemcen

Faculty of Letters and Languages

Department of English

Students' Names :

Khoudour Rayene

Guindo Hasimi Salif

Participant's Number

CONSENT FORM

Research Title :

"The Effects of Agrammatic Broca's Aphasia on the Arabic Morpho-syntactic Structure: The Case of Down syndrome Children in Tlemcen"

1-I confirm that I have read and understood the present research information sheet on this date _____ that will be included in the above mentioned study. I have fully understood the explanation given to me by the researchers on this subject. _____

2. I understand that my participation in this survey is voluntary and that I may withdraw at any time and without any justification.

3. I understand that the data collected during this research may be given to the appropriate authorities if necessary. I give my permission for these authorities to have access to my personal data. The researchers guarantee the respect of all the confidentialities. ☐

4. I understand that the results of this research may be published and/or presented at academic seminars or conferences. I give my permission for my anonymous, non-identifying data to be used in this way. ☐

5. I give my consent for the survey to be audio recorded. The recording will be transcribed and analysed for research purposes. ☐

6. I agree that the data I provide may be used verbatim in publications without naming me, but I am aware that there may be a risk for me to be identified if necessary. ☐

7. I agree to participate in the present study. ☐

Participant's name :.....

Date:.....

Signature:.....

Name of the Consent Receiver : .....

Date:.....

Signature:.....

Appendix H: Database

Appendix H-1: Database Menu: Code and Structure

Bouton de commande: Commande23

Bouton de commande: Commande25

Étiquette: Étiquette10

Étiquette: Étiquette11

Étiquette: Étiquette12

Étiquette: Étiquette13

Étiquette: Étiquette14

Étiquette: Étiquette15

Étiquette: Étiquette39

Étiquette: Étiquette40

Bouton de commande: formpahse1

Bouton de commande: formphase02

Bouton de commande: formphase03

Bouton de commande: formphase04

Image: Image20

Image: Image22

Image: Image24

Image: IndépendantOLE17

Cadre d'objet indépendant: IndépendantOLE19

Bouton de commande: Phase01data_analysis

Bouton de commande: quiter

Code

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  'True
END
Attribute VB_Name = "Form_Menu"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = True
Attribute VB_Exposed = False
Option Compare Database

