Lexical, Inflectional and Agreement Production of Arabic Noun Phrase in Agrammatism

A thesis submitted for the requirement of the degree of

Master of Philosophy in Human Communication Sciences

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September 2020

Abstract

Agrammatism is a language disorder due to an acquired brain damage. Studying agrammatism in highly inflectional languages like Arabic can be very revealing for linguistic theories and highly significant for speech language pathology. The Arabic noun phrase exhibits one of the richest morpho-syntactic structures in Arabic. Despite being morpho-syntactically rich, the Arabic noun phrase did not receive enough attention in aphasia literature. The current study aims to explore the production of the noun phrase by Arabic speakers with agrammatism to increase knowledge of morpho-syntax in aphasia. The study examines the lexical, inflectional and agreement production in three types of Arabic noun phrase: the adjectival noun phrase, the construct state noun phrase, and the non-construct state noun phrase. This study is the first study that addresses the production of these different Arabic noun phrase types in agrammatism.

Nine Saudi Arabic speakers with aphasia and agrammatism demonstrating varying degrees of severity participated in the study. A testing tool was developed to elicit the production of the three Arabic noun phrase types. The test development resulted in four linguistic subtests: the *Number and Gender Agreement Subtest*, the *Definiteness Agreement Subset*, the *Construct State Subtest* and the *Non-Construct State Subtest*. A pilot study was carried on the test instrument prior to conducting the main experiment to test the reliability and the validity of the instrument.

The results of the four linguistic subtests revealed that there was higher accuracy for masculine than for feminine and for singular than for plural forms. The indefinite forms tended to be produced for definite forms. Most gender and number errors were due to production of masculine singular inflection, and the feminine plural was more impaired than masculine plural. Lastly, most ungrammatical phrases were due to inflectional errors in either the adjective or the particle, and most lexical errors in *the Number and Gender Agreement Subtest* and *Non-construct State Subtest* were modifiers' lexical errors.

The results contributed to the morph-syntactic characterisation of noun phrase production in aphasia and agrammatism within Arabic and cross-linguistically. The data were mainly analysed from a neurolinguistic perspective taking into consideration a range of different morpho-syntactic theories of NP and agrammatism. The data were also considered within psycholinguistic accounts of gender and number processing, and recent accounts of language production in aphasia instantiated in usage-based accounts of grammar. Patterns of error have been accounted for by all three theoretical accounts, but no one single account could interpret all error patterns. The study has provided a number of theoretical implications, and has implied directions for future research of Arabic NP in agrammatism.

Publications Arising

Student conference presentations

Almuzaini, S., Alabdulkarim, L., Body, R., & Herbert, R. (2014). Production of nominal elements by Saudi speakers with agrammatism, Department of Human Communication Sciences PGR Conference, University of Sheffield, 28 June 2014.

Other conference presentations

Almuzaini, S., Alabdulkarim, L., Body, R., & Herbert, R. (2015). Arabic NP in Agrammatism: A case Study, Saudi Society for Speech and Language Pathology and Audiology Conference, King Saud University, 1-3 Nov. 2015.

Almuzaini, S., Alabdulkarim, L., Tattersall, C., & Herbert, R. (2017). Number and gender agreement in Saudi Arabic Agrammatism, 18th International Science of Aphasia Conference, Geneva, 11-14 Sep. 2017.

Invited talks

Almuzaini, S., Alabdulkarim, L., Body, R., & Herbert, R. (2015). Agrammatism in Aphasia, College of Arts, King Saud University, 14 April 2015.

Almuzaini, S., Alabdulkarim, L., Body, R., & Herbert, R. (2015). Arabic NP in Agrammatism: A case Study, College of Applied Medical Studies Research Meeting, King Saud University, 9 Dec. 2015.

Almuzaini, S., Alabdulkarim, L., Tattersall, C., & Herbert, R. (2016). Arabic NP in Agrammatism, British Aphasiology Society Research Update Meeting, University of Manchester, 28 April 2016.

Acknowledgements

First, praise goes to Allah who has empowered me until the end of this path.

Second, I am extremely grateful to my first supervisor, Dr. Ruth Herbert, for her guidance, invaluable support and trust in me as an academic researcher. Her patience and acceptance during my intellectual growth have been unlimited. I have been so fortunate to benefit from her academic and life skills which I hope to reflect in the future.

To my second supervisor, Dr. Richard Body, I am enormously thankful for his helpful feedback and efforts in facilitating complicated matters to me during the first two years of my PhD. To Catherine Tattersall, thanks for stepping in as a second supervisor and for her support in solving academic matters.

To Dr. Lamya Abdulkarim, my appreciation of her time, feedback, and knowledge in Arabic is huge. Her support both academically and personally has been endless.

My extreme appreciation goes to my Mum—the fuel of this dissertation. Her love, prayers and motivations have been vital for the completion of this thesis. Although my Dad has passed away years ago, his love and protection can be reflected in this work. To all of my family, my husband, my siblings and my kids, I am extremely in debt for their support and patience when I often have not had the time to spend with them.

To all participants in this study, I am very thankful for their voluntarily participation and willing to be part of this study as well as for taking the trouble to reach the test location. Thanks for Sultan Bin Abdelaziz Humanitarian City and King Fahad Medical City for welcoming my study. I appreciate all the efforts of the speech-language therapists who have engaged with me in fruitful discussions and have enthusiastically assisted me in finding candidates.

Appreciations go also to my colleagues in King Saud University who have been supportive and understanding. To colleagues at The University of Sheffield, thank you for the valuable time I spent with you and for the connection in spite of the distance.

Last but not least, many thanks to my sponsor King Saud University who has given me the opportunity to pursue this goal. I wish that this accomplishment will be a start for another.

Table of Contents

Page Number

List of Tables

Page Number

List of Figures and Extracts

List of Abbreviations

AAS	Aphasia assessment subtests
Adj	Adjective
ANOVA	Analysis of variance
AP	Adjective phrase
ASC-H	Argument Structure Complexity Hypothesis
AT	Adaptation Theory
CP	Complementiser phrase
D	Determiner
Def	Definite
Dem	Demonstrator
Dgen	Phonetically null determiner
DOC-H	Derived Order Complexity Hypothesis
DP	Determiner phrase
D-structure	Deep structure
DUAL	Dual
F	Feminine
F PL	Feminine plural
F SG	Feminine singular
GenP	Gender phrase
GM	Generalised Minimality
Indef	indefinite
KFMC	Kin Fahad Medial City
LF	Logical form
M	Masculine
MDH	Morphological Distribution Hypothesis
Miscel.	Miscellaneous
M PL	Masculine plural
M SG	Masculine singular
NP	Noun phrase

NPS	Noun phrase subtests
NR	No response
Num	Number
NumP	Number phrase
TPH	Tree Pruning Hypothesis
PL	Phonological form
PRES	Present
PRNW	Phonologically related non-word
ProGram	Information PROminence and GRAMmar in mind and brain
SA	Saudi Arabic
SBACH	Sultan Bin Abdelaziz Humanitarian City
Spec	Specifier
SG	Singular
SLP	Speech language pathologist
SRNW	Semantically related non-word
S-structure	Surface structure
TP	Tense phrase
URNW	Unrelated non-word

1. INTRODUCTION AND LITERATURE REVIEW

In this chapter, an overview of the study is first presented. Then a review of the relevant literature is discussed.

1.1 Study overview

Arabic in general and Arabic noun phrase (NP) in particular have a rich, complex morpho-syntax. For example, Arabic adjectives in the adjectival NP must agree with the noun that they modify in gender, number and definiteness as shown in the following example.

(1)

ʔl-kursi el-muri:ħ
det-chair det-comfortable
the comfortable chair

Another type of Arabic NP is the *construct state* NP which corresponds to the genitive NP in English (e.g. 'the teacher's book'). However, the construct state exhibits some salient properties: it consists of two nouns where the first noun is always the head of the NP, the head noun and the complement in the construct state must be adjacent to each other and, most importantly, the head noun must always be indefinite. An example of the construct state NP is shown in the following.

(2)

masbħ el-fundig
swimming pool det-hotel
the hotel's swimming pool

In addition, Arabic is one of the top five most spoken languages in the world and the most spoken Semitic language with around 422 million speakers (Lewis, 2009). Despite being morpho-syntactically rich and a widely spoken language, the knowledge base of aphasia and agrammatism in Arabic is extremely limited. The characteristics of Arabic NP have not been studied in aphasia and agrammatism and studying them is necessary. The study will help achieve a main goal in the literature, which is to characterise language-universal and language-specific features of the deficit. The characterisation of NP production in Arabic by speakers with aphasia and agrammatism will also inform linguistic theories as well as theories of aphasia and agrammatism. This is because Arabic NPs are morpho-syntactically rich as explained above, and a breakdown in such richness could provide important theoretical implications. This will in turn contribute to assessment and intervention of aphasia and agrammatism.

The current thesis explores NP production by Saudi Arabic (SA) speakers with agrammatism, by investigating the lexical, inflectional and agreement errors in three types of Arabic NP: adjectival NP, construct state NP and non-construct state NP.

1.1.1 Structure of the thesis

The thesis consists of ten chapters. Chapter One, which is the current chapter, provides an overview of the study and a review of the relevant literature. The literature review is divided into three main sections: the description and theoretical explanations of agrammatism, NP production in agrammatism and the morphology and syntax of Arabic NP. The chapter concludes with the study rationale and aims.

Chapter Two through Chapter Four present the methodology of the study. Chapter Two deals with a development of four linguistic subtests for testing the production of Arabic NP: gender and number agreement, definiteness agreement, construct state and non-construct state subtest. The chapter highlights the aims, procedures and validation of the subtests that will be used in the main experiment. Chapter Three deals with a pilot study of the test instruments to test the appropriateness, reliability and validity of the instruments. The methodology for collecting the

Arabic NP data are then introduced in Chapter Four. The chapter provides information about the participants, the design, the materials and the procedure for conducting the experiment.

The results are introduced in Chapter Five to Chapter Nine. Chapter Five provides the results of the aphasia assessment and divides the participants into two groups based on their severity: Group I which includes people with mild aphasia and Group II that includes people with moderate to severe aphasia. The results of each of the four subtests which are gender and number agreement, definiteness agreement, construct state and non-construct state subtests, are given in Chapter Six through Chapter Nine. Each of these chapters analyses the lexical, inflectional and agreement errors of the two groups independently.

Chapter Ten discusses the results and ends with the study limitations and conclusions.

1.2 Agrammatism

This section provides an overview of research into agrammatism. The definitions and the approaches to the study of agrammatism are introduced.

Agrammatism is a language disorder that arises in people with acquired aphasia. Aphasia is defined in the next section followed by the definition of agrammatism which is introduced in section (1.2.2).

1.2.1 Definition of aphasia

Several definitions of aphasia have been provided (e.g. Benson & Ardila, 1996; Davis, 1993; Schuell et al., 1965). A very wildly accepted definition was provided by Damasio (1998, p. 25) who defined aphasia as a disturbance that affects the process of formulating and comprehending verbal messages as a result of a brain lesion.

Aphasia results from a lesion to the language areas in the brain, which are typically located in the left hemisphere of the brain, and which include critical areas including Broca's area, Wernicke's area, motor cortex, and arcuate fasciculus (Petrides, 2013). The most common underlying cause of aphasia is often a cerebrovascular accident (CVA; Benson & Ardila, 1996) which is a sudden reduction or cessation in the blood supply to language areas within the brain (Mlcoch & Metter, 2001). CVA can be a result of blockages, when a blood clot blocks a blood vessel in the brain, so-called ischaemic stroke, or a leak, when blood escapes through the vessel wall which has become weak or thin and susceptible to collapse, known as haemorrhagic stroke.

Aphasia can also occur due to traumatic brain injury, when the lesion affects the language areas, or Alzheimer's disease, which is a progressive condition where the language functions worsen over time (Benson & Ardila, 1996). However, these causes are not under discussion and CVA is the aetiology of interest in the current study.

Aphasia can be classified into different syndromes. The classification of aphasia is reviewed in the following sections.

1.2.1.1 Aphasia classification

Observations by Paul Broca (1861) and Karl Wernicke (1874) during the 19th century (as cited in Caplan, 1987) suggested that aphasia can be classified into types or syndromes. In 1861 Broca identified a patient whose oral expressive language was limited to the monosyllable *tan* but whose ability to comprehend language and ability to express himself through gestures and facial expressions were within normal parameters, according to anecdotal reports at the time. The patient's lesion was in the posterior portion of the inferior frontal convolution of the left hemisphere, which is now known as Broca's area. Broca claimed that this brain region was the neural site of language production. In 1874 Karl Wernicke described a second aphasic syndrome that was very different to that which Broca had identified. In this instance, the patients produced fluent expressive language, but the oral expressive language contained phonological errors, word form errors and words that were semantically inappropriate. The patients in question also presented with difficulties in comprehension of spoken language. The lesions in these cases were in the posterior portion of the left superior temporal gyrus, which is now known as Wernicke's area.

Broca's and Wernicke's observations led to a classification of aphasia based on differences in fluency, auditory comprehension, and oral-expressive language closely associated with specific lesion sites. This early classification system was later revised (Benson, 1988; Goodglass & Kaplan, 1972; Kertesz, 1979) and the revisions yielded a taxonomy compromising seven aphasia syndromes.

1.2.1.2 Aphasia syndromes

The syndromes can be divided into fluent and non-fluent. Fluent syndromes include Wernicke's, transcortical sensory, conduction and anomic aphasia where longer phrase length, ease of production of spoken language, and syntactic structures are relatively preserved. Non-fluent syndromes include global, Broca's, and transcortical motor aphasia which are all characterised by short phrase length and impaired morpho-syntax. The fluent and the non-fluent syndromes are further classified based on auditory comprehension, spoken word repetition and naming abilities. A summary of the symptoms of each syndrome is provided in the following sections.

Fluent aphasia syndromes

Wernicke's, transcortical sensory, conduction and anomic aphasia are each described here.

The salient characteristic in Wernicke's aphasia is impaired auditory comprehension at the word, phrase and sentence level. Speakers with Wernicke's aphasia may produce long sentences with complex syntax (Helasvuo, Klippi & Laakso, 2001); however, their expressive language contains grammatical morpheme errors such as errors in pronouns and verb tenses (Bates et al., 2001). It also includes phonological and semantic errors and may include neologistic jargon: a new word created by the intrusion of one or more phonemes into the targeted word, these words are completely new or nonsensical and a motor speech disorder is not present in the patient (e.g., *moticks* for "*minutes*"; Benson & Ardila, 1996). Repetition, naming, reading and writing can be impaired (Wertz, Dronkers & Ogar, 2004). Lesions in Wernicke's aphasia were classically associated with damage to the left hemisphere auditory association cortex, which incorporates Brodmann's areas 22, 37, 39 and 40 (Damasio, 1992). However, reports such as Basso et al., (1985) showed that some patients might present with Wernicke's aphasia resulting from exclusively anterior lesions.

In transcortical sensory aphasia, auditory comprehension, expressive language and the ability to name, read and write are similar to Wernicke's aphasia. However, speakers with transcortical sensory aphasia can repeat words and long, complex sentences unlike Wernicke's aphasia (Wertz, Dronkers & Ogar, 2004). This syndrome may result from lesions to the areas surrounding the Wernicke's area either posteriorly or inferiorly (Damasio, 1992).

The salient sign in conduction aphasia is impaired ability to repeat words and phrases while having relatively preserved auditory comprehension, and oral expressive language. While oral expressive language is preserved, some phonological errors might be produced. Naming, reading and writing can be mildly disrupted (Wertz, Dronkers & Ogar, 2004). Damasio (1992) located the lesion site in the left hemisphere supramarginal gyrus with or without extension to white matter beneath the insula and damage in the left primary auditory cortices, the insula and the underlying white matter. Dronkers and Ludy (1998) reported some patients who had conduction aphasia, but the location of the lesion was in the posterior-superior temporal gyrus, often extending into the inferior parietal lobule.

Anomic aphasia involves primarily a difficulty in finding the correct word especially names of objects. The symptom anomia can be present in all syndromes of aphasia (Laine & Martin, 2006) but the syndrome anomic aphasia consists primarily of this symptom. Auditory comprehension is relatively intact, expressive language shows long phrase length and intact syntax, repetition is preserved and reading and writing shows anomia can be mildly impaired. People with anomic aphasia often substitute synonyms for the intended words, and often replace the intended word with a generalization such as “things” (Wertz, Dronkers & Ogar, p. 250). However, the location of the lesion is not precisely defined, and anomic aphasia can arise subsequent to either anterior or posterior lesions (Dronkers & Larsen, 2001). Kreisler et al. (2000) suggested that the lesion site may be located in the thalamus or frontal cortex, the insula, and anterior part of the temporal gyri.