Private Sub Form_Open(Cancel As Integer)
 DoCmd.Maximize
```

```
End Sub
```

Autorisations d'accès utilisateur

admin	Suppression; Lire permissions; Définir permissions; Modifier propriétaire

Autorisations d'accès groupe

Admins	Suppression; Lire permissions; Définir permissions; Modifier propriétaire
Users	Suppression; Lire permissions; Définir permissions; Modifier propriétaire

Appendix I: Interview Guide

دليل المقابلة
الوقت: نصف ساعة.
المكان:

الوقت	الأسئلة
٣٠ دقيقة	١- هل تلاميذ متلازمة داون يعانون من مشاكل أو صعوبات في اللغة العربية؟ ما هي هاته الصعوبات ؟ ٢- هل يواجه تلاميذ متلازمة داون مشاكل أو صعوبات في النحو و الصرف؟ ما هي هاته الصعوبات؟ ٣- هل حدث أن وجدتم صعوبات في النحو مثل الابتداء، والفاعلية، والمفعولية، التقديم، والتأخير، والإعراب، والبناء، والذكر، والحذف و المبني للمجهول؟ ما هي هذه الصعوبات ؟ و هل أثرت على فهم التلاميذ للمعنى؟ ٤- هل حدث أن لاحظتم صعوبات في الصرف من أحكام الفِعل وتقسيماته (ماضٍ، ومضارع، وأمر، الصّحة والاعتلال، الجمود والتّصرّف) أو الاسم وتقسيماته (التّذكير والتّأنيث، الإفراد والتّثنية والجمع، التّجرّد والزّيادة)؟ هل لاحظتم هذه الصعوبات في الحديث التلقائي و العفوي للتلاميذ ؟ ٥- هل لاحظتم أية صعوبات في الكلمات الوظيفية كحروف الجر و العطف و حروف الشرط و الإستفهام؟ هل حدث أن لاحظتم حذف هذه الكلمات من طرف التلاميذ في كتابتهم أو حديثهم ؟

Interview Guide:

Time: 30 minutes.
Location:
Date:

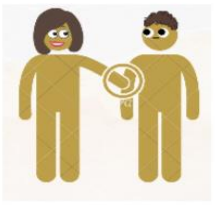
30 minutes	The questions: 1- Are Down syndrome pupils experiencing Arabic language problems or difficulties? What are these difficulties? 2- Are Down syndrome pupils experiencing problems or difficulties in syntax and morphology? What are these difficulties? 3- Have you encountered difficulties such as cases of being the object، cases of being the subject, forwarding, postponing, the Arabic case system [ʔiʕraːb], indeclinablity, omission, mentioning and passive voice? What are these difficulties? Did it affect pupils' understanding of the meaning? 4- Have you noticed difficulties in dispensing with verb's provisions and divisions (past, present, imperative, defective, etc.) or noun's divisions (masculine, feminine, singular, dual, plural, etc.)? Have you noticed these difficulties in the spontaneous speech of pupils? 5- Have you noticed any difficulties with functional words such as prepositions, conditional particles and interrogative particles? Have you noticed the deletion of these words by the pupils in their writing or speaking?

Appendix J: Test Questions

أَضَعُ حَرْفَ الْجَرِّ فِي الْمَكَانِ الْمُنَاسِبِ: مِنَ، إِلَى، فِي

- ذَهَبْتُ ..... السَّيَّارَةِ..... السُّوقِ.
- خَرَجَ التِّلْمِيذُ ..... القِسْمِ.
- وَضَعَتْ أُمِّي المَلَابِسَ ..... الغَسَّالَةِ.
- سَنَذْهَبُ ..... الْبَحْرِ.

أَرْبِطُ:



لُمَسَتِ الأُخْتُ مِنْ طَرَفِ أَخِيهَا.

أُحَوِّطُ عَلَى الْجُمْلَةِ الْفِعْلِيَّةِ:

- الْوَلَدُ نَجَحَ فِي الْإِمْتِحَانِ.
- أَكَلَ الطِّفْلُ تُفَّاحَةً.
- الْجَوُّ جَمِيلٌ.

أُحَوِّطُ عَلَى الْفِعْلِ الْمُضَارِعِ:

- كُلَّ يَوْمٍ يَذْهَبُ التِّلْمِيذُ إِلَى المَدْرَسَةِ فَتَقُولُ لَهُ الْمُعَلِمَةُ إِجْلِسْ و أَكْمِلْ قِرَاءَةَ النَّصِّ.
- قَرَأَ التِّلْمِيذُ النَّصَّ و كَتَبَ فِي كُرَّاسِهِ الدَّرْسَ.
- يَجْرِي التَّلَامِيذُ فِي السَّاحَةِ.

صَرِّف الفعل أَكَلَ في المَاضِي:

هُمَا .....
هُنَّ .....

أَضَعُ الْكَلِمَاتَ دَاخِلَ الْجَدْوَلِ:

مُعَلِّمَةٌ، وَلَدٌ، بِئْرٌ، فَتَاةٌ، أَرْضٌ، سَمَاءٌ، تِلْمِيذَةٌ

الْمُؤَنَّث	الْمُذَكَّر

أُحَوِّلُ إِلَى الْجَمْعِ:

مُعَلِّمٌ: .....
بِئْرٌ: .....
تِلْمِيذَةٌ: .....
رَجُلٌ: .....
سَمَاءٌ: .....

أَضَعُ الْكَلِمَاتَ دَاخِلَ الْجَدْوَلِ:

رَجُلَانِ، تِلْمِيذٌ، كِتَابَانِ، كُرَاسٌ

الْمُفْرَدُ	الْمُثَنَّى

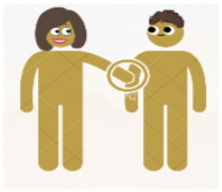
أُحَوِّطُ عَلَى إِسْمِ الإِنْسَانِ:

مُحَمَّدٌ ، قَلَمٌ ، مُعَلِّمٌ ، أُمِّي ، طَبِيبٌ ، أَسَدٌ ، رائد فضاء

أَضَعُ حَرْفَ الْجَرِّ فِي الْمَكَانِ الْمُنَاسِبِ: مِنَ، إِلَى، فِي
(I put the particles in the right place: from, to, in)

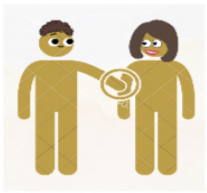
- ذَهَبْتُ ..... السَّيَّارَةِ..... السُّوقِ. "I went ... the car... the mall"
- خَرَجَ التِّلْمِيذُ ..... القِسْمِ. "The pupil got out ... the classroom"
- وَضَعَتْ أُمِّي المَلَابِسَ ..... الغَسَّالَةِ. "My mom put the clothes ... the watching machine"
- سَنَذْهَبُ ..... الْبَحْرِ. "We are going ... the see"

أَرْبِطُ:
(I select the right picture)



لُمِسَتِ الأُخْتُ مِنْ طَرَفِ أَخِيهَا.

"The sister was touched by her brother"



أُحَوِّطُ عَلَى الْجُمْلَةِ الْفِعْلِيَّةِ:
(I select the verbal sentence)

- الْوَلَدُ نَجَحَ فِي الْإِمْتِحَانِ. "The boy succeeded in the exam"
- أَكَلَ الطِّفْلُ تُفَّاحَةً. "Ate the boy the apple"
- الْجَوُّ جَمِيلٌ. "The weather is beautiful"

أُحَوِّطُ عَلَى الْفِعْلِ الْمُضَارِعِ:
(I circle the verb in the present simple tense)

- كُلَّ يَوْمٍ يَذْهَبُ التِّلْمِيذُ إِلَى المَدْرَسَةِ فَتَقُولُ لَهُ الْمُعَلِمَةُ إِجْلِسْ و أَكْمِلْ قِرَاءَةَ النَّصِّ.
-
"Every day the boy goes to the school the teacher tells him sit and finish reading the text"
- قَرَأَ التِّلْمِيذُ النَّصَّ و كَتَبَ فِي كُرَّاسِهِ الدَّرْسَ.
- "Read the pupil the text and wrote in his copybook the lesson"
- يَجْرِي التَّلَامِيذُ فِي السَّاحَةِ.

- "Run the pupils in the square"

صَرِّف الفعل أَكَلَ في المَاضِي:
(Conjugate the verb to eat in the past simple)

هُمَا (they for dual) .....
هُنَّ (they for feminine plural).....

أَضَعُ الْكَلِمَاتَ دَاخِلَ الْجَدْوَلِ:
(I put the words inside the table)

مُعَلِّمَةٌ، وَلَدٌ، بِئْرٌ، فَتَاةٌ، أَرْضٌ، سَمَاءٌ، تِلْمِيذَةٌ
teacher (female), boy, well, girl, earth, sky, pupil (female)

المُؤَنَّث Feminine	المُذَكَّر Masculine

أُحَوِّلُ إِلَى الْجَمْعِ:
(I transform to plural form)

مُعَلِّمٌ (teacher male): .....
بِئْرٌ(well): .....
تِلْمِيذَةٌ(pupil female): .....
رَجُلٌ(man): .....
سَمَاءٌ(sky): .....

أَضَعُ الْكَلِمَاتَ دَاخِلَ الْجَدْوَلِ:
(I put the words in the table)

رَجُلَانِ، تِلْمِيذٌ، كِتَابَانِ، كُرَّاسٌ
men (dual form), pupil, books (dual form), copybook

المُفْرَدُ Singular	المُثَنَّى Dual

أُحَوِّطُ عَلَى إِسْمِ الإِنْسَانِ:
(I circle human name)

مُحَمَّدٌ ، قَلَمٌ ، مُعَلِّمٌ ، أُمِّي ، طَبِيبٌ ، أَسَدٌ ، رائد فضاء
Mohamed, pen, teacher, mother, doctor, lion, astronaut

Appendix K: Observation Grid

Date	April, 10th 2023
	orally. During the first session of observation, the teacher asked the students to conjugate verbs with different pronouns. It was apparent that the " "أpupils have an eminent difficulty with subject-verb agreement. Only one pupil found that the in " "أراجعbecomes " "تwith " "أنتand that was with the help of the teacher. Moreover, one of the pupils used ") "دروسناour lessons) instead of ") "دروسكyour lessons) with ") "أنتyou). Additionally, one of the pupils said that " "أناshould be " "ناinstead of " ."أنتAnother pupil said that " "أin " "أراجعshould be changed to " "نwith " ."أنتFurthermore, most of the students were silent and reluctant when asked to replace the pronoun ") "أناI) with ") "أنتyou). Moreover, they exhibited a comprehension deficit of tenses. Only two pupils were able to discern that the verb in
Theme 4	**Observing Inflectional Morphemes in Nouns Classification:** The pupils displayed observable issues with inflectional morphemes in nouns classification orally. When they were asked if the proper noun" "شكريis a noun or a verb, they were all silent and hesitated to answer except for one pupil. Moreover, one of the pupils considered the adjective ") "نشيطenergetic) to be a verb whereas the rest of the pupils struggled to remember the lesson of adjectives. Additionally, One pupil used the adjective ") "كبيرbig) to describe his female friend despite the fact that the teacher used the adjective ") "صغيرةsmall) with the feminine inflectional morpheme to provoke them to find " ."كبيرة Similarly, one of the pupils used the word animal ((حيوانto refer to a group of animals (.(حيواناتBesides, one of the pupils selected the noun ") "قصةa story) when asked to circle the adjective in a sentence and another student claimed the noun ") "غذاءnutrition) to be an adjective. Furthermore, One of the pupils read the adjective" "طويلas " "طويلةin " "جدتي شعرها طويل"showing an ostensible noun-adjective agreement issue.
Theme 5	**Observing Comprehension Deficit:** During the observation, the pupils demonstrated a comprehension deficit both at the syntactic and the morphological levels. This latter was also discerned in their oral speech production. During the teacher's efforts to review previously covered material with the pupils upon their return from the holidays, it became apparent that the pupils encountered challenges in recalling the knowledge they had previously acquired. Additionally, most of them were reluctant to read, showing an apparent difficulty with reading. Withal, they did not know how to make pauses between words properly. The same can be said about the unneeded pauses between letters like in the word " ش ج ع ."ا As for "i'rāb", they tend to remember it with gestures like the accusative sign with hands above their heads and the nominative sign by moving their hands in a round shape next to their mouths. Furthermore, the pupils employed non-verbal gestures to indicate question instructions such as using hand movements to create circular motions in the air. Moreover, during the oral production session, one pupil erroneously asserted that the lion lives in the house, in addition to that there was a collective hesitation among the pupils when asked whether the lion is a wild or a domestic animal. Furthermore, when