Non-fluent aphasia syndromes

This section describes global, Broca’s and Transcortical Motor aphasia.

Global aphasia is characterized by reduced auditory comprehension which may be limited to inconsistent comprehension of single words, poor oral-expressive language that is often limited to a recurring stereotype such as “bees, bees, bees,” an inability to repeat words or phrases and severe impairment to naming, reading and writing abilities. Automatic expressions including profanity and counting may be preserved in the oral-expressive language (Wertz, Dronkers & Ogar, 2004, p. 249). Global aphasia results from a large left hemisphere lesion that may involve the frontal, temporal and parietal lobes, the insula and underlying white matter (Dronkers & Larsen, 2001).

Speakers with Broca's aphasia have relatively good auditory comprehension for single words and short sentences, but not so for grammatically complex sentences such as sentences with embedded relative clauses. Speakers with this syndrome produce phrases with shorter lengths and the production tends to be halting and agrammatic: containing mainly content words such as nouns and a lack of function words such as tense and agreement inflections (*Benson* & *Ardila*, 1996). Repetition of words and sentences is poor and the ability to name, write and read is impaired as well (Wertz, Dronkers & Ogar, 2004). The lesion responsible for Broca's aphasia has been classically associated with damage in the left, inferior frontal gyrus, Brodmann's areas 44 and 45 (Damasio, 1992). However, some reports showed that some speakers with Broca's aphasia had lesions which far exceeded Broca's area. For example, Mohr et al., (1975) analysed brain lesions in ten cases with Broca's aphasia and the lesion was located in the upper division of the left middle-cerebral artery, the operculum from the anterior frontal lobe through Broca's area to the anterior parietal regions.

The language behaviour of speakers with transcortical motor aphasia is similar to that in Broca's aphasia (Wertz, Dronkers & Ogar, 2004). Auditory comprehension is preserved for short, noncomplex sentences only; expressive language is halting and agrammatic; and naming, reading and writing abilities are also impaired. However, speakers with this syndrome have intact repetition ability, which differentiates this syndrome from Broca's aphasia. The lesion site is located in the left anterior-superior frontal lobe (Alexander, Benson, & Stuss, 1989).

Limitations of the syndromes classification

Such classification of aphasia into syndromes is known as the syndrome approach, or the Boston neo-classical model (Goodglass, 1993). This classification provides a broad descriptive characterisation that is extremely useful for clinicians and researchers. For example, a clinician will expect production to be non-fluent with omissions of verbs and grammatical markers in a person with Broca's aphasia, and sentence-level skills are likely to be a priority target area for speech therapy for this person. The classification is also beneficial in the selection of participants for aphasia and linguistics research. However, this classification has its limitations that have been identified in research investigations.

Heterogeneity among participants belonging to the same syndrome has been one major limitation (Byng et al., 1990). Speakers belonging to the same syndrome only show some similarities and they do not present with the same set of symptoms (Darley, 1982). Pattern of impairments and severity vary across speakers belonging to the same syndrome. Darley argued that aphasia should not be solely classified based on the syndromes approach but rather on the basis of the severity and the co-existence of other communication disorders such as apraxia of speech. In addition, Members of the same syndrome might also differ in lesion sites (Basso et el., 1985; Dronkers & Larsen, 2001). Another argument concerns the theoretical basis of this classification (Schwartz, 1984). The classification is based on early observations by neurologists, and it lacked a solid theoretical account of language which might in turn lead to inaccurate conclusions about the nature of the language impairments. The syndromes classification has also been criticized for providing limited help for clinicians planning therapy. It is argued that it gives insufficient information about which problems a person has. For example, knowing that a person has Broca's aphasia does not guarantee that the person does not need therapy for comprehension problem, nor does it give an accurate indication that the person requires therapy in articulation of sound segments, production of grammar or formulation of syntactic structures (Caplan, 2004).

Summary

It can be seen from the above review that a number of aphasia syndromes exhibit grammatical and syntactic deficits at the comprehension level, production level or both. Global, Broca's, and transcortical motor aphasia all show signs of syntactic deficit and reduced syntactic complexity at the production and comprehension level. Fluent syndromes, Wernicke's aphasia in particular, also show a syntactic deficit but of a different nature affecting the grammatical morphemes primarily. The grammatical and syntactic deficits in aphasia are considered characteristics of agrammatism. Agrammatism is defined in the following section.

1.2.2 Definition of agrammatism

Agrammatism is a language disorder that occurs in people with acquired aphasia, but it has been most heavily associated with and extensively studied in Broca's aphasia (Thompson & Bastiaanse, 2012). Agrammatism affects the production and comprehension of sentences and phrases in both spoken and written language (Goodglass & Menn, 1985; Druks, 2017; Kolk, 1998). Tissot, Mounin and Lhermitte (1973) characterized the expressive language production in agrammatism by: deletion of function words such as prepositions, pronouns, auxiliary verbs and copulas; the predominance of nouns and the paucity of verbs; deletion of verb inflection, with substitution of the infinitive for finite verb forms; deletion of agreement of person, number, and gender in highly inflected languages; and the substitution of nouns in the nominative case for nouns with complex cases. In Comprehension, agrammatism is characterised by difficulty in comprehending specific sentences: sentences where the two thematic roles (who is doing what) could be reserved (e.g. ‘‘The cat is chasing the dog’’; Caramazza and Zurif, 1976), sentences with non-canonical word order (Schwartz, Saffran and Marin, 1980) and sentences with embedded clauses (Lukatela, Shankweiler & Crain, 1995).

Classical aphasiologists during the late 19th century recognized the existence of specific grammatical and syntactic impairments in aphasia. The identification of agrammatism in the classical period is reviewed in the following sections.

1.2.2.1 Agrammatism in the classical period

Observations made by German neurologists during the late 19th century and the early 20th century provided the first descriptions of agrammatism.

De Bleser (1987) referred to a study by Arnold Pick (1889) who reported the case of Barbara Myska whose comprehension was severely impaired post stroke, though her hearing was normal. Her expressive language production was severely impaired as she mixed German and Czech and was unable to connect words syntactically. She died five months post onset due to pneumonia and the post-mortem examination showed a lesion in the temporal lobe. Pick (1889) referred to the general syntactic and grammatical problems in this case as 'agrammatic speech' and hypothesized that it resulted from impairment in the sensory language centre, sited in the temporal lobe.

Studies during the classical period conceptualized agrammatism as a language disorder (Pick, 1889) found in both production and comprehension (Salomon, 1914). Agrammatism has been characterised by production of halting speech, difficulty in producing and comprehending long sentences or sentences with complex syntax, omission of inflections, and substitution of words (Kleist, 1914; Salomon, 1914). Several important arguments concerning agrammatism were raised during that period. These arguments are discussed in the following.

Cortical damage leading to agrammatism

De Bleser (1987) referred to a case study described by Salomon (1914), who reported a German speaker (A-St) who presented with post-stroke aphasia. A-St's spontaneous speech was slow containing short phrases, pauses, omissions of inflections and substitutions of words with phonologically similar nonwords. A St's repetition was impaired, encompassing errors similar to the errors found in his spontaneous speech. His comprehension was intact with ability to comprehend long and complex sentences. His reading pace was slow and his writing reflected grammatical impairments like those found in his oral output. Salomon (1914) did not conduct a post-mortem examination of the brain, but he explained the findings based on the Wernicke-Lichtheim model of language (Lichtheim, 1885).

The Wernicke-Lichtheim model of language (Lichtheim, 1885) is a box-and-arrow model consisting of sensory, motor and conceptual centres. Sensory and motor centres are localized in the brain, while the conceptual centre is distributed across the brain and it consists of connection systems, association systems that connect among cortical areas and projection systems that connect between cortical areas and the sensory and motor organs (Caplan, 1978). The model was able to account for Broca's and Wernicke's aphasia which are due to lesions in the motor and sensory centres respectively, and to conduction, transcortical motor and transcortical sensory aphasia which are due to damage to the association systems.

The model does not incorporate any mention of syntax but according to Salomon (1914) it conceives grammatical impairments in agrammatism as a secondary response to the effortful speech production found in people with Broca's aphasia. Based on the language findings, the findings of Broca (1861), and referring to the Wernicke-Lichtheim model (Lichtheim, 1885), Salomon hypothesised that the location of the lesion in the case of A St was in the left frontal lobe. Salomon also made another contribution by differentiating between agrammatic production and comprehension. Whereas agrammatic production was due to lesions in the motor area in the left frontal lobe, he maintained that agrammatic comprehension resulted from incomplete connection between the sensory and the motor areas, due to damage to the motor centre in the left frontal lobe.

Salomon's (1914) conclusion regarding the lesion site responsible for agrammatism was different from Pick's (1913) conclusions. Whereas Salomon hypothesised that the lesion was in the left frontal lobe, Pick assumed it was located in the left temporal lobe. Pick argued that the grammatical impairment in people with lesions in the frontal motor region is not a true form of agrammatism, a phenomenon that he referred to as "a pseudo-agrammatism" (Druks, 2017, p. 5). He maintained that the substrate for real agrammatism was the temporal sensory area, and people who present with agrammatism following a lesion in the frontal motor region are in a stage where they have recovered from global aphasia, which encompassed both motor and sensory aphasia, and only the motor symptoms are visible at this stage.

Agrammatism differentiated from paragrammatism

Kleist (1914) made an important contribution to the debate concerning the site of the lesion in cases with grammatical impairments (cited in Druks, 2017). Kleist differentiated between agrammatism and *paragrammatism*. He described agrammatism as speech with simplified, short utterances with no subordinated clauses which lacks grammatical morphemes. He claimed this is due to damage to the frontal lobe, and that motor representation is lost or impaired in agrammatism. On the other hand, he reported that paragrammatism includes sentences with preserved syntactic structure but impaired lexical words and grammatical morphemes. The deficit in paragrammatism, according to Kleist, is localized in the temporal lobe, and auditory representation is similarly lost or impaired. According to this classification, agrammatism is present in non-fluent types of aphasia which includes global, Broca's aphasia and transcortical motor aphasia, whereas paragrammatism is associated with Wernicke's aphasia in particular and other fluent types: transcortical sensory, conduction and anomic aphasia.

The economy of effort hypothesis (Isserlin, 1922)

Isserlin (1922) used Kleist's (1914) classification of agrammatism to document three cases with agrammatism (cited in Lorch, 1989). Unlike Kleist, Isserlin argued that the omission of grammatical morphemes and the telegraphic speech that is seen in some speakers with agrammatism is an unconscious adaptation to the difficulty a patient faces as he speaks rather than an indication of a loss or impairment at the representation of grammar. According to Isserlin, the telegraphic speech is an adequate means of expression that is sufficient for the daily requirements of language speaking. Isserlin maintained that evidence for the claim that agrammatism results from an unconscious adaptation comes from the writing of people with agrammatism. Unlike in oral expressive language, people with apparently agrammatic language do not routinely produce telegraphic language in their writing, which contains fewer grammatical and syntactic errors than the spoken equivalent and simple paraphasia, unintended utterances which may be syllables, words or phrases (Benson & Ardila, 1996). Isserlin's hypothesis is known as the *economy of effort hypothesis* which has had a significant impact on understanding agrammatism and has influenced subsequent theories of agrammatism particularly the adaptation theory (Kolk, 1987; Kolk & Heeschen, 1990; 1992; 1996).

Summary

It can be seen that the studies in the classical period from the late 19th to the early 20th century provided the basic defining features of agrammatism. Agrammatism has been differentiated from paragrammatism which was a condition associated with Wernicke's aphasia and other fluent types of aphasia (Kleist, 1914). It was seen as a result of either a loss/impairment in the grammatical representation (Kleist, 1914) or as an adaptation to the grammatical difficulty a person faces as she speaks (Isserlin, 1922). The primary descriptions and theories of agrammatism during the classical period have significantly influenced subsequent research. The research of agrammatism that took place after the classical period is discussed in the following sections.

1.2.2.2 Agrammatism after the classical period

Aphasia and agrammatism research after the classical period were influenced by the new developments in the field of psychology and linguistics. The adoption of theories from psychology to the study of brain-damaged individuals, including people with aphasia, led to the establishment of a completely new field known as cognitive neuropsychology.

Cognitive neuropsychology and its relevance to the study of agrammatism

Coltheart (2001) defined cognitive neuropsychology as a branch of cognitive psychology that studies the structure and function of cognitive processing, including language, through the analysis of studies of people with cognitive impairments. It aims to infer models of typical cognitive processing on the basis of atypical cognitive processing, and to understand the underlying mechanisms of cognitive processing (Rapp & Goldrick, 2006).

Cognitive neuropsychology uses language models which are box-and-arrow models with centres and connections. The boxes represent components of the language modality whereas the arrows represent the interactions between these components (Howard & Patterson, 1989; Rapp & Goldrick, 2006). The use of box-and-arrow models is effective in determining impaired components and mechanisms from spared ones in a given case. The cognitive neuropsychology models provide a theoretical basis on which assessments and rehabilitations of aphasia can be accomplished (Howard & Patterson, 1989). Most research in cognitive neuropsychology has been on single words, but there has been some research focusing on sentence processing (e.g. Garrett, 1980). Since the focus of research in this field has mainly been on single words, the use of these models in agrammatism research has limitations (Druks, 2017). However, cognitive neuropsychology and most research in agrammatism share certain assumptions which include *modularity*, *universality* and *subtraction* (Basso, 2003).

Assumptions of cognitive neuropsychology

Modularity states that cognition consists of the functioning of a number of independent processing units which are domain specific, computationally autonomous and informationally encapsulated (Fodor, 1983). Coltheart (2001) explained that domain specificity refers to the notion that a single module responds to one type of input at a given time, whereas computational autonomy refers to the proposal that a given module does not share general processes (such as attention and memory) with other modules, and information encapsulation means that each module has access to a restricted and predetermined type of information.

The assumption of *universality* refers to the notion that all humans share a universal cognitive system. This entails that there are no significant differences between individuals (Basso, 2003; Coltheart, 2001), and makes it possible to make inferences from one individual to another.

Finally, *subtraction hypothesis* assumes that brain damage can subtract the function from a cognitive system but cannot add new functions to it; brain damage does not reorganise brain function. An impaired cognitive system is the same as a normal cognitive system except that one or more of the operations are impaired due to brain damage (Ellis & Young, 1996). This entails that brain damage can provide a window into the functional organization of the mind.

Tools in cognitive neuropsychology

Cognitive neuropsychology investigates aphasia using a number of different tools. The tools which are of interest to the current thesis include: analysis of accuracy rates and errors, identifying dissociations/double dissociations, and the use of case studies or case series designs.

One of the major tools used in cognitive neuropsychology is the analysis of errors made by brain-damaged individuals. According to cognitive neuropsychologists, errors can indicate the functional organization of the mind since only one or more operations are impaired in brain-damaged individuals and their cognitive system is similar to non-brain-damaged individuals. Error analysis has provided an insight into the representations and internal mechanisms of language components (Basso, 2003; Rapp & Goldrick, 2006). In-depth analyses of structured errors can be very informative by providing theoretically motivated explanations of the functional architecture of language processing (Basso, 2003). For example, Khwaileh, Body & Herbert (2015) analysed production errors of regular and irregular plural nouns by three Arabic speakers with agrammatism and the analysis reflected a dual mechanism of regular and irregular processing since irregular plurals included fewer substitution and omission errors unlike regular.

Dissociations and double dissociations are considered strong evidence in cognitive neuropsychology. Dissociation refers to the independence of two specific functions shown by intact performance on one function in parallel with impaired performance on the second within the same individual. If two functions dissociate, it implies the existence of two distinct types of information processing which are processed independently. It may however also suggest that the two functions involve the same cognitive processes, but they vary in difficulty (McCarthy & Warrington, 1990). For example, Friedmann (2005) reported a dissociation between the production of tense and agreement inflections in Hebrew and Arabic speakers with agrammatism. The results showed intact production of tense inflections combined with impaired production of agreement inflections. Friedmann assumed that accessing tense phrase is more difficult than agreement phrase in agrammatism because tense phrase is located higher in the syntactic tree.