Date	April, 10th 2023
	talking about the circus, the pupil who recently went to it was participating and she was enthusiastic about it, whereas the rest of the pupils were reluctant. Besides, the teacher read the text with the aid of gestures, pictures and tools and she was constantly explaining new words by performing the action of the word. For instance, the action "يقفز = ينطto jump) which pushed the pupils to start participating and imitating the action. The teacher also explained the word ")"ضخمhuge) with opening her hands and with simple words like " كبير و ."سمينThe teacher also explained words like ") "مخيلةimagination) and ") "مقعدseat) with gestures, antonyms, simple terms and dialectal Arabic. Moreover, the teacher was constantly repeating the new words along with their explanations. Additionally, the pupils exhibited an apparent difficulty with their short-term memory. When the teacher removed the picture from the board and requested one of the pupils to recall all the animals depicted in the picture, the pupil hesitated and expressed that she forgot. Furthermore, when the pupils were asked to write what they saw in the picture, the teacher was dictating the words letter by letter repetitively so that they could manage to write them down. Additionally, they used gestures to remember how letters are written, like the letter " "تwith hands when it is in the middle of a word.
Theme 6	**Observing Grammatical Related Processes/Operations:** The pupils were observed to use scattered words with no grammatical structures. For instance, they did not use full sentences when describing the picture, instead they used scattered words like in " بماذا يلعب الفيل؟", "كرة،كرة".Additionally, when asked about what the lion was doing, a pupil said "seat" ((مقعدto explain that the lion was sitting on a chair.
Behaviour	The pupils displayed a warm reception, expressing their welcome through embraces and cheerful countenances. They were enthusiastic and started opening conversations with the researcher by telling stories about their last activities. Regarding their behaviour inside the classroom, the majority were lazy, tired, reluctant and easily distracted. The pupils also displayed innumerable pauses between letters when reading.
Environment	Both classes were full of colourful pictures of letters, days of the week, numbers, seasons, and syntactic rules. In addition, the items present included a mirror, a printer, a microwave, and a fridge.

Appendix L: Interview Guide

Questions de l'Interview

Tout d'abord, pouvez-vous vous présenter (en relation avec votre profile actuel de spécialiste en génétique).

1-Qu'est-ce que le génome pour l'humain ?

a- Pouvez-vous nous expliquer comment le génome forme le corps?

b- Comment le cerveau est-il formé et régulé par le génome ?

c- Sachant que le génome forme tous les organes du corps, peut-on dire que le génome et le code de la vie?

2- Pouvez-vous donner une description du profil génétique des trisomiques?

a- Quelle est la cause génétique de ce syndrome ?

b- Qu'est-ce qui différencie les trisomiques des personnes ordinaires, génétiquement?

c- Par exemple, le développement de la langue est très lent chez les enfants trisomiques. Peut-on dire que cette différence dans l'acquisition de la langue qui existe entre les enfants ordinaires et les enfants trisomiques est causée par l'anomalie génétique ?

d- Des recherches précédentes ont démontré que l'enfant trisomique a certaines différences neurologiques telles qu'une réduction de la taille du cerveau, une lenteur dans la formation des neurones, un dysfonctionnement des activités synaptiques et autres. Peut-on affirmer que ces anomalies neurologiques sont causées par l'anomalie génétique ?

3- Quel est le rôle du génome sur la faculté à apprendre comme l'acquisition de la langue par exemple?

a- Quel est le rôle du génome sur la cognition (par exemple la mémoire à courte et à long terme)?

b- Sachant que l'anomalie génétique est innée, peut-on dire que le problème de production de langues qu'elle cause est aussi génétiquement inné? Je veux dire, est-il possible de dire que ses enfants ont une aphasie de Broca depuis la naissance? L'aphasie de Broca est un déficit qui empêche la bonne production du langage, surtout la grammaire, ce qui est symptomatique chez les trisomiques et particulièrement les enfants.

c- Les études précédentes montrent que la morphologie des organes de production de la langue sont mal formés chez les enfants trisomiques, ce qui joue un rôle important dans le déficit de la production de la langue, est-elle donc une cause directe de l'anomalie génétique?

4- Des chercheurs ont rapporté que des facteurs génétiques pourraient causer des troubles de la langue, peut-on dire que l'anomalie génétique est la cause directe des troubles du langage chez les enfants trisomiques?

a- Peut-on affirmer que le génome est la réelle source de la langue et que le cerveau est un organe exécutif de la production et la perception de la langue?

5- Les résultats de nos recherches ont démontré que les enfants trisomiques, parlant l'Arabe, ont les mêmes difficultés du langage que ceux parlant d'autres langues comme l'Anglais ou l'Allemand ce qui montre le caractère universel de ces problèmes. Parmi ces difficultés nous avons: l'omission des syllabes finales (appelées des morphèmes d'inflexion dans les verbes et les noms comme les terminaisons des verbes et les marques du pluriel) l'omission des particules comme من ،الى ،في ،و, et la difficulté à utiliser et à comprendre les phrase de manière ordonnée et complexe, comme la voix passive. Selon moi, si ces difficultés convergent dans différentes langues et cultures, c'est qu'il y a quelque chose qui les lie. Ça pourrait être l'anomalie génétique qui leur est commune. **Pouvez-vous donner un commentaire génétique sur ces résultats ?**

6- Y a-t-il de nouvelles découvertes sur le profil génétique des enfants trisomiques; surtout celles en relation avec leur profil linguistique. Si oui, lesquels ?

a- Avez-vous quelque chose à ajouter?

Merci infiniment pour votre disponibilité et votre aide. Nous vous en sommes très reconnaissants.

Interview Questions

First of all, Could you introduce yourself (in relation to your current profile as a specialist in genetics).

1-What is the genome for humans?

a- Could you explain how the genome forms the body?

b- How is the brain formed and regulated by the genome? How?

c- Knowing that the genome forms all the organs of the body, can we say that the genome and the code of life?

2- Could you give a description of the genetic profile of Down syndrome?

a- What is the genetic cause of this syndrome?

b- What differentiates Down syndrome from ordinary people, genetically?

c- For example, language development is very slow in children with Down syndrome. Can we say that this difference in language acquisition that exists between ordinary children and children with Down syndrome is caused by the genetic abnormality?

d- Previous research has shown that the child with Down syndrome has certain neurological differences such as a reduction in brain size, slowness in the formation of neurons, dysfunction of synaptic activities and others. Can we say that these neurological abnormalities are caused by the genetic abnormality?

3- What is the role of the genome on the ability to learn such as language acquisition for example?

a- What is the role of the genome on cognition (e.g. short- and long-term memory)?

b- Knowing that the genetic anomaly is innate, can we say that the language production problem it causes is also genetically innate? I mean, is it possible to say that her children have had Broca's aphasia since birth? Broca's aphasia is a deficit that prevents the proper production, of language, mainly grammar, which is symptomatic in Down syndrome patients and especially children.

c-Previous studies showed that the morphology of the organs of production of the tongue are poorly formed in children with Down syndrome, which plays an important role in the deficit of the production of the tongue, is it therefore a direct cause of the genetic abnormality?

4- Researchers have reported that genetic factors could cause language disorders, can we say that the genetic abnormality is the direct cause of language disorders in children with Down syndrome?

a- Can we affirm that the genome is the real source of language and that the brain is an executive organ of the production and perception of language?

5- The results of our research have shown that children with Down syndrome, speaking Arabic, have the same language difficulties as those speaking other languages such as English or German, which shows the universal nature of these problems. Among these difficulties we have: the omission of final syllables (called inflection morphemes in verbs and nouns like verb endings and plural marks), the omission of particles like من الى، في، و, and the difficulty in using and understanding sentences in an orderly and complex way, like the passive voice. In my opinion, if these difficulties converge in different languages and cultures, it is because there is something that binds them. This could be the genetic abnormality that is common to them. **Could you give a genetic comment or interpretation of these results?**