The single dissociation is differentiated from double dissociation. Double dissociations can be inferred by comparing case studies. Double dissociation within a single case may be present when a participant is impaired in one function and unimpaired in another function within a given task but shows a reverse pattern in another task. For example, Rapp and Caramazza (2002) described a participant who showed double dissociation of nouns and verbs. The participant performed better with the use of nouns rather than verbs in writing but showed the opposite pattern in speaking. Double dissociations across participants may occur when one participant is impaired in one function and unimpaired in another function, and another participant presents with an opposite pattern of impairments and preservations. Double dissociations imply that the two functions are governed by independent cognitive processes.

Cognitive neuropsychology uses single cases and case series in an attempt to identify the impairments and the preservation of relatively small components of cognitive function and to find patterns that can be inadvertently hidden in group studies (Ellis & Young, 1996). Therefore, cognitive neuropsychologists maintain the argument that single cases provide a detailed description of aphasia. Cognitive neuropsychologists do not claim that there exists a single syndrome which many patients exhibit, but they do claim that there is a single theory of the relevant cognitive system that can further explain and highlight a range of symptoms occurring in different individuals with aphasia (Coltheart, 1984; 2001). By the use of single cases, cognitive neuropsychologists disagree with the syndrome approach (Goodglass, 1993) of aphasia which looked for similarities across participants, and which in turn may have overlooked the differences presented (Howard & Patterson, 1989; Rapp & Goldrick, 2006).

Cognitive neuropsychology and linguistics

In cognitive neuropsychology, linguistic methods and theories are utilised in order to understand performance in aphasia (Perkins and Howard, 1995). Researchers and clinicians can make use of linguistic methods and tools to analyse and describe in detail the semantic, syntactic, morphological, phonological and phonetic characteristics in speakers with aphasia. Psycholinguistic models and theories are used to explain aphasic data. For example, language access models, such as Weaver++ model (Levelt et. al., 1999), have been the basis for many studies investigating noun phrase production in aphasia and agrammatism (e.g. Khwaileh, Body and Herbert, 2017; Lorenz and Zwitserlood, 2014).

Summary

The study of aphasia, including agrammatism, after the classical period was influenced by the advancements in the fields of psychology and linguistics and the appearance of cognitive neuropsychology. Cognitive neuropsychology investigates impaired cognitive processing, including language, to understand the impairment and to infer models of typical cognitive processing. Linguistic methods and tools are used to understand aphasia and agrammatism such as the application of theories from psycholinguistics to the study of agrammatism. Studying aphasia and agrammatism does not only help in understanding the language deficits but can provide significant theoretical implications to linguistics and psychology.

The application of psycholinguistic models to the study of agrammatism is one dominant approach in the literature. This approach is discussed in the following section together with other approaches which share some of the assumptions of cognitive neuropsychology.

1.2.3 Approaches to the study of agrammatism

This section reviews the current, dominant approaches to the study of agrammatism with a focus on approaches that apply to the investigation of NP production. The section is divided into three subsections: the psycholinguistic approach, the neurolinguistic approach and the usage-based approach.

1.2.3.1 The psycholinguistic approach

The psycholinguistic approach to the study of agrammatism adopts theories and methods from psycholinguistics. Psycholinguistics is mainly concerned with the analysis of typical language use to unravel the mechanism in which language is processed and represented in the brain (Blumstein, 2015). It studies language in two different directions: language as a means of elucidating psychological theories and processes, such as the effect of language on memory, and the effect of psychological constrains on language, such as the effect of memory limitations on language production and comprehension. The main topics in psycholinguistics include acquisition, comprehension, and production of language (Ratner & Gleason, 2009).

In aphasia research, psycholinguistic theories are used to analyse aphasic data in order to understand typical language processing and representation. Another aim of using psycholinguistic theories in aphasia is to help in the classification, assessment and intervention of aphasia. A number of studies investigated NP production in agrammatism across different languages such as Arabic (Khwaileh, Body & Herbert, 2015; Khwaileh, Body & Herbert, 2017; Safi-Stagni, 1992), English (Herbert & Best, 2010), German (Lorenz & Zwitserlood, 2014; Seyboth, Blanken, Ehmann, Schwarz & Bormann, 2012), and Italian (Luzzatti & De Bleser, 1999; Mondini, Luzzatti, Saletta, Allamano & Semenza, 2005; Scarnà & Ellis, 2002) in light of psycholinguistic models of language processing and word production. These models are reviewed in the following section.

Models of word production

Producing a language requires accessing information stored in the mental lexicon and then unconsciously turning this information into spoken or written words. Researchers have created different production models in an attempt to describe this process. The derivation of these models was based on data of speech errors (Garrett, 1975), tip-of-the-tongue errors (Brown and McNeil, 1966; Jones and Langford, 1987), experimental studies on non-brain damaged speakers (Butterworth, 1975) and aphasia (Dell et al., 1997).

The Wernicke-Lichtheim model (Lichtheeim, 1885) is an example of a classical model of word production which aimed to identify language components and their neuro-anatomical correlates. This approach to developing models was dominant until the 1960s. In the 1970s, the identification of the cognitive organisation of word retrieval rather than language components became the main focus in model developing (Dell, 1986; Garrett, 1976). These models which emerged after the 1970s can be classified into two types: functional models and connectionist models (Basso, 2003).

Functional models share the assumption that two stages are required in the process of language production: the retrieval of a word’s meaning at the semantic representation and the retrieval of a corresponding phonological word form at the phonological representation. Functional models use boxes and arrows with boxes as representation components and storage buffers and arrows as pathways between representational stores. Connectionist models are similar in these aspects; however, they assume that there is interaction between some or all stages of word retrieval and this interaction can be within and between the representations and storage buffers (Dell & Cholin, 2012). Fromkin (1971), Garret (1975; 1976), Levelt (1989) and Butterworth (1982) are examples of functional models, whereas Dell (1986), Dell and O'Seaghdha (1992) and Rapp and Goldrick (2000) are examples of connectionist models.

Models of word production also differ in a number of aspects. First, they differ in the representation of conceptual information at the semantic level. Levelt et al. (1999) assume that conceptual information is represented by a single node for each concept. On the other hand, Dell et al. (1997) argue that conceptual information is represented as a set of semantic feature units.

Second, word production models differ with regard to the levels between the semantic and the phonological level. Levelt et al. (1999) suggest in their model, the Weaver++, that a lemma level, responsible for the syntactic information of a word, and a morphological level exist between the semantic and the phonological level. The lemma maps onto the morphological level prior to the phonological level. However, the morphological level is not proposed in Dell et al.'s (1997) interactive 2-step model.

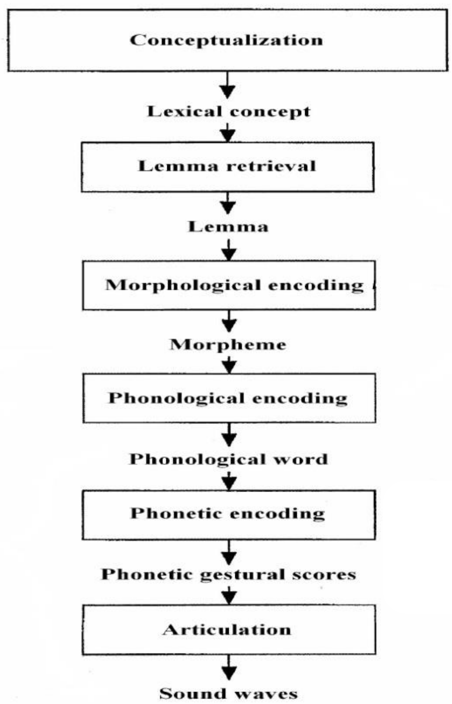
Third, access to syntax during production differ from one model to another. The interactive 2-step model (Dell et al., 1997) and the Weaver++ model (Levelt et al., 1999) assume obligatory access to the lemma level and hence to lexical syntax. However, Caramazza (1997) assumes in the independent network model that syntax is represented independently, and that syntax does not have to be activated to access word form. According to Caramazza, syntax is only accessed if it is required in the output task such as when adjective-noun or determiner-noun agreement must be computed.

A number of studies investigated NP production in the context of the Weaver++ model (Levelt et al., 1999) and the independent network model (Caramazza, 1997). These models are further discussed in the following.

The Weaver++ model

The Weaver++ (Word-form Encoding by Activation and VERification) model was developed on the basis of a number of psycholinguistic studies in non-Arabic languages (Levelt, 1989, 1992; Levelt et al., 1999; Roelofs, 1992). Figure 1.1 presents this model.

Figure 1.1: The Weaver++ model (based on Levelt et al., 1999)

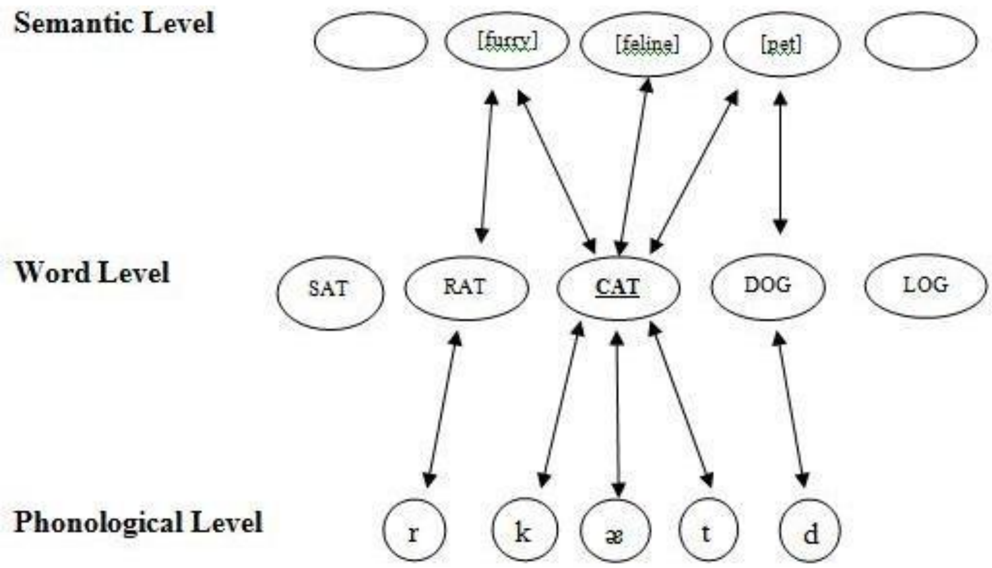


Word production in this model begins with the formulation of a concept, which is linked to a lexical concept. Lemma is then selected. A lemma is the lexical representation that involves a word's syntactic information. The form of the word is then accessed after lemma selection. The word’s form involves accessing the morphological form, specifying the metrical shape and retrieving the phonological content. The word is then articulated. Lexical access in this model is sequential through spreading activation emanating from the lexical concept node.

The interactive 2-step model

This model a connectionist theory which was developed based on computer simulations and aphasic data. The interactive 2-step model (Dell et al., 1997) is shown in Figure 1.2.

Figure 1.2: The interactive 2-step model (Dell et al., 1997)



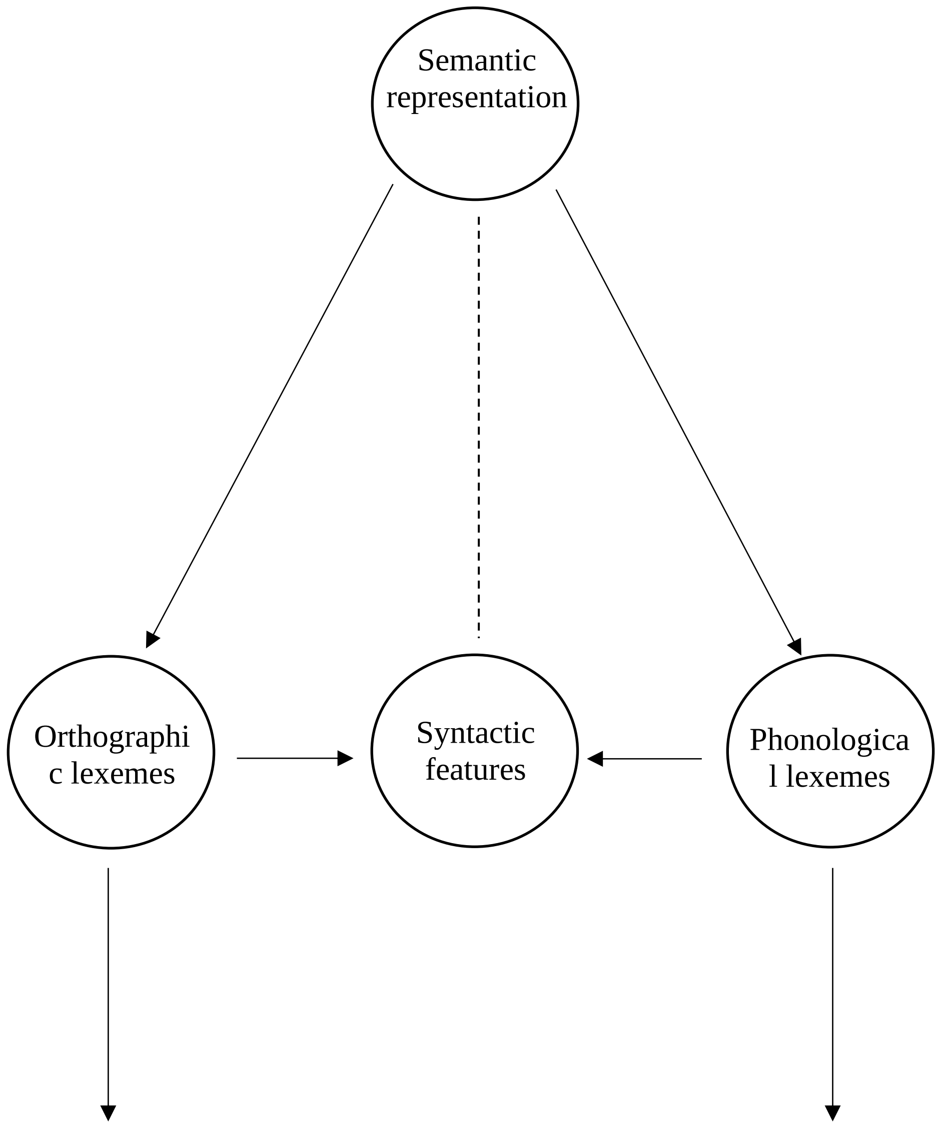
This model consists of three levels of representation: semantic, word and phonological level. The activation in this model is both feed forward and feedback. The feed forward activation begins at the conceptual level which primes semantic features. Next, semantic neighbours that have similar semantic features with the target word are activated. The primed semantic feature nodes spread activation to the lexical nodes. The lexical nodes then select the relevant phonological segments, and this activates phonological neighbours of the target word. Feedback activation works in the same way at each level by spreading activation to previous level.

The independent network model

Based on data from aphasia studies in non-Arabic (Caramazza & Hillis, 1991; Hillis & Caramazza, 1995; Rapp & Caramazza, 1997; Rapp, Benzing, & Caramazza, 1995), the independent network model (IN-model) was developed to account for selective grammatical class deficits, restricted to either oral or written production. In this model, it is assumed that lexical knowledge is organised in sets of independent networks which are connected to each other by a modality-specific lexical node. This is illustrated in Figure 1.3.

Word production in this model starts with the selection of semantic representation at the lexical-semantic network, which represents word meanings as sets of semantic properties or features. This selection spreads activation simultaneously and independently toward the syntactic network and to the phonological and the orthographic lexeme networks. The syntactic network represents a word's syntactic features such as grammatical category, gender and tense. Phonological and orthographic lexeme networks consist of the modality-specific representations of lexical items. The syntactic, phonological lexeme, and the orthographic lexeme networks are linked together. According to this model, the phonological and orthographic content of the lexeme nodes may become available independently of their grammatical features.

Figure 1.3: The IN-model (based on Caramazza, 1997)



Psycholinguistic representation and processing of grammatical gender

The Weaver ++ (Levelt et al., 1999), the interactive 2-step (Dell et al., 1997) and the IN-model (Caramazza, 1997) all share the assumption that grammatical and syntactic information including gender are represented at a separate level that is dependent form conceptual and phonological level. This is so-called *lemma level* in Weaver ++, *word level* the Interactive 2-step, and syntactic level in the IN-model. The psycholinguistic representation and processing of grammatical gender has been discussed in detail in the Weaver ++ model. According to this model, grammatical gender is stored at the lemma level and different types of grammatical gender are represented in different nodes, and all nouns belonging to the same grammatical gender share one gender node (Jescheniak & Levelt, 1994).