6- Are there any new discoveries on the genetic profile of children with Down syndrome; especially those related to their linguistic profile. If so, what are they?

a- Do you have anything to add?

Thank you so much for your availability and help. We are very grateful.

Phase1

University of Tlemcen
Departement of English

Phase01 Data Collection

SSI 1	BKH20_02_2023RKHTlemcen
SSI	1- Are Down syndrome pupils experiencing Arabic language problems or difficulties? What are these difficulties? 2- Are Down syndrome pupils experiencing problems or difficulties in syntax and morphology? What are these difficulties? 3- Have you encountered difficulties such as cases of being the object، cases of being the subject, forwarding, postponing, the Arabic case system [ʔiʕra:b], indeclinablity, omission, mentioning and passive voice? What are these difficulties? Did it affect pupils' understanding of the meaning? 4- Have you noticed difficulties in dispensing with verb's provisions and divisions (past, present, imperative, defective, etc.) or noun's divisions (masculine, feminine, singular, dual, plural, etc.)? Have you noticed these difficulties in the spontaneous speech of pupils? 5- Have you noticed any difficulties with functional words such as prepositions, conditional particles and interrogative particles?Have you noticed the deletion of these words by the pupils in their writing or speaking?
Setting	Alabouli Primary School,Tlemcen, Algeria. 3rd year.
Recording DateTime	M4A 02_2023RKHTlemcen.m4a (Ligne de comr
Transcription	

Appendix M-1: Interview Collected Data Repertoire in the Database : Code and Structure

D:\Trisomie\Trisomie.accdb mercredi 31 mai 2023
Table: Phase1 Page: 1

Propriétés

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HideNewField:	Faux	LastUpdated:	12/03/2023 17:34:01
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OrderByOnLoad:	Vrai	Orientation:	De gauche à droite
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Updatable:	Faux		

Colonnes

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SSI	Mémo	-
Setting	Mémo	-
DateTime	Date/Heure	8
Recording	Objet OLE	-
Transcription	Mémo	-
Translation	Mémo	-
Note1	Mémo	-
Note2	Mémo	-
Note3	Mémo	-
Note4	Mémo	-
Note5	Mémo	-
Objects	Objet OLE	-

Index de la table

Nom	Nombre de champs
PrimaryKey	1
Champs :	
Nphase1	Ascendant

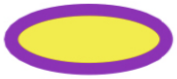
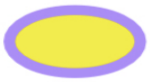
Autorisations d'accès utilisateur

admin	Suppression; Lire permissions; Définir permissions; Modifier propriétaire, Lire définition; Écrire définition; Lire données; Insérer données; Mettre à jour données; Supprimer données

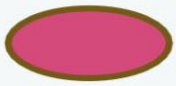
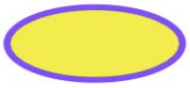
Autorisations d'accès groupe

Admins	Suppression; Lire permissions; Définir permissions; Modifier propriétaire, Lire définition; Écrire définition; Lire données; Insérer données; Mettre à jour données; Supprimer données
Users	Suppression; Lire permissions; Définir permissions; Modifier propriétaire, Lire définition; Écrire définition; Lire données; Insérer données; Mettre à jour données; Supprimer données

Appendix N: Interview Meaning Coding Key

Code	Text	Code	Text
إسم إنسان Human's noun		التحويل صعب Transformation is hard	
إسم شيء Thing's noun		مشكل الحذف The problem of omission	
إسم مؤنث Feminine noun		حذف حروف الجر Omitting prepositions	
إسم مذكر Masculine noun		حذف الكلمات الوظيفية Omitting function words	
مشاكل الجمع Plural's problems		حذف حروف الربط Omitting conjunctions	
جمع المذكر السالم The sound masculine plural		حذف حروف الشرط Omitting conditionals	
جمع المؤنث السالم The sound feminine plural		أهمية الدارجة The importance of the dialect	
صعوبة في جمع التكسير Difficulty in the broken plural		حروف الإستفهام Interrogative particles	
التكرار، التمرن و التطبيق Repetition and practice		الألف و اللام الشمسية Sun "al"	

Code	Text	Code	Text
القراءة Reading		عدم فهم الروحانيات The non-understanding of spiritual concepts	
صعوبة في أضداد و مرادفات الكلمات Difficulty in words' synonyms and antonyms		الحروف The letters	
أهمية مألوفية الكلمة The importance of the familiarity of the word		التفريق بين الأسماء و الأفعال/ التفريق بين الجمل Making the difference between nouns and verbs/ making the difference between sentences	
الفهم و الإدراك Understanding and realisation		حالات مختلفة Different cases	
صعوبة الإعراب Difficulty in [ʔiʕraːb]		صعوبة في إسترجاع المعلومات القبلية Difficulty in retrieving previous information	
لا إدراك للأوزان No realisation for measures		Un prérequis A prerequisite	
حذف الواو و النون Omission of inflectional suffixes "ون"		الحفظ من أجل الحفظ Memorising for the sake of memorising	
كلمات مقطعة Scattered words		أهمية الأسئلة المباشرة The importance of direct questions	

Code	Text	Code	Text
مشاكل في الذاكرة قصيرة المدى Problems in the short term memory		أهمية أن تكون الأشياء مكتوبة أمامه The importance of having things written before him	
حروف العطف Coordinating conjunctions		مشكلة في التوظيف Problem in employability	
رصيد لغوي فقير Poor linguistic repertoire		Des supports visuels, gestuels et sonores Visual, gestural and audio aids	
أهمية تلخيص النص The importance of summarising the text		العمر العقلي و العمر الزماني Mental age and chronological age	
أهمية حكاية النص كحكاية The importance of narrating the text like a story		الإفراد و التثنية Singular and dual	
أهمية إعطاء فرصة التكلم و القراءة The importance of giving the chance for talking and reading		التجرد و الزيادة Derived and non derived forms	
يجب دائما السهل الممتنع Always facilitate things		حديث غير متناسق Incoherent discourse	
يجب إعطاء الأمثلة Giving examples is a must		الأطفال كسالى The children are lazy	
التخلف/ التأخر Retardation		كبر حجم اللسان في الفم Protrusion	

Code	Text	Code	Text
إرتخاء في عضلات الفم و الوجه Orofacial hypotonia		Les doubles instructions Double questions	
نقص التركيز Lack of concentration			
Repère Reference			

Appendix O: Interview Analysis Repertoire in the Database

Appendix O-1: Interview Data Analysis Repertoire in the Database: Code and Structure

D:\Trisomie\Trisomie.accdb mercredi 31 mai 2023
Table: Phase1_Analysis Page: 1

Propriétés

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Updatable:	Faux		

Colonnes

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Meaning_Coding	Objet OLE	-
Meaning_Coding_Key	Objet OLE	-
Meaning_Coding_Note	Mémo	-
Meaning_Condensation	Objet OLE	-
Meaning_Condensation_Note	Mémo	-
Themes	Objet OLE	-
Themes_Note	Mémo	-
Meaning_Interpretaion	Mémo	-

Index de la table

Nom	Nombre de champs
Nphase1	1
Champs :	
Nphase1ana	Ascendant
PrimaryKey	1

Champs :

Nphase1ana	Ascendant

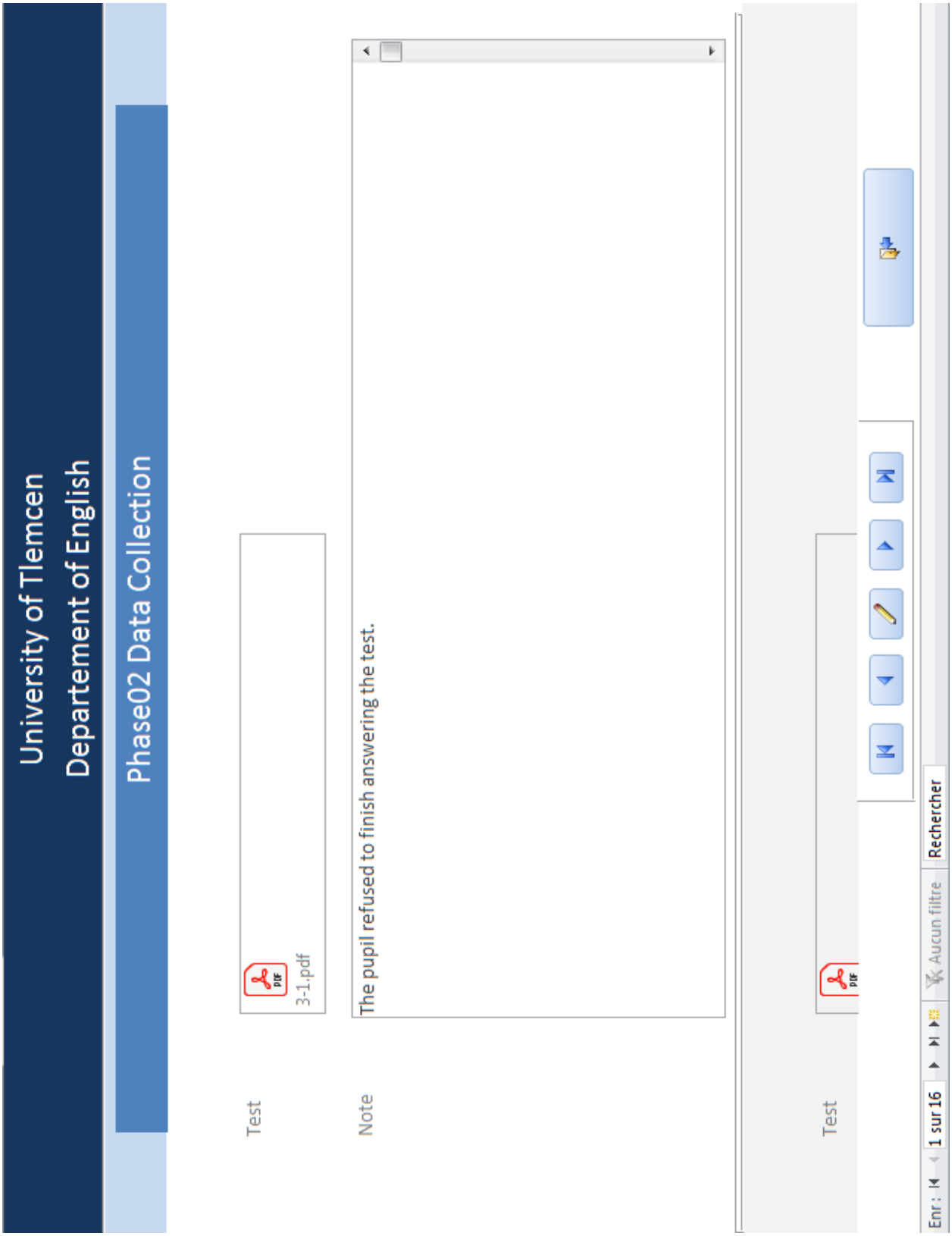
Autorisations d'accès utilisateur

admin	Suppression; Lire permissions; Définir permissions; Modifier propriétaire, Lire définition; Écrire définition; Lire données; Insérer données; Mettre à jour données; Supprimer données

Autorisations d'accès groupe

Admins	Suppression; Lire permissions; Définir permissions; Modifier propriétaire, Lire définition; Écrire définition; Lire données; Insérer données; Mettre à jour données; Supprimer données
Users	Suppression; Lire permissions; Définir permissions; Modifier propriétaire, Lire définition; Écrire définition; Lire données; Insérer données; Mettre à jour données; Supprimer données

Appendix P: Test Data Collection Repertoire in the Database



Appendix P-1: Test Data Collection Repertoire in the Database: Code and Structure

D:\Trisomie\Trisomie.accdb mercredi 31 mai 2023
Table: Phase2 Page: 1

Propriétés

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OrderByOnLoad:	Vrai	Orientation:	De gauche à droite
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Updatable:	Faux		

Colonnes

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Test	Objet OLE	-
Note	Mémo	-

Index de la table

Nom	Nombre de champs
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Champs :	
Nphase2	Ascendant

Autorisations d'accès utilisateur

admin	Suppression; Lire permissions; Définir permissions; Modifier propriétaire, Lire définition; Écrire définition; Lire données; Insérer données; Mettre à jour données; Supprimer données

Autorisations d'accès groupe

Admins	Suppression; Lire permissions; Définir permissions; Modifier propriétaire, Lire définition; Écrire définition; Lire données; Insérer données; Mettre à jour données; Supprimer données
Users	Suppression; Lire permissions; Définir permissions; Modifier propriétaire, Lire définition; Écrire définition; Lire données; Insérer données; Mettre à jour données; Supprimer données

Appendix Q: Cross-Analysis of Requests Using SQL: Techniques and Insights

D:\Trisomie\Trisomie.accdb mercredi 31 mai 2023
Requête: Ex7analysecroisé_Analyse croisée Page: 1

Propriétés

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LastUpdated:	09/04/2023 22:29:42	MaxRecords:	0
ODBCTimeout:	60	Orientation:	De gauche à droite
RecordLocks:	Aucun	RecordsAffected:	0
RecordsetType:	Feuille de réponse dynamique	ReturnsRecords:	Vrai
Type:	16	Updatable:	Vrai

SQL