While these models agree that gender is represented in an independent level, they disagree on whether accessing grammatical and syntactic information including gender is sensitive to frequency. Frequency refers to the estimated occurrence of a word in a language (Bates et al., 2003), and it is argued that high-frequency words are accessed faster than low-frequency words by non-brain-damaged speakers (Kitterdge, Dell, Verkuilen & Schwartz, 2008). The Weaver ++ does not assume effect of frequency at lemma level, and argues for frequency effect at the phonological level only (Levelt et al., 1999). The Interactive 2-step model and IN-model argue that frequency affects all levels of lexical access including grammatical and syntactic level and thus retrieval of grammatical gender (Dell, 1990; Kitterdge, Dell, Verkuilen & Schwartz, 2008).

Representation of compound nouns in the Weaver++ and IN-model

The representation of compound nouns differs in the Weaver++ model (Levelt et al., 1999) and the IN-model (Caramazza, 1997). The difference concerns whether compound nouns are represented holistically, or in terms of constituent morphemes. Levelt et al., (1999) assumed that compounds have single, holistic representations at the lemma level; however, they correspond to multiple morphemes at the word form level. The IN-model did not explicitly deal with the representation of compound nouns, but it tacitly assumed holistic form representations for complex words (Janssen et al., 2008).

The above section presented psycholinguistic models of word production that have been adopted in the study of NP in agrammatism. The next section reviews models of psycholinguistic processing of grammatical number. These models have been the focus of some studies of investigating NP production in agrammatism.

Dual mechanism accounts of grammatical number

The dual mechanism is a psycholinguistic theory of morphological production. Proponents of this theory assume that morphologically complex forms are processed through stored full-form representations or by rules that compose inflected or derived word forms from smaller morphological units (Clahsen,1999; 2006; Kiparsky, 1982; Pinker and Ullman, 2002).

The psycholinguistic processing of regular and irregular plurals, such as the English plural nouns ‘kids and ‘children’ respectively, has been explained in the context of the dual mechanism accounts. One explanation was provided by Kiparsky (1982) based on free speech data of non-brain damaged individuals. Kiparsky claimed that there was a two-level representation of lexical morphology. *Level I,* which represents irregular morphemes that are stored in the lexicon and do not undergo any morphological analysis while processing. There are thus separate lexical entries in the lexicon for all irregular forms and morphemes at this level are processed as whole units. *Level II* includes regular morphemes and is computed rather than stored. Regular morphemes at this level require retrieval of stem and affix and application of rules to produce the final form.

Another dual mechanism explanation of regular and irregular plural processing is found in Pinker and Ullman’s model (Pinker, 1999; Pinker & Ullman, 2002; Ullman, 2001). This model was developed based on a study (Ullman et al., 1997) which analysed the processing of regular and irregular English past tense forms in participants with Parkinson’s and Alzheimer’s disease using a sentence completion task. A double dissociation in the processing of regular and irregular past tense was found. Participants with Parkinson’s disease, which results from anterior brain damage, produced more correct irregular forms than regular forms whereas participants with Alzheimer's disease, which is due to posterior brain damage, showed the opposite pattern. Pinker and Ullman (Pinker, 1999; Pinker & Ullman, 2002; Ullman, 2001) hypothesised the existence of one route for stored full forms that is for irregular forms, and a second route for computed forms that is for regular forms. This was similar to the assumption made by Kiparsky (1982); however, Pinker and Ullman's model differed from Kiparsky in two aspects. First, Pinker and Ullman described the two routes as an associative system and combinatorial system. The associative system is the stored forms route and emerges from the declarative memory that contains a list of all known words. Irregular forms are processed via the associative system. The combinatorial system, on the other hand, is the computed forms route and is a system that combines particular affixes into stems based on pre-defined combination rules. Regular forms are processed via the combinatorial system. Second, Pinker and Ullman claimed that these systems have a neurological base, an assumption that was not made by Kiparsky. Posterior parts of the temporal lobe are associated with the processing of irregular morphology, whereas the frontal lobe is associated with the processing of regular morphology combinatorial rules.

Summary

The above section has introduced the psycholinguistic approach to the study of agrammatism. This approach analysed language in aphasia in the context of models of typical language production and comprehension. The models that have been used in the analysis of NP production in agrammatism have been reviewed. These models were word production models and models of psycholinguistic processing of regular and irregular morphology.

The neurolinguistic approach is introduced in the next section.

1.2.3.2 The neurolinguistic approach

The neurolinguistic approach in agrammatism is dominated by the theory of Universal Grammar (UG; Chomsky, 1957) and transformational generative grammar (e.g. Transformational grammar, Chomsky, 1965; Government and Binding, 1981; Minimalist program, 1995). Neurolinguistic theories of agrammatism are theories that usually attempt to investigate the cause behind agrammatism to provide implications for the assessment and the intervention in agrammatism and to inform theories of transformational generative grammar by providing evidences of how natural language is represented or processed in the brain. Neurolinguistic investigations are often based on assumptions of the language theory of Universal Grammar (UG; Chomsky, 1957) which claimed that children are endowed with an innate language faculty, which includes universal principles of grammar and which enables them to acquire a language. This was motivated by the fact that children are able to use the grammar of a language and use language efficiently in a short period of time in spite of the limited linguistic exposure or the poverty of stimulus that children experience during their early stages of language acquisition. A child is endowed with a set of rules and the production of a language depends on rules application. According to this view, knowledge (competence) of human language is differentiated from its use (performance) and human knowledge can be seen via grammaticality judgement or slips of the tongue, by non-brain-damaged people, or by omission and substitution errors, by brain-damaged individuals.

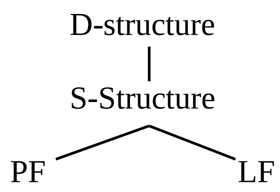
Since the neurolinguistic investigations of agrammatism were mainly informed by UG theories, which described the representation of language rather than language processing, some researchers following the neurolinguistic approach assumed that agrammatism is an impairment at the representation of language or knowledge of language. Caplan and Goodglass (as cited in Caplan, 1972, pp. 281 & 288) and Menn and Obler (1990) assumed that syntactic knowledge is completely lost in agrammatism, and speakers with agrammatism use non-linguistic strategies to concatenate words into sentences. Grodzinsky (1990) and Ouhalla (1993) argued that all knowledge of functional elements is lost in agrammatism. Hagiwara (1995) and Friedmann and Grodzinsky (1997), on the other hand, argued that syntactic knowledge is partially lost and only some functional elements are impaired in agrammatism. They based their arguments on data from French, Italian, Japanese (Hagiwara, 1995), Hebrew and Palestinian Arabic (Friedmann, 1994; Friedmann & Grodzinsky, 1997) agrammatism where some structures such as agreement, coordination and yes/no questions were spared, whereas other structures such as tense, subordination and wh-questions were impaired. Friedmann (1994) and Friedmann and Grodzinsky (1997) explained such dissociation by introducing the tree pruning hypothesis.

In the following, the tree pruning hypothesis (Friedmann, 1994; Friedmann and Grodzinsky, 1997) and other dominant neurolinguistic hypotheses that accounted for agrammatic production, and which are relevant to the current investigation, are discussed.

The Tree Pruning Hypothesis

The tree pruning hypothesis (TPH; Friedmann, 1994; Friedmann and Grodzinsky, 1997) is a theory that explains specific elements of the production deficit in agrammatism by hypothesising impairments to certain higher nodes in the syntactic tree such as the complementiser phrase (CP) node. Essentially, the TPH is built on the following model of grammar (Chomsky, 1981; Figure 1.4).

Figure 1.4: Chomsky's (1981) model of grammar.

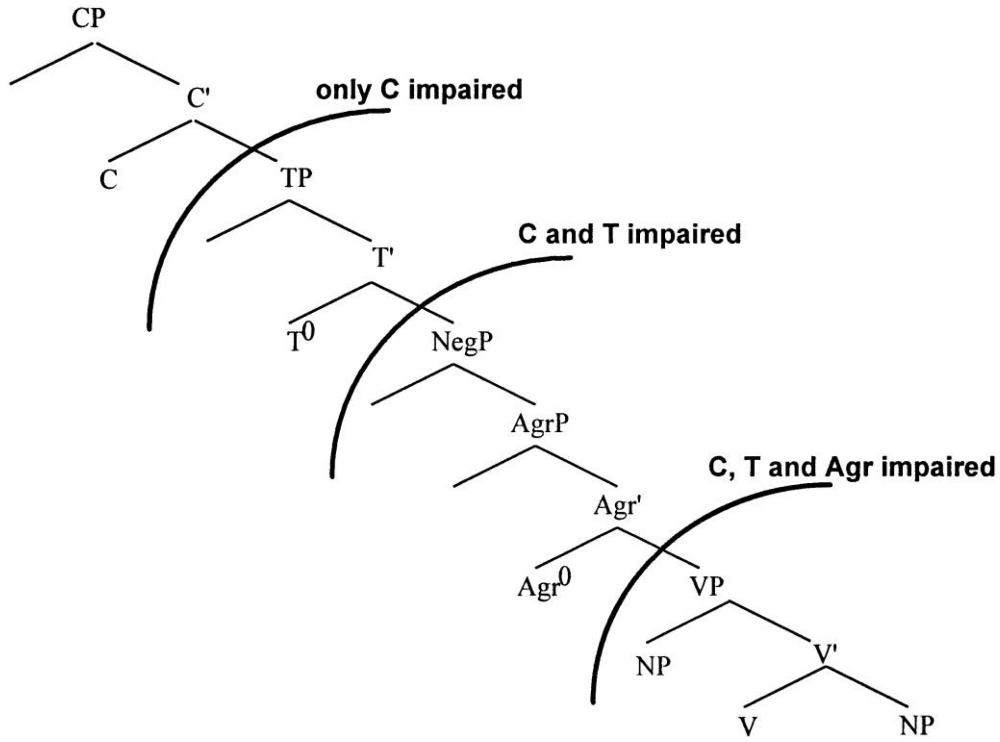


In this model, there are four levels of representations for the derivation of syntactic structures. The derivation first starts at D-Structure which is responsible for matching the logical, semantic information with the grammatical functions of sentences. Then, S-Structure is derived from D-Structure by application of transformations. Afterwards, the syntactic derivation splits, obtaining the phonological representation at PF and the semantic representation at LF.

Based on this model, a clause consists of lexical and functional phrases arranged in a hierarchical fashion. Lexical phrases, such as verb phrase and NPs, are located in the lower portion of the syntactic tree structure, whereas functional phrases, such as inflectional phrases, and complementiser phrases, are positioned progressively higher in the syntactic tree (Chomsky, 1995). Based on this, Friedmann and Grodzinsky (1997) assumes a hierarchical structure (Figure 1.5) for a clause in order to give a systematic account of aphasic patients' impaired syntactic abilities.

Within this hierarchical structure, the order of the inflectional phrase (IP) is the agreement phrase (AgrP) then the tense phrase (TP), AgrP > TP. Individuals with Agrammatism are usually unable to project their syntactic tree up to the TP node, and tense inflection is impaired in agrammatism accordingly. Nodes under the TP are usually spared, so production of verb agreement inflection is intact. Structures that require nodes higher than the TP node such as CP are difficult to produce and this explains why speakers with agrammatism do not produce well-formed embedded sentences or wh-questions (Friedmann, 1994; Friedmann & Grodzinsky, 1995; Friedmann, 2001). In particular, the TPH predicts that the higher a syntactic projection is in the syntactic structure, the more likely it is that the projection will be impaired, and once a projection is impaired, any node above it will also be impaired.

Figure 1.5: TPH's hierarchical structure by Friedmann and Grodzinsky (1997)



Friedmann and Grodzinsky (1997) based their arguments on results obtained from a female Hebrew speaker with agrammatism. The participant was able to choose a correct verb form inflected for agreement but not able to choose a correct verb form inflected for tense in sentence completion tasks. The participant had also difficulty in production of wh-words, complementizers and embedded sentence structures which are all elements of CP.

Data from other studies on Arabic and Hebrew by Friedmann (2001; 2002) supported the TPH argument. The result of the tense/agreement dissociation was reported in another study carried out by Friedmann (2002). Friedmann analysed the production of tense and agreement inflections by 13 Hebrew and two Arabic speakers with agrammatism using verb completion and sentence repetition tasks. Friedmann also explained the results in terms of impairment into the tense node which is higher than the agreement node in both Arabic and Hebrew.

In another study involving 16 Hebrew and two Palestinian Arabic speakers with agrammatism, Friedmann (2005) explored the patterns of variations in the performance between the participants and the severity of their agrammatism in light of TPH. The study first investigated the production of tense inflections (at the TP), agreement inflections (at the AgrP), wh-questions (at the CP) and relative clauses (at the CP) through two sentence completion tasks and two elicitation tasks. It also investigated the recovery of these four syntactic levels over 18 months. The results of the first investigation showed that speakers with severe agrammatism produced more errors in tense inflections, wh-questions and relative clauses than errors in agreement inflections. This indicated that speakers with sever agrammatism were unable to access nodes from TP and above. Speakers with milder agrammatism, on the other hand, produced more errors in wh-questions and relative clauses than errors in tense inflections. Friedmann claimed that this indicated that speakers with mild agrammatism were unable to access CP nodes. The author concluded that the syntactic tree could account for the variation in the participants' performance and their severity of agrammatism by claiming pruning of certain syntactic nodes. The results of the second investigation showed that spontaneous recovery is consistent with hierarchical order of the syntactic tree. AgrP, TP, and CP were impaired at the first stage, then AgrP recovered in the next stage, and finally TP recovered in the last stage. Friedmann concluded that TPH can effectively describe stages of spontaneous recovery as well as to its ability to characterise agrammatism and account for individual differences in agrammatism.

Other Arabic studies explored agrammatic data in light of TPH. Diouny (2007) tested tense/agreement dissociation as predicted by TPH in Moroccan Arabic with four speakers with agrammatism using picture description, repetition, sentence completion and grammaticality judgement tasks. The participants produced more tense errors (49.7%) than agreement errors (83.5%) and thus replicated a similar pattern of tense/agreement dissociation proposed by TPH.

The TPH's syntactic account could not explain the data fully. Although tense inflections in Moroccan Arabic were impaired and agreement inflections were spared in line with TPH predictions, Moroccan Arabic has the AgrP over the TP in the syntactic tree and this cannot be explained by TPH. Diouny argued that a processing account that argues for the intactness of syntactic knowledge in agrammatism could explain the deficit in Moroccan Arabic. The author maintained that the apparent impairment in grammatical inflections in Moroccan Arabic is due to an increase in computational load. It can be seen that Diouny's findings can be explained by the TPH but his finding is not so easily accommodated within the theory and presents a challenge to its ability to fully account for language production in agrammatism.

In a study which was designed in line with predictions of the TPH, Albustanji, Milman, Fox & Bourgeois (2013) investigated the production of questions, tense, agreement and negation by 15 Jordanian Arabic speakers with agrammatism using a sentence completion task and question elicitation tasks. Tense/agreement dissociation was observed with tense inflections (60.3%) being more impaired than agreement inflections (89.7%). Moreover, wh-questions were significantly more impaired (43.5%) than yes/no questions (86.6%). While this is predicted by the TPH, the authors argued that a closer look at the type of errors found in wh-questions contradicted the notion of the hierarchical account proposed by TPH. Errors in wh-questions production included tense inflection errors at the TP rather than errors at the CP. The participants were able to project their syntactic tree up to the CP node although they made errors at the TP node, which is lower than the CP. This finding is not explained by the hierarchical account of TPH, which predicts that impairment at the level of TP urges impairment at higher nodes — the CP level.

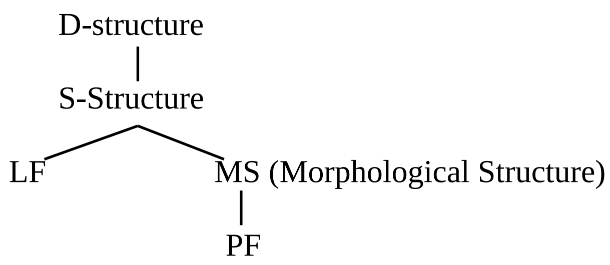
Data from non-Arabic studies (e.g. Benedet et al., 1998; Burchert, Swoboda- Moll & De Bleser, 2005; Milman, 1997; Stavrakaki & Kouvava, 2003; Wenzlaff & Clahsen, 2005) has indicated that the production of elements associated with complementiser phrases were more impaired than the production of elements associated with lower functional projections. It was also found that speakers with agrammatism reflected a dissociation between tense and agreement inflections in verbs, with tense being more impaired than agreement. However, data from studies in Korean (Lee, 2003), German (Burchert et al., 2005), and English (Lee, Milman & Thompson, 2005) have shown that tense phrases were more impaired than complementiser phrases, although complementiser phrases are structurally located higher than tense phrases.

In particular, Thompson and colleagues (Dickey et al., 2008; Lee et al., 2005; 2008; Thompson et al., 2002) found that participants with agrammatism had significantly higher accuracy for complementisers than for tense inflections in both production and grammaticality judgment tasks. In addition, substitutions of incorrect morphemes rather than omissions of morphemes dominated tense inflection errors. This suggested an ability to project verb inflection and to implement inflectional rules. Thompson and colleagues (2002) proposed an alternative account which they referred to as the Distributed Morphology Hypothesis (DMH). The DMH is discussed in the following section.

The Distributed Morphology Hypothesis

DMH (Dickey et al., 2008; Lee et al., 2005; 2008; Thompson et al., 2002) is based on the theory of Distributed Morphology (Embick & Noyer, 2007; Halle & Marantz, 1993; Harley & Noyer, 1999), which adopts the following model of grammar (Halle & Marantz, 1993).

Figure 1.6: Halle & Marantz's (1993) model of grammar.



This model of grammar (Halle & Marantz, 1993) assumes that morphology is computed among the several components of the grammar and there is an interface called Morphological Structure (MS) that is located between the S-Structure and Phonological Representation (PF). An element possesses morpho-syntactic/semantic features at the S-Structure, obtains phonological features at the MS and these phonological features are interpreted at PF. The term Distributed Morphology is thus used because the morphology of an utterance is the product of operations distributed over more than one level.

The DMH claimed that even if individuals with aphasia have intact hierarchical syntactic structure, impairment still results if they have flawed feature-to-morpheme mapping at the MS. According to DMH, because inflections require feature-to-morpheme mapping at the MS, they are among the most impaired functional morphemes in agrammatism. In addition, DMH predicts that inflectionally derived forms such as 'these' are more impaired than forms which are not derived or involve no inflections such as 'this'.

DMH was tested in a study carried by Wang, Yoshida and Thompson (2014). The authors investigated the differences between production of clauses and nominal phrases in light of TPH (Friedmann, 1994; 2001; Friedmann & Grodzinsky, 1995) and DMH (Dickey et al, 2008; Lee et al., 2008; Thompson et al., 2002) and examined the degree to which they are impaired in agrammatism. The participants of the study were ten English speakers with agrammatism and ten non-brain-damaged participants. The tasks involved a sentence completion task where participants inserted complementisers (e.g 'if'), auxiliary verbs (e.g. 'have') and verbs (e.g. 'ask') in clauses; and numerals (e.g. 'one') and determiners (e.g. 'this') in nominal phrases. The tasks also included a grammaticality judgment task where participants judged the grammaticality of functional morphemes in clauses and nominal phrases. The results showed that speakers with agrammatism were significantly more accurate at the production of complementiser than at the production of auxiliary verbs in clauses. This pattern contradicted the assumption made by TPH which predicted impaired production of higher nodes such complementiser phrase (complementisers) and preserved production of lower nodes such as tense phrase (auxiliary verbs). The production accuracy of speakers with agrammatism for 'have' was significantly higher than that for 'had'. This was consistent with DMH which predicted that inflectionally derived forms such as 'had' are more impaired than forms which are not derived or involve no inflections such as 'have'. As for nominal inflections, the production of numerals by speakers with agrammatism was significantly more accurate than production of determiners. This pattern supported TPH since numerals are located lower than determiners in the syntactic tree. Participants with agrammatism also showed preserved production of the demonstrative 'this' compared to 'these'. The authors explained this dissociation in light of DMH since 'these' is a derived form. As for the results of the grammaticality judgement task, functional morphemes that did not involve inflections were more accurate than those which involved inflections in the agrammatic data. It can be seen that neither the TPH nor the DMH could account for all the production data in Wang et. al.'s (2014) study, and that there were certain results that could be accounted for by either one of the two theories but not the other.

Although neither the TPH nor the DMH was able to account for all production data in agrammatism, TPH has received greater attention in the literature than the attention received by DMH. Application of the TPH and DMH to NP production in aphasia is limited to the study by Wang, Yoshida and Thompson (2014). Applications of these hypotheses to the production of Arabic NP in aphasia would inform them significantly.

One of the most influential theories of agrammatism that argued that agrammatism is a processing disorder rather than a deficit in linguistic knowledge is the adaptation theory (AT; Kolk, 1987; Kolk & Heeschen, 1990; 1992; 1996). Although this theory did not employ linguistic construct and only used linguistic terminology, it has greatly impacted lots of neurolinguistic hypotheses. In the following, AT is first discussed and the hypotheses that were influenced by AT are then introduced.

The Adaptation Theory

Based on Dutch and German studies, Kolk and Heeschen introduced AT (Kolk, 1987; Kolk & Heeschen, 1990; 1992; 1996) which is a theory that viewed fluent and non-fluent aphasia, including agrammatism, as a processing disorder due to reduced processing capacity. The assumptions of AT have roots in arguments made by Isserlin (1922; discussed in section 1.2.2.3) who postulated the *economy of effort hypothesis* which argues for an unconscious adaptation to the difficulty faced by speakers with agrammatism rather than a loss or impairment at the representation of grammar. According to AT, the overt linguistic output by speakers with aphasia does not reflect an underlying impairment at the representation of language. However, it results from the particular way speakers with aphasia adapt to the impairment or repair utterances, a way which Kolk and Heeschen referred to as corrective adaptation.

Corrective adaptation can be either overt or covert (Kolk & Heeschen, 1996). In overt repair, the speaker with aphasia consciously repairs the sentence when he predicts that the generation will be unsuccessful. This can explain why aphasic speakers prefer sentences without embeddings such as the ‘the man came’ over sentences with embeddings as in ‘the man with the hat came’. In covert repair, the speech-monitoring mechanism discovers an underlying error and generates part of the internal representation again. This is reflected in the repetition of a sentence fragment and long pauses in aphasic speech. The result of the corrective adaptation is non-fluent speech and low speech rate. Kolk and Heeschen claimed that the reason for the corrective adaptation may be due complexity or length of the utterance.

AT extends its assumptions to the claim that Broca’s aphasia, expressive, non-fluent, and Wernicke’s aphasia, receptive fluent, stem from a similar processing deficit with respect to the production of grammatical morphology (Kolk & Heeschen, 1992). This is due to the resemblance between Broca’s aphasia and Wernicke’s aphasia in the production of substitution rather than omission errors of grammatical morphology in picture description tasks. However, in spontaneous speech tasks, speakers with Broca’s aphasia differed from speakers with Wernicke’s aphasia as they overuse adaptation strategies. Kolk and Heeschen also claimed that a task effect exists where errors in spontaneous speech by Broca’s aphasics are different in nature from errors in elicited speech tasks.

The assumptions introduced by AT have been tested by other studies. For example, Martin, Wezel, Blossom-Stach and Feher (1989) analysed production of verb inflections and articles by four English speakers with agrammatism in spontaneous speech and picture description tasks. The results demonstrated that some participants showed difficulty in inflections rather than determiners, whereas the reverse was seen in others. This morphological dissociation could not be explained by the assumption of adaptive strategies. However, the author reported task effect as predicted by AT in one participant who made more omission errors in articles in connected speech, whereas only a few omission errors of articles were found in picture descriptions.

Another example of a study which analysed agrammatism in light of AT is Hesketh and Bishop's (1996) examination of English agrammatism. The study involved three different experiments conducted using 14 participants. The first experiment tested the production of spontaneous speech. They reported task effect, but they did not report any effect from length or complexity. Passive construction was elicited in the second experiment and the results did not reflect the participants' use of adaptive strategies. The third experiment aimed at testing omission and substitution of grammatical morphemes. Hesketh and Bishop reported the omission of verbs and closed class words, which supports the adaptative strategy hypothesised by Kolk and Heeschen. AT was able to account for only some of the results in Hesketh and Bishop's study and there were some results which challenged the theory.

AT's assumption where agrammatism is a processing disorder has greatly impacted hypotheses and theories of agrammatism. The following sections present some neurolinguistic hypotheses of agrammatism which were influenced by AT and its view of a agrammatism as a processing disorder.

The Derived Order Problem Hypothesis

Like AT (Kolk & Heeschen, 1998), The Derived Order Problem Hypothesis (DOP-H; Bastiaanse and van Zonneveld, 2005) views agrammatism as a processing disorder. Bastiaanse and van Zonneveld used the word order to explain certain impairments in agrammatism. They used the classical distinction between basic orders, such as Subject–Verb–Object in English and Subject–Object–Verb in Dutch, and derived orders, which are all grammatical orders other than the basic orders. They explained that all derived orders will be more difficult to produce and comprehend by speakers with aphasia.

Bastiaanse and van Zonneveld (2005) based their arguments on findings from Dutch speakers with agrammatism. Their results showed that the production of finite verbs was easier in the embedding than in the matrix clause. This could not be explained by AT which predicts that embeddings are more difficult to produce than matrix clauses since they involve a greater computational load. Bastiaanse and van Zonneveld maintained that finite verbs was easier in the embedding than in the matrix clause in the production of their Dutch speakers with agrammatism because finite verbs in the embeddings take the basic order in Dutch, where the order of the finite verb in the matrix clause is derived. Bastiaanse and van Zonneveld added that their results also demonstrated that production of unaccusative verbs, verbs whose subject is not responsible for the action as in ‘the glass breaks’, was more difficult than production of the transitive verbs, verbs whose subject is responsible for the action and have an object as in ‘he breaks the glass.’ They maintained that this was because unaccusative require derived word order where the theme (the object in this case) should be in subject position. DOC-H was able to account for some errors in Bastiaanse and van Zonneveld’s study that AT could not explain them.

Several studies have investigated DOC-H in different languages. In English, it was found that yes/no questions are hard to produce by speakers with agrammatism because they are derived, and the auxiliary is moved to a position that precedes the subject (Bastiaanse and Thompson, 2003). In German, Burchert et al., (2008) have reported difficulties with producing sentences in which the object is in a derived position, and similar results have been reported for Turkish speakers with agrammatism (Yarbay Duman et al., 2007; 2008).

Anjarningsih, Haryadi-Soebadi, Gofir, and Bastiaanse (2012) argued against the DOC-H. They have reported the use of a substantial number of passives with derived order by agrammatic speakers of Standard Indonesian in spontaneous speech. While this is contrary to what the DOP-H predicts, it is suggested that the fact that passive constructions are frequent in Standard

Indonesian may explain the agrammatic speakers' ability to produce them. This is discussed in more detail in section (1.2.3.3).

It can be seen that DOP-H was able to account for specific errors that employ derivation but it is unable to account for all patterns of errors in agrammatism such the tense/agreement dissociation.

The Argument Structure Complexity Hypothesis

The Argument Structure Complexity Hypothesis (ASC-H) by Thompson (2003) is another hypothesis that views agrammatism as a processing disorder. Thompson analysed verb production by English speakers with agrammatism. All verbs have arguments which are the subject and the object that a verb takes. A verb has one subject but the number of the objects varies depending on the type of the verb. Intransitive verbs require no object such as the verb 'run' as in 'the cat runs,' transitive verbs require an object such as the verb 'read' as in 'John reads a book,' and ditransitive verbs require two objects such as the verb 'give' in the sentence 'Sam gives the glasses to Tom.' Thompson examined these different types of verbs and the analysis indicated that ditransitive verbs were more difficult to produce by speakers with agrammatism than transitive verbs, and transitive verbs were more difficult than intransitive verbs. Thompson hypothesised that production of a verb requires processing of the verb as well as its argument(s). Verb production increases in difficulty as the number of arguments and movements increases. Verbs with fewer arguments and movements, as with intransitive verbs, are less difficult for speakers with agrammatism than verbs with more arguments and movements, as with transitive verbs.

Kegl (1995) also found that the argument structure properties of verbs influence production in agrammatism. She analysed the narrative samples of an English speaker with agrammatism and found that the participant produced a wide array of verbs with various argument structures.

Kegal further analysed the intransitive verbs produced by the participants and compared between two types of intransitive verbs: unaccusative and unergatives verbs. Unaccusative verbs are verbs such as ‘melt’, ‘broke’ or ‘fell’ where the subject is not responsible for the action (e.g. ‘the glass broke’). Unergative verbs refer to verbs such as ‘laugh’ and ‘run’ where the subject initiates the action (Crystal, 2001). The results showed that the participant did not produce any unaccusative verbs, whereas the participant produced unergatives verbs. Although they both similarly have a single argument, the argument type is different in each type. In unaccusative verb, the argument is an internal argument, which is an object in the deep structure. In unergative verbs, the argument is an external argument, which is a subject in the deep structure. This difference in the type of argument affects the subsequent syntactic derivation. The deep structure representation of unaccusative verbs, where the argument is an object in the deep structure, renders them more syntactically complex than unergative verbs.

This unergative/unaccusative dissociation is also supported by a subsequent investigation by Thompson (2003). In both narrative discourse and picture-naming tasks, Thompson tested seven English participants with agrammatism and found that access to unaccusatives was more difficult than access to unergatives. Similar to Kegl (1995), Thompson concluded that the unaccusatives argument structure properties create an environment in which movement is required and, accordingly, they are more complex to process.

It can be seen that ASC-H was able to account for production impairments in verbs in particular and is limited to elements concerning the argument structures. The theory could not account for impairments in elements with no argument structures as with nouns.

The Generalised Minimality

Another neurolinguistic account that shares the assumption of the processing disorder explanation with the AT (Kolk, 1987; Kolk & Heeschen, 1990; 1992; 1996) is the Generalised

Minimality (GM; Grillo, 2005; 2008; 2009). GM is similar to the TPH which analyses agrammatism based on structural hierarchy and attributes problem to agrammatism to impairment to higher nodes such as the complementiser phrase. Unlike TPH, GM does not claim pruning of any syntactic nodes in agrammatism, but it assumes that agrammatism is due to problems with certain syntactic movements and inability to access morpho-syntactic features. The movements that are difficult in agrammatism are movements of NP which involve extraction from the object position and the crossing of the moved NP over another NP.

Grillo (2005) illustrated that Hebrew speakers with agrammatism performed well in sentence/picture matching tasks when the sentence included a basic word order of Hebrew (SVO) and were at chance when the sentences included other word orders (OSV, OVS). This was explained by claiming that subject features were not activated, and the movement was blocked, and the sentence could not be interpreted by the agrammatic patient. As for the problem with accessing the morpho-syntactic features in agrammatism, Grillo explained that the features that are associated with CP nodes are more problematic than the features associated with lower nodes such as NP nodes. The features that are associated with CP are discourse features whereas the features that are associated with lower nodes are usually number, gender and case features. Discourse features are usually the most affected in agrammatism and they target the position in the left periphery of clauses, such as the relative clause in ‘the cat *who chased the mouse*.’ Grillo (2005) explained that in order to interpret the relative clause successfully, the person has to build a complex discourse representation involving a set of ‘cats’, only one of which chased the ‘mouse’ in addition to the processing of the syntactic features such as number and gender.

The predictions of GM were examined in a study by Garraffa and Grillo (2008) who tested the comprehension of relative clause and production of wh-questions in an Italian speaker with agrammatism. Comprehension of relative clauses was tested using a referent identification task where the participant was shown a picture, listened to a stimulus and then had to answer a question which included a relative clause. Production of wh-questions was examined using a question elicitation task. The results showed that comprehension of the subject relative (i.e. ‘it is the cat who chased the mouse’) were more preserved than comprehension of the object relative (i.e. ‘it is the mouse who the cat chased’). Garraffa and Grillo explained that subject relatives were more preserved because the movement involved a movement of a subject out of a verb phrase and there was no intervening NP (i.e. ‘it is the cat <the cat> who chased the mouse’). In the object relative, the object is moved crossing an NP (i.e. ‘it is the mouse who the cat chased <the mouse>’). In addition to a movement of an NP crossing another NP, Garraffa and Grillo maintained that discourse features which are absent in the object relative make the object NP (i.e. ‘the mouse’) indistinguishable from the intervening NP (i.e. ‘the cat’). As for the production of wh-questions, Garraffa and Grillo reported that the participant produced grammatical questions containing ‘who’ and ‘what’ in subject position and ‘what’ in object position and ungrammatical production of ‘who’ in object position. This pattern was in line with GM, except for the grammatical production of ‘what’ in object position. Garraffa and Grillo explained that ‘what’ in object position (e.g. ‘what did you eat <what>’) carry scope-discourse features and when moved, it crossed an intervening NP (‘you’). However, the participant was able to produce ‘what’ in object position because it carried – an animate feature that distinguished it from the intervening NP (‘you’) which carried the + animate feature. The authors added that animacy mismatch between the moved object and the intervening subject explained the relatively spared production of ‘what’ in the object position.