```
TRANSFORM Sum(Ex7analysecroisé.[NBREP]) AS SommeDeNBREP
SELECT Ex7analysecroisé.[Q]
FROM Ex7analysecroisé
GROUP BY Ex7analysecroisé.[Q]
PIVOT Ex7analysecroisé.[REP];
```

Autorisations d'accès utilisateur

admin	Suppression; Lire permissions; Définir permissions; Modifier propriétaire, Lire définition; Écrire définition; Lire données; Insérer données; Mettre à jour données; Supprimer données

Autorisations d'accès groupe

Admins	Suppression; Lire permissions; Définir permissions; Modifier propriétaire, Lire définition; Écrire définition; Lire données; Insérer données; Mettre à jour données; Supprimer données
Users	Suppression; Lire permissions; Définir permissions; Modifier propriétaire, Lire définition; Écrire définition; Lire données; Insérer données; Mettre à jour données; Supprimer données

Propriétés

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OrderByOn:	Faux	OrderByOnLoad:	Vrai
Orientation:	De gauche à droite	PublishToWeb:	1
ReadOnlyWhenDisconnected:	Faux	RecordLocks:	Aucun
RecordsAffected:	0	RecordsetType:	Feuille de réponse dynamiqu
ReturnsRecords:	Vrai	ThemeFontIndex:	-1
TotalsRow:	Faux	Type:	16
Updatable:	Vrai		

SQL