Empirical evidence for GM is limited. In language acquisition in typically developing children and healthy adult speakers, Friedmann, Belletti and Rizzi (2009) suggested that when the intervening subject in object relative clauses is a pronoun, comprehension of object relative clauses was enhanced. The enhanced comprehension was attributed to feature dissimilarity between the moved and the intervening element.

The assumption that the feature dissimilarity between the moved and the intervening element facilitates comprehension of object relative clauses was examined in German agrammatism (Adelt, Stadie, Lassotta, Adani & Burchert, 2017). The study tested the comprehension of relative clauses by ten German speakers with Broca's aphasia and anomia as well as to 20 non-brain-damaged speakers using an auditory referent identification task. The type of the relative clause was either a subject relative clause or an object relative clause. Within the object relative clause, the type of the subject was either a full NP subject (e.g. 'where is the boy who the *girl* is kissing?') or a pronoun subject (i.e. 'where is the boy who *she* is kissing?'). Results showed that non-brain-damaged participants performed more accurately with subject relative clause than object relative clause, whereas the opposite results were reported for participants with aphasia. However, results of the type of the subject within the object relative clause showed that performance was more accurate when the relative clauses had pronoun subjects. The authors explained that a pronoun carries the feature [- NP], which makes it distinguishable from the intervening NPs (i.e. 'boy') which carries the [+NP] feature. The results suggested that the degree of featural distinctness was shown to facilitate comprehension in aphasia. The authors concluded that because people with aphasia have reduced processing capacities, a higher degree of featural dissimilarity is required to distinguish the moved from the intervening element in object relatives.

It can be seen that GM can account for certain impairments in agrammatism particularly with impairments in CP but its ability to account for other impairments has not been tested yet.

There are other hypotheses that have been put forward to account for agrammatism following a neurolinguistic approach such as the Trace Deletion Hypothesis (Grodzinsky, 1990) for agrammatic comprehension and Tense Under-specification Hypothesis (Wenzlaff & Clashen, 2004) and Tense and Agreement Under-specification Hypothesis (Burchert et al., 2005) for agrammatic production. However, the above review was limited to agrammatic hypotheses that accounted for production, which received considerable attention by other researchers or are relevant to the current investigation.

Summary

The above section has reviewed the neurolinguistic approach to the study of agrammatism. Such an approach has contributed to the understanding and characterisation of agrammatism and led to the development of different hypotheses all of which have mainly tried to identify the cause of agrammatism by either attributing it to impairments at knowledge of grammar or processing of grammatical knowledge. While the neurolinguistic hypotheses were not able to account for all impairments in agrammatism and were limited to certain structures, they demonstrated that morpho-syntax has a strong effect on agrammatic production. More complex morpho-syntactic structures tended to be more impaired in agrammatism than less complex ones.

The next section reviews the usage-based approach which is an alternative approach to the study of agrammatism and that focuses on frequency effect rather than structural factors

1.2.3.3 The usage-based approach

Usage-based approaches to language involve theories such as Cognitive Grammar (e.g., Langacker, 1987; 1991), Role and Reference Grammar (e.g., Van Valin & LaPolla, 1997), Functional (Discourse) Grammar (e.g., Dik, 1997; Hengeveld & Mackenzie, 2008) and Construction Grammar (Croft, 2001; Goldberg, 1995; Tomasello, 2009). The main theoretical positions that usage-based approaches share explicitly contrast to generative grammar and the

UG principles (e.g., Transformational grammar, Chomsky, 1965; Government and Binding, 1981; Minimalist program, 1995). UG advocates claimed that the linguistic experience which children are exposed to is insufficient for the acquisition of language and children are born with an innate language faculty and language is considered a domain-specific module, a separate entity in its own. In contrast, researchers following the usage-based approach argued against the existence of the language faculty and claim that certain domain-general processing capacities enable language acquisition. In addition, usage-based accounts do not differentiate between competence and performance, unlike the UG, and say that language is not autonomous from usage. Rule-based language structures and exceptions are not different according to the usage-based approaches and the same processing capacities are applied equally in both structures. Linguists following the usage-based approaches identified three main domain-general processes: chunking, analogy and categorisation. By applying such processes, a child acquires basic linguistic units (or constructions) (Tomasello, 2009). These processes are introduced in the following sections.

Chunking

Chunking is a cognitive process that leads to the learning of sequences (Solopchuk, Alamia, Oliver & Zenon, 2016). Chunking is based on the frequency of occurrence of certain elements within other units in a particular domain. In language acquisition, highly frequent combinations of adjacent phonemes, morphemes or words result in chunks. An example can be seen by Baybee and Schiebman's (1999) explanation of 'don't'. The authors measured the contexts in which 'don't' occurred and found that the vowel in 'don't' was reduced when it occurred in contexts that are frequent, such as with the pronoun 'I'. They explained that the reduction of the vowel in such specific contexts indicated the existence of certain relationships between ‘don’t’ and the other linguistic entity in the context of occurrence. This in turn was an indication of the existence of the chunking process in the language.

Analogy

Analogy is a cognitive process of mapping structures between domains (Gentner, 1983). Bybee (2010) identified linguistic analogy which refers to the use of a novel item in an existing construction, which enhances language productivity. An example of the application of analogy processes can be seen in the *Let’s X* expression. Van der Auwera, Dobrushina and Goussev (2013) explained that the phrase *Let’s X*, such as in ‘Let’s go’, implies a positive action. New coined words such as ‘jive’ would be interpreted as a positive action if it occurs in the expression *Let’s X* (‘Let’s jive’). Thus, the process of analogy enables the understanding of the meaning of new words.

Categorisation

Humans use the process of categorisation to classify items and predict the features of new items (Markman & Ross, 2003). Bybee (2010) explained that a construction contains schematic positions for sets of items that belong to specific categories. For example, the position of *X* in the *Let’s X* expression includes a set of words, such as ‘go’ and ‘jive’, all of which imply a positive action and belong to the same category. Humans identify a category based on frequency. Taylor (2015) showed that frequency is central to the identification of categories and of the prototypical members in each category. In examining the NP in the English time expression *for NP*, Taylor identified the NPs ‘hours’, ‘days’, ‘weeks’ and ‘months’ as more frequent and prototypical than other expressions such as ‘many days’ or ‘several weeks’.

It can be seen that usage-based accounts believe that certain cognitive processes enable the acquisition of language based on language use. This means that frequency is a major factor for language acquisition and has a significant effect on language use. The effect of frequency on the language by non-brain damaged speakers and speakers with aphasia is explained in the next section.

Frequency

In non-brain damaged speakers, data has been accumulated to show that lexical frequency, the estimated occurrence of a word in a language, has a significant effect on word retrieval (e.g. Bates et al., 2003; Brysbaert, 1996; Oldfield & Wingfield, 1965). Words with high frequency elicit shorter reaction times than words with lower frequency. This indicates that frequency has an effect on word processing (Balota & Chumbley, 1985).

The effect of lexical frequency is also reported in studies investigating production by speakers with aphasia. In a picture naming task, pictures of objects with high frequency names elicited faster naming responses (Newcombe, Oldfield and Wingfield, 1965) and more accurate word retrieval (Kay & Ellis, 1987; Kittredge, Dell, Verkuilen & Schwartz, 2008; Nozari, Kittredge, Dell & Schwartz, 2010) than objects with low frequency names. The frequency effect was also reported in a written word naming task (Raymer et al., 1997) and a repetition task where speakers with aphasia responded more quickly when naming or repeating high frequency words compared to low frequency words (Bose, van Lieshout & Square, 2007).

While the effect of lexical frequency on the production of nouns has been straightforward, analyses of the effect of lexical frequency and production of verbs have shown different results. For example, Kemmerer and Tranel (2000) analysed verbs production in picture naming by 19 participants with aphasia and found that lexical frequency was not a significant factor and impaired or borderline performance in verb naming was detected. However, the case series analysis demonstrated greater difficulties with low frequency verbs than high frequency verbs in four participants, and greater difficulty with high frequency than low frequency verbs in two participants. Bastiaanse, Wieling and Wolthuis (2016) analysed picture naming data taken form a group of 54 speakers with aphasia and found an effect of lexical frequency only for the naming of nouns, after controlling for other properties known to affect word production.

In usage-based approaches, frequency is a driving force for the development of grammar and it affects language structure. A child's language acquisition is the result of the frequent exposure to linguistic patterns and the use of domain-general cognitive processes. Frequency enhances the representation of linguistic patterns in the mind and supports the activation and processing of such patterns (Diessel, 2017). Accordingly, the frequency of a certain linguistic unit varies across languages, contexts and individuals. For example, Dąbrowska (2015) reported that the capacity of processing rare syntactic constructions correlated with the participants' educational levels. Highly educated people had more frequent exposure to rare syntactic structures and thus these structures are more entrenched in them.

Usage-based linguists have identified three types of frequency. The first type of frequency refers to how often a linguistic unit occurs in a language and this type is called the *token frequency* (Bybee, 2007). The verb 'go', for example, occurs 881 times in the British English dialect (Leech, Rayson & Wilson, 2001). The *type frequency* is the second type of frequency and it refers to the number of distinct items that can occur in a particular construction (Bybee, 2007). For example, there are 398 verbs which can occur in the construction *Let's X* as the British National Corpus lists. The third frequency type is the *contextualised frequency* which refers to the association between linguistic items (Divjak & Caldwell-Harris, 2015). Within the construction *Let's X*, the verb 'go' occurred 901 times whereas 'dance' occurred only ten times according to the British National Corpus. This indicates that 'Let's go' has a higher contextualised frequency than the construction 'Let's dance'.

In the literature of aphasia, frequency effects have received little attention beyond the single word level. A review of usage-based studies of the effect of frequency at the non-single word level in aphasia was provided by Gahl and Menn (2016). The review considered a set of studies of the effect of verb bias on aphasia. Verb bias refers to the probability that a verb appears in certain syntactic structures over others (DeDe, 2012; 2013a; 2013b; Gahl, 2002; Gahl et al., 2003; Russo, Peach & Shapiro, 1998). For example, the verb *walk* is biased to occur in intransitive sentence structures (e.g. Fred walked over the bridge) compared to transitive structures (e.g. Fred walked the dog) (Trueswell, Tanenhaus & Kello, 1993). The authors reanalysed these studies and found that verb bias interacts with the context of use (i.e. unaccusative, transitive, actives or passives) in sentence comprehension. It was also found that more biased forms were easier for people with aphasia. For example, a verb that is more likely to appear in its transitive form, was easier for speakers with aphasia to comprehend when it is in a transitive form than in an intransitive form. The correlation between verb bias and spared language use highlights the relevance of both word and construction frequency.

In production, Menn, Gahl, Holland, Ramsberger and Jurafsky (2003) conducted a case study of a speaker with Broca's aphasia to examine the effect of verb bias using a repetition task. The participant repeated 98 sentences containing verbs which occurred either in their biased structures or not. It was found that the participant had difficulty to repeat sentences in general but she produced more complete responses when a verb occurred in their biased structure.

Based on data taken from the *Aphasia Bank* corpus, DiLallo et al. (2017) examined a set of 22 verbs that had a transitive or intransitive verb bias and reviewed data from typical participants and participants with aphasia. The result was similar to previous reports where verb bias affected production in both groups. In addition, no significant difference between the two groups was detected and this demonstrated that verb bias affected both groups to the same extent. It was found that more production errors were produced by the participants with aphasia when the verb occurred in its unbiased structure.

Jap, Martinez-Ferreiro, and Bastiaanse (2016) examined the frequency of constructions in Standard Indonesian. Constructions are pairings between a linguistic form and a function derived from language use, and they have various levels of complexity and abstractions (Goldberg, 2013). A linguistic pattern is considered a construction if an aspect of its form or function is not predictable from its component parts, such as the English active and passive constructions, or if it occurs with sufficient frequency, such as the *What is X doing X?* construction identified by Kay and Fillmore (1999).

Jap, Martinez-Ferreiro and Bastiaanse (2016) tested use of active and passive constructions by aphasics speaking Standard Indonesian. The data showed participants did not have problems in passive production, and their production was relatively more preserved than production reported in speakers of other languages. The results were explained by assuming an effect of construction frequency where passives are more frequent in Standard Indonesian and thus more entrenched in speakers of this language.

Gregory, Varley and Herbert (2012) investigated noun production using mass and count nouns in determiner-plus-noun constructions with English speakers with aphasia and a group of non-brain damaged participants. Naming latencies of nouns was examined by providing the participants with determiners that were congruent, incongruent, or neutral. An example of a determiner that is congruent with the noun is the determiner *each* in ‘each book’ where only count nouns combine usually with *each*. Neutral determiners can be seen in ‘that book’ where *that* combines with both mass and count nouns in usual production. Incongruent determiners can be seen in ‘some book’ where *some* is usual with mass but not with single count nouns. It was found that determiner-plus-noun combinations that are congruent or neutral facilitates production of the noun, in comparison with incongruent determiner-plus-noun combinations. The authors suggested that the results can be explained by the assumption that the determiners which are used with mass nouns facilitate those nouns, and likewise for count nouns. A secondary analysis which the authors conducted looked at the effect of construction frequency and found that incongruent pairs were less frequent than congruent and neutral pairs and this was consistent with the claim that frequency of occurrence of particular construction affects production in aphasia. The study suggested that determiners which are frequently produced together in a NP with a given noun, act as effective facilitators of the production of the noun.

Frequency is not the only factor that has received attention within usage-based accounts. The distinction between grammatical and lexical items has been another important area of research in usage-based accounts of aphasia. Grammatical elements, such as tense inflections, prepositions and articles, are the most affected items in agrammatism, although they are more frequent than lexical items in a language. This argument has been labelled as the grammatical-lexical distinction and is an issue that cannot be explained by frequency. Usage-based researchers (Boye & Harder, 2012; Messerschmidt, Boye, Overmark, Kristensen & Harder, 2018) argue that the classification of lexical and grammatical items has to be revised in order for the theory to account for the lexical-grammatical dissociation in agrammatism. This argument is reviewed in the next section.

The grammatical-lexical distinction

Classically, the grammatical and lexical items were classified based on distributional criteria (Stewart, 2015), semantic criteria (Schwartz, Saffran & Marin, 1980), or criteria such as closed versus open-class membership or obligatoriness versus optionality (Friederici, 1982). The classification criteria are not theoretically robust according to usage-based linguists (Boye & Harder, 2012; Messerschmidt, Boye, Overmark, Kristensen & Harder, 2018). They maintain that the distinction between grammatical and lexical items has been theoretically shaped and dominated by Generative Grammar (Chomsky, 1965) which is more interested in syntax rather than affixes, articles and auxiliaries which are other aspects of grammar (Bastiaanse & Thompson, 2012). Usage-based linguists provided a new distinction between grammatical and lexical items, which they claimed was more inclusive and theoretically robust. Such a distinction is introduced by Boye and Harder (2012) in the ProGram (information PROminence and GRAMmar in mind and brain) theory which is a usage-based theory of language structure.

The ProGram theory (Boye & Harder, 2012) is usage-based in that it accounts for the distinction in terms of conventionalised communicative functions. It is based on the fact that complex mental input requires prioritisation. Morphemes, words or phrases in a sentence are attended to differently, based on their importance for communication. This entails that lexical items are prioritised, since they are important for delivering the message, whereas the grammatical items are secondary. According to the ProGram theory, there are three criteria for distinguishing grammatical and lexical items. Only lexical items can be focalised, (e.g. by means of clefting, focus particles, or stress); addressed in the subsequent discourse; and elaborated on through modification. Grammatical items cannot be focalised, addressed, or modified (Boye & Harder, 2012; Messerschmidt, Boye, Overmark, Kristensen & Harder, 2018).

The ProGram theory (Boye & Harder, 2012) provided an explanation for agrammatism. According to the theory, the neurocognitive capacities for combining simple information units into complex wholes is damaged in agrammatism. Damage to such neurocognitive capacities would affect grammatical items. Hence, the speaker with agrammatism picks the crucial elements for communicative function, which are lexical items, and ignores others because of limited processing capacity (Martínez-Ferreiro, Bastiaanse & Boye, 2019). Agrammatism is a processing disorder and a reduction in language processing similar to the explanation made by the AT (Kolk, 1987; Kolk & Heeschen, 1990; 1992; 1996).

The classification of grammatical and lexical items made by the ProGram theory (Boye & Harder, 2012) has been significant for accounting for grammatical impairments in aphasia. A number of recent studies analysed production of grammatical versus lexical verbs in Dutch and Danish (Boye & Bastiaanse, 2018; Messerschmidt et al., 2018), grammatical versus lexical prepositions based on the modification criterion in Dutch (Messerschmidt et al., 2018) and Spanish (Martínez-Ferreiro et al., 2018) and grammatical versus lexical pronouns based on the focalisation criterion in French (Ishkhanyan, Sahraoui, Harder, Mogensen & Boye, 2017) and Spanish (Martínez-Ferreiro et al., 2018). Overall, these studies showed that grammatical members as classified by the ProGram theory were more severely affected in non-fluent aphasia than members classified as lexical.

For example, Boye and Bastiaanse (2018) analysed the grammatical verbs, which are auxiliary verbs such as *hebben* ('have') + participle, and lexical verbs, which are full verbs such as *hebben* ('have') + NP, and the Dutch modal verbs which include both grammatical and lexical members. The analysis considered the spontaneous speech of Dutch and Danish speaking individuals with agrammatism and matched controls. The production of grammatical verbs was compared with the production of lexical verbs, and the general distribution of grammatical and lexical variants in connected discourse was examined. Data generally showed that an individual with agrammatic aphasia produced a reduced proportion of grammatical forms in comparison to control participants.

In another study analysing the production of pronouns, Messerschmidt et al., (2018) distinguished between grammatical and lexical Danish prepositions based on the modification criterion introduced by the ProGram theory (Boye & Harder, 2012). Through analysing the spontaneous speech samples of individuals with fluent and non-fluent aphasia, the results showed that the proportion of grammatical to lexical prepositions was significantly lower in the speech of the participant with brain damage than in the speech of the non-brain-damaged control.

The ProGram theory has been applied to a limited number of linguistic structures. The usefulness of the theory in accounting for impairments in other linguistic structures has to be studied.

Summary

Studies of aphasia following the usage-based approach considered frequency as a main factor influencing language production and comprehension. Frequency does not explain all impairments in agrammatism as in impaired production of grammatical items such as number and tense inflections. Some usage-based accounts of aphasia attributed the deficit in grammatical items to a reduction in language processing capacities, in which the speaker with agrammatism picks only the lexical elements that are crucial for communicative function. The above studies were based on non-Arabic data. Examining the effect of frequency on language use in aphasia and the lexical/grammatical distinction using Arabic data is needed.

1.3 Noun phrase production in agrammatism

This section reviews the studies of the NP production in agrammatism in order to examine their methodology, approaches and main findings which will enable the development of an appropriate methodology for the current study. Before reviewing these studies, a definition and a description of NP is provided.

1.3.1 The definition of a noun phrase

An NP is a phrase that has a noun as its head (Crystal, 1997). For example, 'the old man' is an NP and its head is the noun 'man'. All elements in the NP other than the head are modifiers. Modifiers can come either before or after the noun. When a modifier comes before the noun, it is usually an article such as '*the* man', possessive noun such as 'dogs*'* bones', possessive pronoun such as '*his* hat', adjective such as '*old* men', or participle such as '*working* women'. Modifiers that come after the noun include prepositional phrases such as 'cats *in boots*', relative clauses such as 'women *who work'*, participle phrases such as 'cars *washed with soap*', and infinitives such as 'willingness *to help*'. All the words in the NP function like a noun in sentences and they typically act as subjects as in '*the old man* sneezed', objects as in 'I saw *the old man*', or prepositional objects as in 'a cat lives with *the old man*' (Hofherr & Zribi-Hertz, 2013).

Specific types of NPs were of interest to researchers investigating production in agrammatism across different languages (e.g. Ahlsen et al., 1996; Bastiaanse, Jonkers, Ruigendijk & Van Zonnveld, 2003; Herbert & Best, 2010; Lorenz & Zwitserloodm, 2014; Luzzatti & De Blecer, 1996; Vigliocco & Zilli, 1999). These NPs included determiner-plus-noun NPs, compound NPs and adjectival NPs. These usually involve production of grammatical elements which are likely to be impaired in agrammatism. Grammatical elements in NPs usually include grammatical gender which is either a *masculine* or a *feminine* and it can be a *neuter* in some languages as in German, and grammatical number which is either a *singular* or a *plural* and it might be *dual* in some languages as in classical Arabic. Grammatical elements in NPs may also involve production of a grammatical case which refers to the relation of the nouns (or pronouns) with the other elements in the sentence, and which may be *nominative*, when the noun is in subject position, *accusative*, when the noun is in object position, *dative*, when the noun is in indirect object position, and *genitive* when a noun possesses another (Crystal, 1997).

The determiner-plus-noun NPs, compound NPs, and adjectival NPs are explained in the following section. To illustrate, production of a determiner-plus-noun NP in German is examined.

1.3.1.1 Determiner-plus-noun noun phrases

The determiner-plus-noun NP is a noun preceded by a determiner which is usually an article. In some languages the article agrees with the noun in number, gender and/or case. For example, production of a determiner-plus-noun NP in German involves agreement in terms of gender, number and case between the noun and the determiner (Bastiaanse, Jonkers, Ruigendijk & Van Zonnveld, 2003). If the German definite article appears with nouns in the nominative position, it is ‘der’ when the noun is masculine singular, ‘die’ when the noun is feminine singular, ‘das’ when the noun is neuter, and ‘die’ when the noun is plural. If the definite article occurs with nouns in the dative position, it is ‘dem’ when the noun is masculine singular, ‘der’ when the noun is feminine singular, ‘dem’ when the noun is neuter, and ‘den’ when the noun is plural. The German definite article appears in various forms depending on the gender, number, and the case of the noun it occurs with.

1.3.1.2 Compound noun phrases

Compounds are new words created by combining free morphemes with either a similar or different grammatical category (Hofherr & Zribi-Hertz, 2013). For instance, a compound noun can be built by combining two nouns as in ‘postman’, an adjective with a noun as in ‘software’, or a noun with a verb as in ‘haircut’. The head of the compound can be the leftmost or the rightmost element depending on the language. In English and German, for instance, it is the rightmost, in French it is the leftmost, and in Italian it can be the leftmost in some compounds or the rightmost in others (Luzzatti & De Blecer, 1996).

Determiners in some languages may agree with the compound nouns in number, gender and/or case based on the number, gender and case of the head of the compound. An example of the number agreement between the determiner and the head of the compound noun can be seen in the English NP ‘those postmen’ where the demonstrative ‘those’ agrees in number with the head of the compound (men). Agreement in terms of number and gender between the determiner and the head of the compound noun can be seen in the Italian compound NP ‘I francobollo’ (the.M.PL franco.M.SG stamp.M.PL ‘the stamps’) where the definite article is masculine plural to match the gender and the number of the head of the compound noun (bollo) which is in masculine plural form.

Another type of compound NP that is interesting for investigators in agrammatism is the Italian prepositional compounds. Italian prepositional compounds are a type of compound where the modifying element is a prepositional phrase as in ‘sedia *a rotelle*’ (chair.F.SG on wheel.F.PL ‘wheelchair’). In some cases, the preposition may be inflected for definiteness, and when it is inflected, it must agree with the following noun in gender and number as in the following example provided by Luzzatti and De Blecer (1996, p. 54).

(3)

a. borsa della spesa
bag.F.SG for.Def.F.SG shoppinf.F.SG
Shopping bag

In this example, the linking preposition ‘della’ is made by a combination of the Italian preposition ‘di’ (for) and the definite article ‘la’ which is the feminine, singular form of the Italian definite article. The feminine, singular, definite article ‘la’ matches the following noun ‘spesa’ in gender and number.

1.3.1.3 Adjectival noun phrases

The adjectival NP is another element that is investigated in agrammatism. The adjectival NP can involve agreement between the noun and the adjectives in some languages such as Italian (Scarnà & Ellis, 2002). In Italian, there are two types of adjectives: adjectives that end with 'o' and others which end with 'e'. Adjectives that end with 'o' such as 'Italiano' (male Italian) has four different inflections depending on the gender and the number of the noun; 'o' for masculine singular, 'i' for masculine plural, 'a' for feminine singular and 'e' for feminine plural. The adjective agrees with the noun in gender and number as illustrated in the following examples.

(4)

a. libr*o* Italian*o*
book-M.SG Italian-M.SG
Italian book.

b. libr*i* Italian*i*
book-M.PL Italian-M.PL
Italian books.

c. signor*a* Italian*a*
madam-F.SG Italian-F.SG
Italian madam.

d. signor*e* Italian*e*
madam-F.PL Italian-F.PL
Italian madams.

For adjectives that end with 'e', two inflections are used for both masculine and feminine: 'e' for singular and 'i' for plural, and the adjectives agree with the noun in gender and number.

1.3.1.4 Summary

There have been specific types of NPs which attracted researchers in the field of agrammatism. These consisted of determiner-plus-noun NPs, compound NPs and adjectival NPs. These types included grammatical elements which are usually impaired in agrammatism, and investigating impaired grammatical elements allows for the understanding of agrammatism and can throw light on the nature of language representation and processing.

A line of research which investigated production of NP in agrammatism focused on the analysis of impaired NP production in light of psycholinguistic models of language. These studies are reviewed in the following section.

1.3.2 Psycholinguistic studies of noun phrase production in aphasia

A number of studies have analysed the production of determiner-plus-noun NPs, compound NPs and adjectival NPs in agrammatism in the context of psycholinguistic models: word production models, particularly the Weaver++ model (Levelt et al., 1999) and the IN-model (Caramazza, 1997), and the dual mechanism accounts (Kiparsky, 1982; Pinker and Ullman, 2002) of morphological production. An important question was about the nature of the lemma level, and the processing and the representation of grammatical gender, grammatical number, or compound nouns.

1.3.2.1 Gender and number in determiner-plus-noun NP

Luzzatti and De Bleser (1999) investigated the nature of the lemma level in a study analysing the production of gender and number inflections in single nouns and NPs by two Italian speakers with agrammatism. The authors used a completion task where participants added the missing gender to single nouns and to articles in determiner-plus-noun NPs. In the single noun task, the performance was generally preserved when the gender was arbitrary and was impaired when the gender corresponded to the sex. Adding the gender to the article in determiner-plus-noun NPs was severely impaired for both participants. The data indicated that when grammatical gender does not correspond to the natural sex, gender information is stored at the lemma (Levelt et al., 1997). It also indicated that syntactic context has an effect on the processing of NP since gender was severely impaired in the NP task. Another task in the same study involved the formation of plural forms out of single and compound nouns. The participants showed a dissociation in the performance of regular versus irregular nouns, with more errors in regular than errors in irregular condition. This supported the dual mechanism by Kiparsky (1982) which predicts that number in irregular nouns is stored at the lexical level (lemma level) whereas number in regular nouns is computed. The formation of plurals out of compound NPs was generally impaired.

Another study which examined the processing of number in det-plus-noun NP was introduced by Herbert and Best (2010) who conducted a case study of an English speaker (MH) with anomia and agrammatism. The study was carried out to investigate the degree to which syntax is activated in tasks not explicitly requiring syntactic information. The study included three main tests: determiner processing, which was tested through visual lexical decision, reading aloud and a repetition task; noun retrieval tested via spoken word to picture matching and oral naming with syntactic and a phonological probes task; and determiner-plus-noun production tested using repetition and reading aloud tasks. MH showed a deficit in processing the determiners presented with mass nouns (‘some’, ‘much’, and ‘most’) compared to determiner paired with count nouns (‘a’ or ‘an’). MH also showed errors in determiner plus mass noun and determiner plus count noun. However, the errors in determiner plus count noun resulted in syntactically well-formed phrases whereas errors in the determiner plus mass noun resulted in omissions of the determiner. The results showed a dissociation between count and mass noun syntax, with mass noun syntax being more impaired than count noun syntax. Herbert and Best suggested that MH's deficit was due to damage to the lemma level which affected the retrieval of NP information. In order to investigate this claim further, Herbert and Best tested the effect of syntactic cuing on spoken noun production. They hypothesised that if syntactic information was responsible for the difference between the productions of count and mass nouns, then providing MH with syntactic information would improve production of mass nouns. This further test involved providing the participant with the determiner (syntactic information) and the participant had to produce the target mass or count noun. For example, target 'milk' would be cued with 'this is some'. Syntactic cuing facilitated production of mass nouns in this task. The authors claimed that this result strongly suggested that syntax influences lexical selection and hence is activated in spoken noun production. This study supports the proposal of the obligatory access of syntax during word production (Levelt et al., 1999).

Production of gender in determiner-plus-noun noun phrase was also examined in German agrammatism by Seyboth, Blanken, Ehmann, Schwarz and Bormann's investigation (2012) using a single case study (EM). The study examined the data within the Weaver ++ (Levelt et al., 1999) which assumes representation of syntactic information at lemme and effect of frequency at phonological level. The participant had to repeat a noun and add the determiner that matches the noun in gender, add the determiner to a written noun, and visually match the determiners with the noun's gender. Assessment of EM's spoken, written, and visual determiner processing revealed a highly significant impairment of masculine determiner (*der*) compared to feminine (*die*) or neutral (*das*) across tasks. Since gender processing was affected across different tasks and modalities, the authors suggested that gender information is represented in a level that is modality independent. The participant could repeat and read aloud determiners including (*der*). This suggested that the deficit was not phonological and gender information is represented at the lemma which carries the syntactic features of a word, similar to findings reported by Herbert and Best (2010). The authors hypothesised that because masculine gender was selectively impaired, there existed central gender nodes for the three genders within the lemma level, and that these might be selectively impaired in agrammatism. Masculine determiner was more frequent than feminine or neutral determiner. This suggested an effect of frequency at lemma which was not in line with the Weaver ++.

Khwaileh, Body and Herbert (2017) also studied determiner plus noun production in three Jordanian Arabic speakers with agrammatism. The aim of this investigation was to explore the degree to which noun syntax facilitates lexical retrieval by examining whether the Arabic definite determiner, /*el*-/, facilitated noun production in Arabic NP. The investigation task involved a picture naming task where participants were asked to name bare nouns in one condition then to name NPs consisting of a determiner plus a noun in the second condition. The results showed that production was significantly more accurate in the second condition. This indicated that activating noun syntax by producing a determiner before a noun facilitated production of nouns in Arabic. The data suggested that production of nouns within a morpho-syntactic frame has a positive effect on accuracy. The authors interpreted the data in the context of the Weaver++ model (Levelt et al., 1999) of word production which assumes activation of syntax during processing of single nouns. The authors claimed that a single noun has slots for syntactic information (represented at a level called the lemma) such as the 'determiner þ noun slot' (p. 150). When the syntactic information such as the determiner is present prior to the noun, it creates a jolt of activation which enhances the retrieval of the target noun. While this study was the first study to explore the production of determiner-plus-noun in Arabic, the study analysed the use of the definite article which does not involve any agreement with the noun in Arabic. A deeper investigation of Arabic determiners should involve analysis of determiners that agree with the noun such as the Arabic demonstratives, which agree in gender and number with the noun, or the Arabic quantifiers, which agree in number with the noun.

The above studies highlighted the differential processes involved in the processing of number in regular versus irregular plural, and gender in nouns with natural gender versus nouns with arbitrary gender. The activation of syntax in the process of word production was also reported.

Compound NPs have received considerable attention in psycholinguistic research of agrammatism. This is reviewed in the following section.