```
TRANSFORM Sum(freqQ1prep.[nb]) AS SommeDenb
SELECT freqQ1prep.[Question]
FROM freqQ1prep
GROUP BY freqQ1prep.[Question]
PIVOT freqQ1prep.[rep];
```

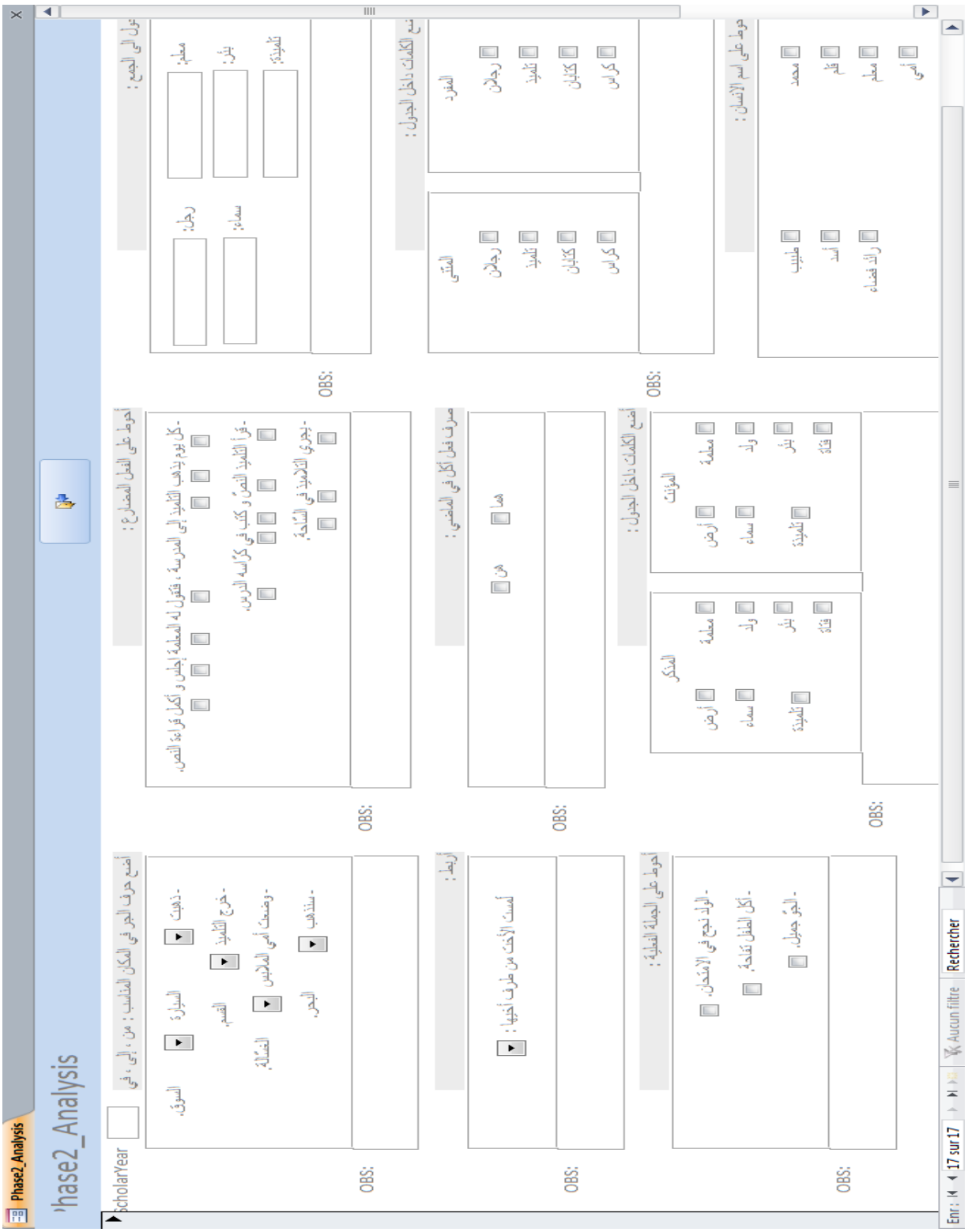
Autorisations d'accès utilisateur

admin	Suppression; Lire permissions; Définir permissions; Modifier propriétaire, Lire définition; Écrire définition; Lire données; Insérer données; Mettre à jour données; Supprimer données

Autorisations d'accès groupe

Admins	Suppression; Lire permissions; Définir permissions; Modifier propriétaire, Lire définition; Écrire définition; Lire données; Insérer données; Mettre à jour données; Supprimer données
Users	Suppression; Lire permissions; Définir permissions; Modifier propriétaire, Lire définition; Écrire définition; Lire données; Insérer données; Mettre à jour données; Supprimer données

Appendix R: Data Analysis of Test Results in the Database



Appendix R-1: The Repertoire of Test Data Analysis in the Database: Code and Structure

D:\Trisomie\Trisomie.accdb mercredi 31 mai 2023
Table: Phase2_Analysis Page: 1

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OrderByOnLoad:	Vrai	Orientation:	De gauche à droite
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Updatable:	Faux		

Colonnes

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EX1Q1B	Texte	255
EX1Q2A	Texte	255
EX1Q3A	Texte	255
EX1Q4A	Texte	255
EX1OBS	Texte	255
EX2Q1	Texte	255
EX2OBS	Texte	255
EX3Q1	Oui/Non	1
EX3Q2	Oui/Non	1
EX3Q3	Oui/Non	1
EX3OBS	Texte	255
Ex4Q1	Oui/Non	1
EX4Q1A	Oui/Non	1
Ex4Q1AA	Oui/Non	1
EX4Q1B	Oui/Non	1
Ex4Q1BB	Oui/Non	1
EX4Q1C	Oui/Non	1
Ex4Q1D	Oui/Non	1
EX4Q2A	Oui/Non	1
EX4Q2AA	Oui/Non	1
EX4Q2B	Oui/Non	1
Ex4Q2BB	Oui/Non	1
EX4Q2C	Oui/Non	1
EX4Q3A	Oui/Non	1

EX4Q3B	Oui/Non	1
Ex4Q3C	Oui/Non	1
EX4OBS	Texte	255
EX5Q1	Oui/Non	1
EX5Q2	Oui/Non	1
EX5OBS	Texte	255
EX6Q1A	Oui/Non	1
EX6Q1B	Oui/Non	1
EX6Q1C	Oui/Non	1
EX6Q1D	Oui/Non	1
EX6Q1E	Oui/Non	1
EX6Q1F	Oui/Non	1
EX6Q1G	Oui/Non	1
EX6Q2A	Oui/Non	1
EX6Q2B	Oui/Non	1
EX6Q2C	Oui/Non	1
EX6Q2D	Oui/Non	1
EX6Q2E	Oui/Non	1
EX6Q2F	Oui/Non	1
EX6Q2G	Oui/Non	1
EX6OBS	Texte	255
EX7Q1	Texte	255
EX7Q2	Texte	255
EX7Q3	Texte	255
EX7Q4	Texte	255
EX7Q5	Texte	255
EX7OBS	Texte	255
EX8Q1A	Oui/Non	1
EX8Q1B	Oui/Non	1
EX8Q1C	Oui/Non	1
EX8Q1D	Oui/Non	1
EX8Q2A	Oui/Non	1
EX8Q2B	Oui/Non	1
EX8Q2C	Oui/Non	1
EX8Q2D	Oui/Non	1
EX8OBS	Texte	255
EX9Q1A	Oui/Non	1
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EX9Q1D	Oui/Non	1
EX9Q1E	Oui/Non	1
EX9Q1F	Oui/Non	1
EX9Q1G	Oui/Non	1
EX9OBS	Texte	255

ScholarYear	Texte	255

Index de la table

Nom	Nombre de champs
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Champs :	
Nphase2ana	Ascendant
PrimaryKey	1
Champs :	
Nphase2ana	Ascendant

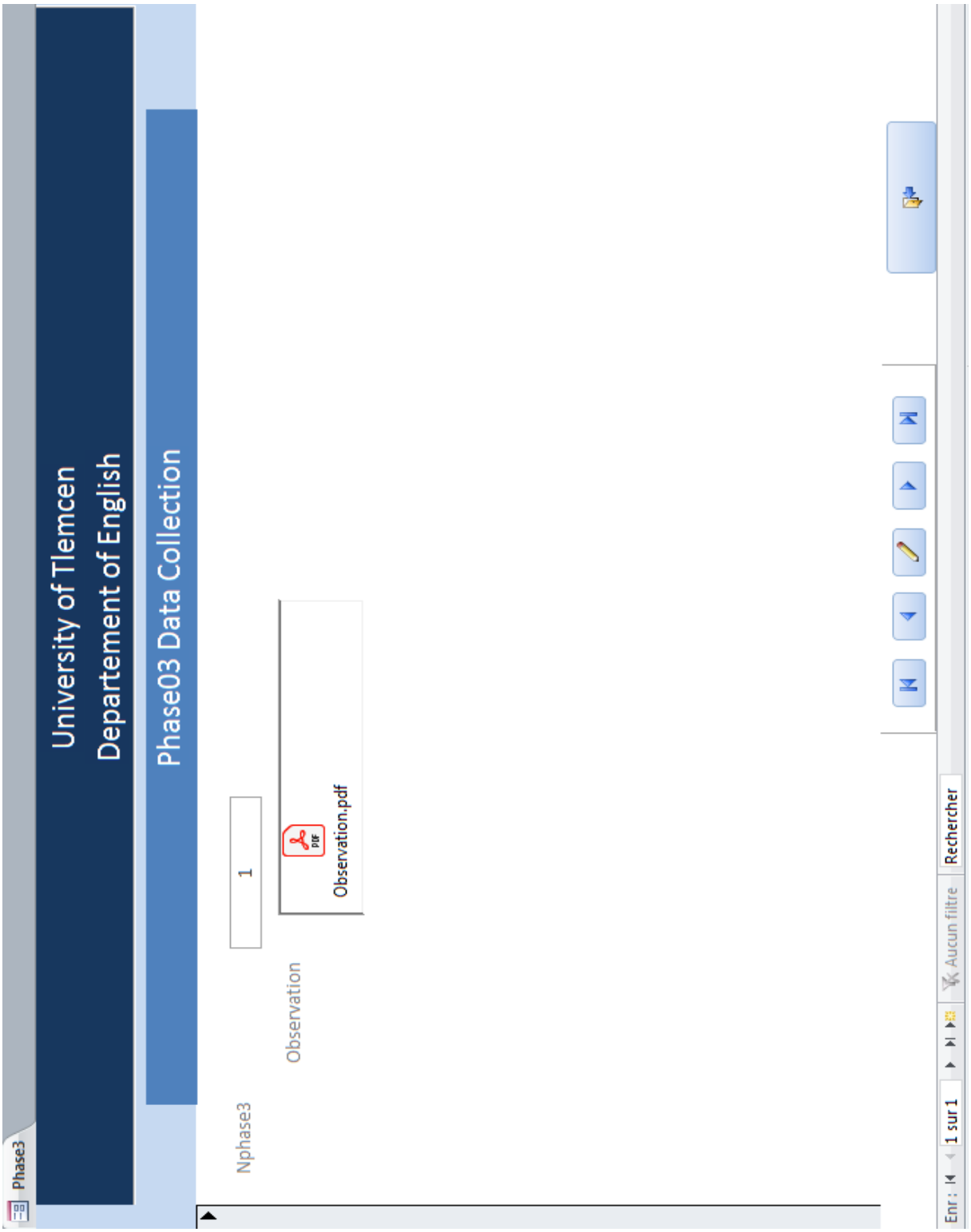
Autorisations d'accès utilisateur

admin	Suppression; Lire permissions; Définir permissions; Modifier propriétaire, Lire définition; Écrire définition; Lire données; Insérer données; Mettre à jour données; Supprimer données

Autorisations d'accès groupe

Admins	Suppression; Lire permissions; Définir permissions; Modifier propriétaire, Lire définition; Écrire définition; Lire données; Insérer données; Mettre à jour données; Supprimer données
Users	Suppression; Lire permissions; Définir permissions; Modifier propriétaire, Lire définition; Écrire définition; Lire données; Insérer données; Mettre à jour données; Supprimer données

Appendix S: The Repertoire of Observation Collected Data in the Database



Appendix S-1: The Repertoire of Observation Collected Data in the Database: Code and Structure

D:\Trisomie\Trisomie.accdb mercredi 31 mai 2023
Table: Phase3 Page: 1

Propriétés

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DatasheetGridlinesThemeColo	3	DateCreated:	12/03/2023 17:34:01
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HideNewField:	Faux	LastUpdated:	12/03/2023 17:34:01
NameMap:	Donnée binaire	OrderByOn:	Faux
OrderByOnLoad:	Vrai	Orientation:	De gauche à droite
PublishToWeb:	1	ReadOnlyWhenDisconnected:	Faux
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ThemeFontIndex:	1	TotalsRow:	Faux
Updatable:	Faux		

Colonnes

Nom	Type	Taille
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Observation	Objet OLE	-

Index de la table

Nom	Nombre de champs
PrimaryKey	1

Champs :

Nphase3	Ascendant

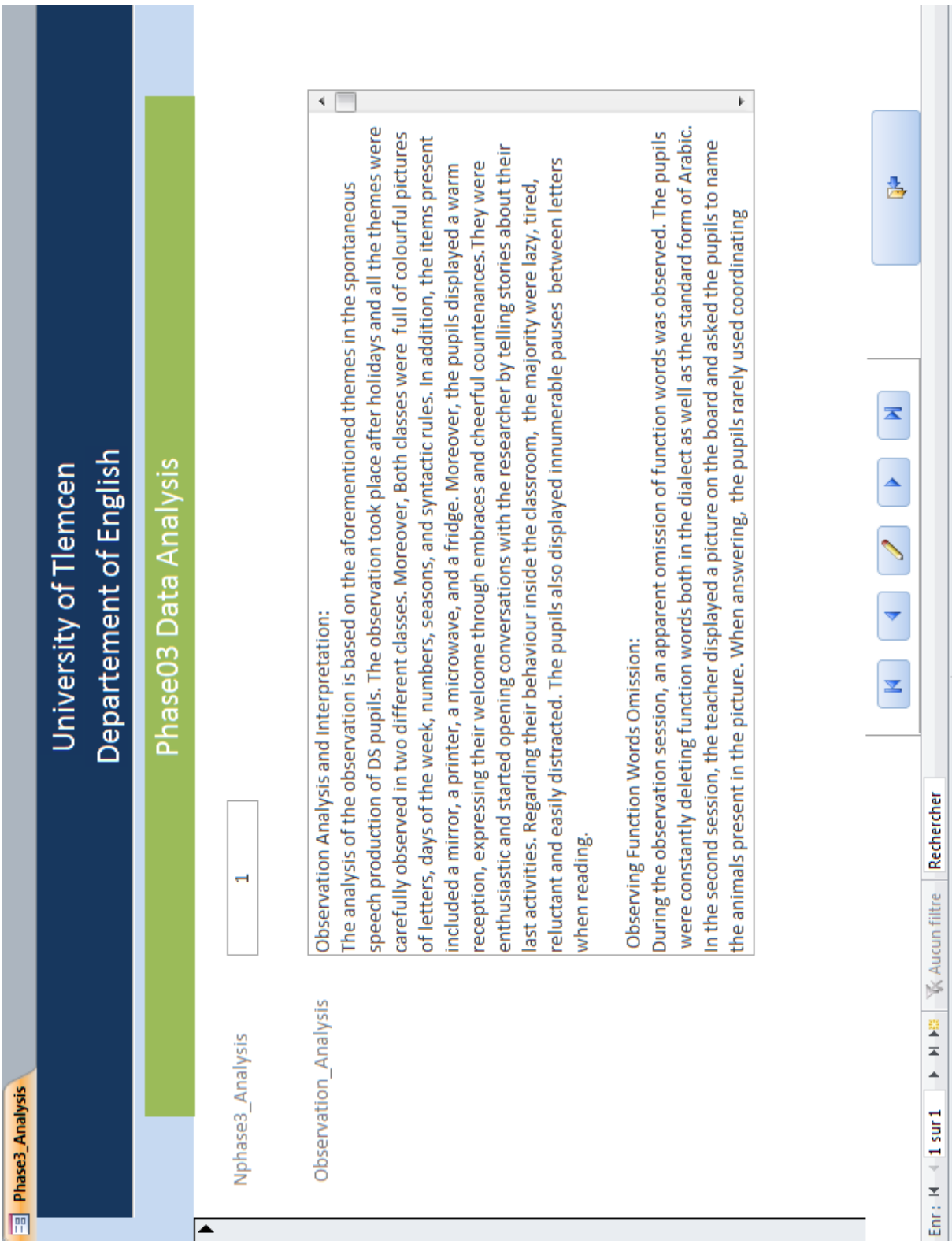
Autorisations d'accès utilisateur

admin	Suppression; Lire permissions; Définir permissions; Modifier propriétaire, Lire définition; Écrire définition; Lire données; Insérer données; Mettre à jour données; Supprimer données

Autorisations d'accès groupe

Admins	Suppression; Lire permissions; Définir permissions; Modifier propriétaire, Lire définition; Écrire définition; Lire données; Insérer données; Mettre à jour données; Supprimer données
Users	Suppression; Lire permissions; Définir permissions; Modifier propriétaire, Lire définition; Écrire définition; Lire données; Insérer données; Mettre à jour données; Supprimer données

Appendix T: The Repertoire of Observation Data Analysis in the Database



Appendix T-1: The Repertoire of Observation Data Analysis in the Database: Code and Structure

D:\Trisomie\Trisomie.accdb mercredi 31 mai 2023
Table: Phase3_Analysis Page: 1

Propriétés

AlternateBackShade:	95	AlternateBackThemeColorInd	1
AlternateBackTint:	100	Attributes:	Attaché
BackShade:	100	BackTint:	100
Connect:	;DATABASE=D:\Trisomie\TrisomieData\TrisomieData.accdb	DatasheetForeThemeColorInd	0
DatasheetGridlinesThemeColo	3	DateCreated:	16/05/2023 18:43:05
DefaultView:	2	DisplayViewsOnSharePointSit	1
FilterOnLoad:	Faux	GUID:	{guid {9E146F75-A941-40CB-8EE1-9EB5988F8A63}}
HideNewField:	Faux	LastUpdated:	16/05/2023 18:43:06
NameMap:	Donnée binaire	OrderByOn:	Faux
OrderByOnLoad:	Vrai	Orientation:	De gauche à droite
PublishToWeb:	1	ReadOnlyWhenDisconnected:	Faux
RecordCount:	-1	SourceTableName:	Phase3_Analysis
ThemeFontIndex:	1	TotalsRow:	Faux
Updatable:	Faux		

Colonnes

Nom	Type	Taille
Nphase3_analysis	Entier long	4
Observation_Analysis	Mémo	-

Index de la table

Nom	Nombre de champs
PrimaryKey	1
Champs :	
Nphase3_analysis	Ascendant

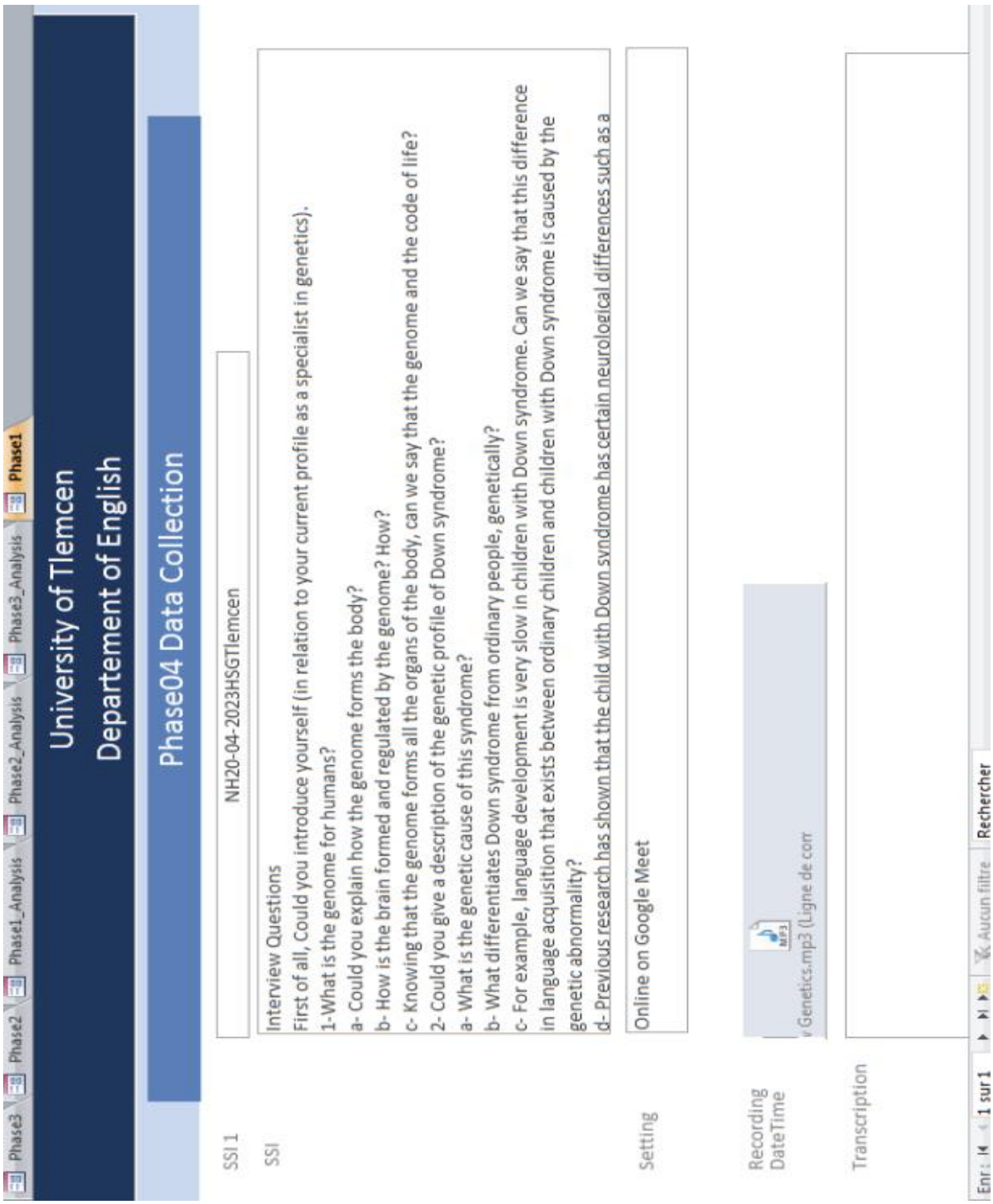
Autorisations d'accès utilisateur

admin	Suppression; Lire permissions; Définir permissions; Modifier propriétaire, Lire définition; Écrire définition; Lire données; Insérer données; Mettre à jour données; Supprimer données

Autorisations d'accès groupe

Admins	Suppression; Lire permissions; Définir permissions; Modifier propriétaire, Lire définition; Écrire définition; Lire données; Insérer données; Mettre à jour données; Supprimer données
Users	Suppression; Lire permissions; Définir permissions; Modifier propriétaire, Lire définition; Écrire définition; Lire données; Insérer données; Mettre à jour données; Supprimer données

Appendix U: The Repertoire of Interview Collected Data in the Database



Appendix U-1: The Repertoire of Interview Collected Data in the Database: Code and Structure

D:\Trisomie\Trisomie.accdb mercredi 31 mai 2023
Table: Phase4 Page: 1

Propriétés

AlternateBackShade:	95	AlternateBackThemeColorInd	1
AlternateBackTint:	100	Attributes:	Attaché
BackShade:	100	BackTint:	100
Connect:	;DATABASE=D:\Trisomie\TrisomieData\TrisomieData.accdb	DatasheetForeThemeColorInd	0
DatasheetGridlinesThemeColo	3	DateCreated:	12/03/2023 17:34:01
DefaultView:	2	DisplayViewsOnSharePointSit	1
FilterOnLoad:	Faux	GUID:	{guid {E34C31E7-7E77-4419-B5DA-5683D1044D7B}}
HideNewField:	Faux	LastUpdated:	12/03/2023 17:34:01
NameMap:	Donnée binaire	OrderByOn:	Faux
OrderByOnLoad:	Vrai	Orientation:	De gauche à droite
PublishToWeb:	1	ReadOnlyWhenDisconnected:	Faux
RecordCount:	-1	SourceTableName:	Phase4
ThemeFontIndex:	1	TotalsRow:	Faux
Updatable:	Faux		

Colonnes

Nom	Type	Taille
Nphase4	Entier long	4
SSInb	Texte	255
SSI	Mémo	-
Setting	Mémo	-
DateTime	Date/Heure	8
Recording	Objet OLE	-
Transcription	Mémo	-
Translation	Mémo	-
Note1	Mémo	-
Note2	Mémo	-
Note3	Mémo	-
Note4	Mémo	-
Note5	Mémo	-
Objects	Objet OLE	-

Index de la table

Nom	Nombre de champs
PrimaryKey	1
Champs :	
Nphase4	Ascendant

Autorisations d'accès utilisateur

admin	Suppression; Lire permissions; Définir permissions; Modifier propriétaire, Lire définition; Écrire définition; Lire données; Insérer données; Mettre à jour données; Supprimer données

Autorisations d'accès groupe

Admins	Suppression; Lire permissions; Définir permissions; Modifier propriétaire, Lire définition; Écrire définition; Lire données; Insérer données; Mettre à jour données; Supprimer données
Users	Suppression; Lire permissions; Définir permissions; Modifier propriétaire, Lire définition; Écrire définition; Lire données; Insérer données; Mettre à jour données; Supprimer données

Appendix V: The Repertoire of Interview Data Analysis in the Database

Appendix V-1: The Repertoire of Interview Data Analysis in the Database: Code and Structure

D:\Trisomie\Trisomie.accdb mercredi 31 mai 2023
Table: Phase4_Analysis Page: 1

Propriétés

AlternateBackShade:	95	AlternateBackThemeColorInd	1
AlternateBackTint:	100	Attributes:	Attaché
BackShade:	100	BackTint:	100
Connect:	;DATABASE=D:\Trisomie\TrisomieData\TrisomieData.accdb	DatasheetForeThemeColorInd	0
DatasheetGridlinesThemeColo	3	DateCreated:	16/05/2023 18:56:58
DefaultView:	2	DisplayViewsOnSharePointSit	1
FilterOnLoad:	Faux	GUID:	{guid {D8C648B6-FDE6-43E8 BCDA-F696F1A61097}}
HideNewField:	Faux	LastUpdated:	16/05/2023 18:56:58
NameMap:	Donnée binaire	OrderByOn:	Faux
OrderByOnLoad:	Vrai	Orientation:	De gauche à droite
PublishToWeb:	1	ReadOnlyWhenDisconnected:	Faux
RecordCount:	-1	SourceTableName:	Phase4_Analysis
ThemeFontIndex:	1	TotalsRow:	Faux
Updatable:	Faux		

Colonnes

Nom	Type	Taille
Nphase4ana	Entier long	4
Methodology	Mémo	-
Meaning_Coding	Objet OLE	-
Meaning_Coding_Note	Mémo	-
Meaning_Condensation	Objet OLE	-
Meaning_Condensation_Note	Mémo	-
Themes	Objet OLE	-
Themes_Note	Mémo	-
Meaning_Interpretaion	Mémo	-

Index de la table

Nom	Nombre de champs	
Nphase1	1	
Champs :		
Nphase4ana		Ascendant
PrimaryKey	1	
Champs :		
Nphase4ana		Ascendant

Autorisations d'accès utilisateur

admin	Suppression; Lire permissions; Définir permissions; Modifier propriétaire, Lire définition; Écrire définition; Lire données; Insérer données; Mettre à jour données; Supprimer données

Autorisations d'accès groupe

Admins	Suppression; Lire permissions; Définir permissions; Modifier propriétaire, Lire définition; Écrire définition; Lire données; Insérer données; Mettre à jour données; Supprimer données
Users	Suppression; Lire permissions; Définir permissions; Modifier propriétaire, Lire définition; Écrire définition; Lire données; Insérer données; Mettre à jour données; Supprimer données

Appendix W: Interview Meaning Coding Key

	Brain dysfunction/neurological diseases
14	Circuits Neuronaux **Neural circuits**
14	Retard du développement cognitif **Delay in cognitive development**
14	Psychomotricité **Psychomotricity**
14	Lenteur **Slowness**
14	Age mental vs âge chronologique **Mental age vs. chronological age**
14	Retard **Delay**
14	Hyperlaxité musculaire **Muscle hyperlaxity**

TEXT KEYS	CODES
14	Retard mental **Mental retardation**
15	Différence génétique entre Trisomie 21 et personnes ordinaires **Genetic difference between Trisomy 21 and ordinary people**
15	Différence de nombre de chromosome **Difference in chromosome number**
	Conséquences physiques et cliniques **Physical and clinical consequences**
15	Particularité génétique **Genetic specificity**
	Expression génétique du chromosome 21 **Gene expression of chromosome 21**
15	Trisomie 21 **Down syndrome**
16	Lenteur dans le traitement de l'information **Slowness in information processing**
16	Conséquence de l'anomalie génétique sur la langue **Consequence of the genetic anomaly on the language**
16	Lenteur et retard dans le développement du langage **Slowness and delay in language development**
16	retard dans le babillage **delay in babbling**
17	Lenteur dans l'apprentissage en général **Slowness in overall learning**
17	Conséquences de l'anomalie génétique sur le cerveau **Consequences of the genetic anomaly on the brain**
17	L'importance de suivi dans l'apprentissage

	The importance of support in learning
17	Uniformité du déficit cognitif **Uniformity of cognitive deficit**
17	Conséquences cognitives **Cognitive consequences**
18	Particularités cognitives individuelles **Individual cognitive specificities**
18	Handicaps **Disabilities**
19	Non uniformité de l'aphasie de Broca **Non-uniformity of Broca's aphasia**
19	Déficit au-delà d'une partie du cerveau **Deficit beyond a brain region**
19	Difficultés et lenteur avec la prononciation **Difficulties and slowness with pronunciation**
19	L'importance de la répétition **The importance of repetition**
19	Problème de mémoire **Memory problem**
20	Difficulté et lenteur avec La compréhension **Difficulty and slowness with comprehension**
20	
20	Difficultés et lenteur avec la prononciation **Difficulty and slowness with pronunciation**
21	Déficit neurologique global **Global neurological deficit**
21	Aphasie de Broca congénitale **Congenital Broca's aphasia**
21	Conséquences physiques et cliniques de l'anomalie génétique **Physical and health consequences of the genetic anomaly**
21	Conséquences linguistiques de l'anomalie génétique **Consequences of the genetic anomaly on language**
22	Prédisposition génétique **Genetic predisposition**
24	Retard dans la compréhension **Delay in comprehension**
24	Aphasie de Broca congénitale **Congenital Broca's aphasia**
24	Uniformité du trouble du langage **Uniformity in language disorder**
24	Difficulté grammaticale **Grammatical difficulty**
26	Phrases simples **Simple utterances**

65 CODES

Appendix X: Analytical Functions in VB: Code Examples and Implementation

D:\Trisomie\Trisomie.accdb mercredi 31 mai 2023
Module: Module1 Page: 1

Propriétés

Container:	Modules	DateCreated:	10/03/2023 12:19:57
LastUpdated:	10/03/2023 12:19:57	Owner:	admin
UserName:	admin		

Code

```
Attribute VB_Name = "Module1"
Option Compare Database

Public Function compteur(srcAll, srch) As Integer
 Dim res As Integer
 Dim src, ta
 Dim i, j, k, tot
 res = 0
 tot = 0
 src = Trim(Nz(srcAll, ""))
 If InStr(srch, "|") > 0 Then
   ta = Split(srch, "|")
   For i = 1 To UBound(ta)
    tot = tot + compteelem(src, ta(i))
   Next
   res = tot
 Else
   res = compteelem(src, srch)
 End If
 compteur = res
End Function

Public Function compteelem(src_, srch) As Integer
 Dim res As Integer
 Dim src
 res = 0
 src = Nz(src_, "")
 While InStr(src, srch) > 0 And srch <> ""
   src = Mid(src, InStr(src, srch) + Len(srch))
   res = res + 1
 Wend
 compteelem = res
End Function
```

Autorisations d'accès utilisateur

admin	Suppression; Lire permissions; Définir permissions; Modifier propriétaire, Lire définition; Modifier définition

Autorisations d'accès groupe

Admins	Suppression; Lire permissions; Définir permissions; Modifier propriétaireLire définition; Modifier définition
Users	Suppression; Lire permissions; Définir permissions; Modifier propriétaireLire définition; Modifier définition

Propriétés

Container:	Modules	DateCreated:	28/03/2023 21:02:55
LastUpdated:	28/03/2023 21:02:55	Owner:	admin
UserName:	admin		

Code

```
Attribute VB_Name = "Module2"
Option Compare Database

Public Function ex1(a1, a2, a3, typ)
Dim s As Integer
s = 0
 If typ = 1 Then

 Else

 End If
End Function
Public Function vaLPlus(a As Boolean)
   If a = True Then
    vaLPlus = 1
   Else
    vaLPlus = 0
   End If
End Function
Public Function valMoins(a As Boolean)
   If a = True Then
    valMoins = 1
   Else
    valMoins = 0
   End If
End Function
Public Function valMin(a As Boolean)
   If a <> True Then
    valMin = 1
   Else
    valMin = 0
   End If
End Function

Public Function ex2(a)
  If a = "PHOTO1" Then
     ex2 = 0
  Else
     ex2 = 1
```

```
  End If
End Function

Public Function ex3(a, b, c)
Dim s As Integer
s = 0
If a = True Then s = s + 1
If b = True Then s = s + 1
'If c = True Then s = s + 1
 ex3 = s
End Function
Public Function ex4(a, b, c)
Dim s As Integer
s = 0
If a = True Then s = s + 1
If b = True Then s = s + 1
If c = True Then s = s + 1
 ex4 = s
End Function
```

Autorisations d'accès utilisateur

admin	Suppression; Lire permissions; Définir permissions; Modifier propriétaire, Lire définition; Modifier définition

Autorisations d'accès groupe

Admins	Suppression; Lire permissions; Définir permissions; Modifier propriétaireLire définition; Modifier définition
Users	Suppression; Lire permissions; Définir permissions; Modifier propriétaireLire définition; Modifier définition

الملخص

تركز هذه الدراسة على الاضطرابات الصرفية والنحوية في اللغة العربية بين الأطفال المصابين بمتلازمة داون، وتدرس بدقة إعاقاتهم اللغوية، وتستجوب نظرية النحو العالمي، وتكشف الأسس الوراثية لهذه الظواهر. تستخدم الدراسة مزيجًا من المنهج الاستقرائي والاستدلالي، وتعتمد على نهج دراسة حالة استكشافية شاملة باستخدام تصميم منهجي مختلط. تم إجراء البحث في محافظة تلمسان، وشمل الأطفال المصابين بمتلازمة داون، ومعلميهم، وطبيب نفساني، وخبير في علم الأمراض الجينية والعصبية. البيانات المجمعة تدعم بوضوح وجود مشاكل صرفية للغة العربية في حالات فقدان بروكا في أطفال الجزائر المصابين بمتلازمة داون. بشكل ملفت، تسلط اللغة العربية الضوء على هذه التحديات اللغوية بشكل أكثر بروزًا من اللغات الأخرى. بالإضافة إلى ذلك، تعترض المشاكل الصرفية التي يظهرها الأطفال المصابون بمتلازمة داون على المبادئ الأساسية لنظرية النحو العالمي. علاوة على ذلك، تؤسس الدراسة رابطًا مباشرًا بين الشذوذ الوراثي المرتبط بمتلازمة داون وظهور اضطرابات اللغة لدى الأطفال المتأثرين. هذه النتائج تساهم في تحقيق تحول بارز في المفهوم، وتعزز تطوير مجال متعدد التخصصات يتجاوز الحدود التقليدية.

الكلمات المفتاحية :اضطرابات اللغة ، العصبية، الجينية، فقدان بروكا، متلازمة داون، الاضطرابات الصرفية و النحوية، اللغة العربية، النحو العالمي.

Summary

This study delves into the morpho-syntactic impairments in the Arabic language among children with Down syndrome, scrutinizes their linguistic disabilities, interrogates Universal Grammar, and unravels the genetic underpinnings. It employs a combination of inductive and deductive reasoning, utilizing an exploratory, single instrumental, and holistic case study approach with a mixed method design. The research was conducted in Tlemcen province, including Down syndrome children, their teachers, a psychologist, and an expert in molecular genetics and neurology. The data collected unequivocally supports the prevalence of Arabic agrammatic representations of Broca's aphasia in Algerian children with Down syndrome. Remarkably, the Arabic language highlights these linguistic challenges more prominently than other languages. Additionally, the agrammatic representations exhibited by children with Down syndrome challenge the foundational principles of Universal Grammar. Furthermore,

the study establishes a direct link between the genetic anomaly associated with Down syndrome and the manifestation of language disorders in affected children. These insights drive a paradigm shift, fostering an interdisciplinary field that transcends traditional boundaries.

Keywords: Language disorders, Neurology, Genetics, Broca's aphasia, Down syndrome, Morpho-syntactic impairments, Arabic language, Universal Grammar.

Résumé

Cette étude se penche sur les déficiences morpho-syntaxiques de la langue Arabe chez les enfants trisomique, examinant minutieusement leurs handicaps linguistiques, et en réexaminant la grammaire universelle tout en dévoile les fondements génétiques qui y sont associés. Elle utilise une combinaison de raisonnement inductif et déductif, en recourant à une approche exploratoire, instrumentale unique et holistique d'étude de cas avec une conception de méthode mixte. La recherche a été menée dans la province de Tlemcen, auprès d'enfants trisomiques, de leurs enseignants, d'un psychologue et d'un expert en génétique moléculaire et en neurologie. Les données recueillies confirment sans équivoque la prévalence, dans la langue Arabe, des représentations agrammaticales liées à l'aphasie de Broca chez les enfants trisomiques en Algérie. Idéalement, la langue Arabe met en exergue ces difficultés linguistiques de manière plus évidente que les autres langues. En outre, les représentations agrammaticales des enfants trisomiques remettent en question les principes fondamentaux de la grammaire universelle. Par ailleurs, l'étude a établi un lien direct entre l'anomalie génétique associée à la Trisomie 21 et la manifestation de troubles du langage chez les enfants affectés. Ces connaissances entraînent un changement de paradigme et favorisent l'émergence d'un domaine interdisciplinaire qui transcende les frontières traditionnelles.

Mots clés : Trouble du langage, Neurologie, Génétique, Aphasie de Broca, Trisomie 21, Déficiences morpho-syntaxique, Langue Arabe, Grammaire Universelle