1.3.2.2 Compound NPs and processing of gender and number

Compound NPs have been analysed to examine the processing of compound and/or the processing of gender and number within compound NPs. For example, Mondini, Luzzatti, Saletta, Allamano, & Semenza (2005) examined the production of Italian prepositional compounds, a NP where the head noun is modified by a prepositional phrase. The study aimed to test the ability of Italian speakers with agrammatism to produce the linking preposition in the prepositional compounds and to explain how it is processed. The data was explained in light of Weaver ++ model described by Levelt et al. (1999) which assumed that frequently used compounds (e.g. 'blackboard'), have single, holistic representations at the lemma level, and they correspond to multiple morphemes at the word form (lexeme) level. Levelt et al. labelled this as the single-lemma-multiple-morpheme case. Mondini et al., (2005) examined the performance of six participants with agrammatism who took part in a completion task, where they added the linking preposition, as well as the performance of one participant (MB) with agrammatism who was tested in detail throughout a number of different tasks. The results of the group showed that the production of the preposition was mildly to severely impaired. Main errors produced were substitution errors of the prepositions. While this is consistent with the well-known damage with function words, the substitution errors reflected an impairment with respect to the listed knowledge of the compounds. As for MB's results, most of the errors in the completion task consisted of omission errors whereas a number of substitution errors were found in the repetition, reading, and completion tasks. While MB tended to omit or substitute the linking preposition, he was able to decide whether a preposition is needed or not when the items were mixed with noun-plus-noun compounds. Mondini et al. assumed that this dissociation between knowledge and the ability to retrieve supported the hypothesis of preserved knowledge at the lemma level and damage to the morpho-phonological word form at the lexeme level. The authors suggested that regardless of the syntactic and semantic unitary structure of the prepositional compounds, the data revealed that prepositional compounds undergo de-composition during their processing. The results were interpreted by claiming that retrieval of the prepositional compounds involve a dual route where a single lemma is activated for the whole compound first and three independent lemmas, for each constituent within the compound, are also activated.

Lorenz and Zwitserlood (2014) also provided another study which involved analysis of the production of compound NPs and determiner-plus-noun NPs by three German participants with aphasia (two with agrammatism and one with fluent aphasia), and a group of non-brain damaged participants. The authors investigated the lexical representation of compound nouns and the grammatical gender in the determiner-plus-noun in light of the Weaver++ (Levelt et al., 1999) and the IN-model (Caramazza, 1997). Three participants were tested in four tasks. First, a picture naming of single and compound NPs. Second, repetition of a word. Third, adding a definite article to single nouns and compound nouns. Finally, a grammaticality judgment task of the gender in the determiner-plus-compound nouns using known and novel compounds. The authors reported that all participants with aphasia were impaired in producing compound nouns rather than simple nouns and were impaired at determiner retrieval for both compound and simple nouns. They maintained that because gender retrieval was impaired in a similar way for compound and single nouns, this supports both the Weaver++ and the IN-model since both claim holistic representations for compounds at the lemma level. However, novel compounds were more impaired than known compounds in the result of the judgment task. This can only be explained by the Weaver++ model in which it was claimed that novel compounds correspond to multiple morphemes at the word form (lexeme) level and thus will be more difficult for individuals with aphasia. This was similar to findings by Mondini, Luzzatti, Saletta, Allamano & Semenza (2005) who examined the production of prepositional compounds in Italian.

The above reviewed studies have analysed the representation of compound nouns. These studies supported the differential processing in the production of known versus unknown compounds.

The next section reviews studies which examined production of number and gender in adjectival NP.

1.3.2.3 Gender and number in adjectival NP

Vigliocco and Zilli (1999) tested gender agreement between noun and adjective in the production of two Italian speakers with agrammatism. The aim of their study was to test whether the conceptual and morpho-phonological information affects production of gender. The main task was a completion task where the participants had to complete an adjectival NP by adding the missing adjective that must be matched with the noun in gender. Adjective-noun agreement was tested in different conditions of the head nouns: conceptual or natural gender, when the gender is determined by the sex, (e.g. ragazz*a* 'girl') vs. grammatical gender, when the gender is arbitrary, (e.g. panchin*a,* 'bench.F'), and morpho-phonologically marked inflections (e.g. 'o' for masculine and 'a' for feminine) and morpho-phonologically unmarked gender inflections (e.g. 'e' for neutral gender). Nouns with conceptual gender were less impaired than those with grammatical gender and this pattern was opposite to what Luzzatti and De Bleser (1999) found; however, Luzzatti and De Bleser's finding was based on production of single nouns whereas the current study was based on production of NPs. Another result by Vigliocco and Zilli was that morpho-phonologically marked gender nouns were less impaired than non-marked nouns. The authors claimed that the current pattern of errors indicated that when conceptual information is congruent with syntactic information, nouns are more robust and resilient to brain damage than when no conceptual support is present, and where nouns are not gender marked phonologically, participants seemed to guess the gender. Vigliocco and Zilli's study highlighted the role of the conceptual and morpho-phonological information in the production of gender.

Production of adjectival NP in agrammatism was also examined by Scarnà and Ellis (2002) who conducted a single case study with an Italian speaker with agrammatism. They used a judgment task of gender and a translation task where the participant translated adjectival phrases from English to Italian adding the appropriate gender inflections. Gender was impaired when the participant was explicitly asked about the gender in the judgment task. This would indicate an impairment at the lemma level which involves the syntactic information; but whilst gender was impaired in the judgment task, it was preserved in the translation task. The authors claimed that the type of task has an effect on performance and that gender should not be tested using implicit metalinguistic judgement but by tasks that are more similar to natural everyday use. The study showed that the lemma level is responsible for syntactic information. It did not show whether syntax is obligatory accessed as predicted in the Weaver ++ model (Levelt et al., 1999), nor did it show a relation between access to syntax and syntactic structures as hypothesised in the IN-model (Caramazza, 1997).

The above is based on analyses of data form non-Arabic speakers. Arabic data for the psycholinguistic representation of grammatical gender are not available. The current study analyses gender agreement in adjectival NPs which would provide new evidence for gender representation.

The next section reviews studies which examined production of number in Arabic in light of processing accounts of number production.

1.3.2.4 Number in Arabic NP in light of the dual mechanism of number processing

Safi-Stagni (1995) analysed number inflection in Arabic by conducting a case study of an Arabic speaker with agrammatism and compared these data with slips of the tongue by non-brain-damaged Arabic speakers. The tasks included naming, word repetition, picture description, and reading aloud. The analysis of the production of grammatical numbers in the production of plural forms by the speaker with agrammatism and the healthy controls reflected a dissociation between regular and irregular plurals, with more impaired production of regular plurals than production of irregular plural forms. Safi-Stagni explained the result based on Kiparsky's (1982) model. Kiparsky's claim could account for this pattern of dissociation because it assumes two levels for lexical processing and explains the pattern found in speakers as retention of stored forms and damage to or lack of accurate function in computation of derived forms.

Khwaileh, Body, and Herbert (2015) also studied regular and irregular plural in Arabic in a study involving noun production with three Jordanian Arabic speakers with agrammatism. They found that production of regular and irregular plurals was impaired. Errors in regular plurals tended to be omission errors of the plural inflection, whereas errors in the irregular plurals tended to be substitution errors. The authors assumed that omission of the plural inflection suggested that regular word forms can be broken into smaller units which can be omitted in agrammatism. Substitution errors in the irregular forms indicated that affixes cannot be dropped out but the whole form could be substituted. The result in Khwaileh, Body and Herbert supported the dual mechanism model reported in (Pinker, 1999).

The above Arabic studies supported the findings of differential processing of regular and irregular plural across languages. Analyses of production errors in Arabic regular plurals are not present. The current study investigates production of Arabic regular plurals within NPs.

1.3.2.5 Summary

The above psycholinguistic studies of NP production in agrammatism have contributed to the understanding of the processing and representation of gender, number and compound nouns. These studies have generally argued in favour of the Weaver ++ model (Levelt et al., 1999) in which it is claimed that syntactic information is accessed in the production of single words and the dual mechanism accounts (Kiparsky, 1982; Pinker and Ullman, 2002) of number processing. The above review has also demonstrated that psycholinguistic studies of the production of Arabic NPs are limited. The production of gender in particular in Arabic aphasia and agrammatism has been not examined yet.

The next section examines studies which adopted a neurolinguistic approach to the analysis of NP production in agrammatism.

1.3.3 Neurolinguistic studies of noun phrase production in aphasia

The relation between case and determiner production within NPs have been investigated in a number of studies form a linguistic perspective. These studies tested whether the production of determiner and determiner’s inflections depends on case assigner and case marker. Case assigners are verbs and verb inflections, whereas case markers are determined by case assigners and are added as inflections to the determiner (Crystal, 1997). These studies are discussed in the following section.

1.3.3.1 The relation between case and determiner production within NPs

Bastiaanse, Jonkers, Ruigendijk, and Van Zonneveld (2003) studied gender and case production in nine Dutch and ten German speakers with agrammatism. The study examined patterns of production of gender and case inflections in NPs consisting of a determiner plus a noun. Articles in Dutch carry gender and number inflection only, whereas in German articles are specified for both gender and case. For the Dutch experiment, the task included a sentence construction test where each participant was shown a picture and asked to produce a sentence of a subject-verb-object type. In the German experiment, participants were asked to produce gender and case marked NPs in two production tasks. The first task involved completing a missing NP which was masculine, singular in a sentence where the position of the NP varied. Then each participant was shown a picture with a written verb and asked to provide a full sentence with the missing NP. Dutch data showed that participants tended to omit the articles in the NPs, whereas the German data showed that participants tended to substitute the articles with 13% of the errors involving substitution of gender and 87% substitution of case. The authors claimed that articles tend to be omitted when there is no case assigner present and substituted when a case assigner is present.

The relationships between case assigner and determiner production in agrammatism were also investigated by Ruigendijk and Friedmann (2008) who further tested whether the presence of verbs and verb inflection affects the production of determiners and case markers in Dutch and Hebrew agrammatism. Eleven Hebrew and eight Dutch speakers with agrammatism participated in three tasks: an interview, a picture description and a sentence elicitation task. The result of the Hebrew data showed that object NPs were produced with a determiner marked for case when the sentence included a transitive verb (e.g. give). In Dutch, the results showed that NPs were produced with a determiner when a verb was present in the sentence. The author claimed that determiners and case markers are not impaired in agrammatic production because they are function words, but because they depend on verbs and verb inflection which are impaired in agrammatism.

The effect of case on determiner production in agrammatism was also reported by Ruigendijk (2010) who compared the production of eight Dutch, seven German, and seven English speakers with agrammatism to examine case, gender and definiteness in these languages. The data consisted of spontaneous speech samples containing 300 words each. The results showed that determiners were omitted in German in obligatory contexts, unlike Dutch and English, where a higher proportion of determiner production was found. This was attributed to the existence of case in German, unlike in Dutch and English. The study indicated that in spontaneous speech determiner production is more impaired when a determiner has to be marked for case.

The difference between determiners production in spontaneous speech and elicitation tasks, where case assigners are provided for participants, was examined by Ruigendijk and Bastiaanse (2010). Ten German speakers with agrammatism participated in a spontaneous speech task and elicitation tasks in which a determiner-plus-noun NP should be inserted in a sentence. In spontaneous speech, participants tended to omit determiners. This is similar to finding by Ruigendijk (2010) who reported omission of determiners in obligatory contexts by German speakers with agrammatism. When the case assigner was provided in the elicitation task, production of determiners significantly increased. The results indicated that in languages where determiners are marked for case, determiner production is impaired in spontaneous speech because case assigner is absent. And when case assigner is provided, determiner production increases. The presence of case assigner facilities production of case-marked determiners.

The claim that the presence of case assigner has an effect on determiners production in agrammatism was further investigated in Danish (Neilsen, Boye, Bastiannse & Lang, 2019). The study aimed to test whether determiners are impaired because they depend on case assigners or because they are function words. In order to test these hypotheses, the study analysed the production of two morphologically and phonologically similar determiners: the indefinite articles, *en* and *et* (an), and numerals, *en* and *et* (one). The indefinite articles are grammatical determiners and considered function words whereas the numerals are lexical determiners according to a view of the grammatical status of determiners (Boye & Harder, 2012). Both of the article and the numerals are not marked for case in Dutch. The study involved five speakers with agrammatism and four non-brain damaged controls who took part in a picture naming task. For elicitation of articles, a picture was presented with an audible description of the object, then another picture of the same target item in a different colour was shown. The participant was asked 'what do you have?' to elicit a NP containing the article 'a' (e.g. 'a' green cup). For elicitation of a numeral, the participant was shown two pictures of an object with an audible description of the object, followed by a single picture of the same object accompanied by a question (e.g. 'how many do you have?'). The aim was to elicit a NP containing a numeral (e.g. 'one' cup). The results showed that participants with agrammatism omitted and substituted more articles than numerals. Since verb case morphology was present in the question in both conditions, the data did not speak to the hypothesis that case morphology affects determiners production. The authors assumed that determiners are impaired because they are function words, since the indefinite article (grammatical determiner) was more impaired than the numeral (lexical determiner) despite having identical morphological and phonological form. This study suggested that when determiners are not marked for case, determiner production does not depend on case assigner.

It can be seen from the above studies that in languages where determiners are marked for case, such as German, determiner production is impaired in spontaneous speech in agrammatism. However, when case assigner is provided for the patient as in the case of elicitation tasks, determiner production increases; the presence of case assigner facilities production of case-marked determiners.

The effect of adjective argument structure is discussed in the next section.

1.3.3.2 Adjective argument structure

The analysis of the relationship between argument structures and agrammatism has been one important area of neurolinguistic research. The effect of the argument structure on agrammatism was reported for verb argument structure (Thompson, 2003), but Meltzer-Asscher and Thompson (2014) investigated adjective production in English NPs to explore the effect of adjective argument structure on agrammatic production. Adjective argument structure was measured by the percentage of predicative adjectives that can potentially take complements. For example, the adjective ‘obvious’ can be optionally modified by a complement as in ‘it is obvious that she was excited’. Fourteen speakers with agrammatism and 14 non-brain-damaged speakers participated in the experiment. The task consisted of storytelling using the *Cinderella* story and post-hoc imageability ratings of adjectives used by both groups. The results indicated no significance difference between the number of adjectives used by the two groups. There was also no significant difference between the imageability of the adjectives used by the two groups. However, speakers with agrammatism used more predicative adjectives (e.g. the dress is ‘nice’) than attributive adjectives (e.g. a ‘nice’ dress) which are considered adjuncts: words, phrases, or sentences that can be removed without affecting the meaning. The authors claimed that this pattern is similar to previously reported results where adjuncts were problematic in agrammatism. The results also showed that speakers with agrammatism used an adjective with a less complex argument structure. The author claimed that this pattern supported the assumption that agrammatism is a deficit in the processing of complex argument structure.

1.3.3.3 Summary

This section has illustrated that neurolinguistic studies of NP production in agrammatism has mainly focused on examining the relationship between case and determiner production. There are other aspects of NP that neurolinguistic research should analyse such as gender and number production or production of compound NPs which have been only investigated in the context of psycholinguistic models and based on data from non-Arabic speakers.

In the following section, studies of NP production which adopted a usage-based approach are discussed.

1.3.4 Usage-based studies of noun phrase production in aphasia

Usage-based studies of NP production in aphasia and agrammatism have been scarce. This maybe because a usage-based approach to aphasia and agrammatism has emerged recently, and as it is still emerging researchers have focused first on investigating elements that are more impaired in communication such as verb phrase production. However, some studies have analysed number production in NP, focusing on the effects of plural-dominance on number production in aphasia. Plural-dominance refers to the relative frequencies of a noun's singular and plural forms. Nouns that are more frequent in the singular form such as 'head' are considered *singular-dominant*, whereas nouns that are more frequent in the plural form such as 'hands' are considered *plural-dominant*.

The role of plural-dominance on NP production in aphasia has originally been a topic of research within psycholinguistics to infer about the representation of grammatical number within word production models. However, this topic has also shed light on usage-based theories of language because it is based on analysis of frequency of singular and plural nouns and its relation to production. The following review focuses on data which highlighted the effect of frequency of singular and plural nouns on production in aphasia.

1.3.4.1 Effects of plural-dominance on number production

Based on English-speaking individuals with anomia, Biedermann et al. (2012) investigated the role of plural-dominance during spoken word production and comprehension in two separate single-case studies of two speakers (DRS and FME). The task involved a picture naming where participants named single and multiple objects and a word-picture matching task. FME mainly showed semantic errors (e.g. ‘mouth’ for ‘nose’) and produced very few number errors in the picture naming task, and did not show a difficulty in the matching of plural nouns in the matching task. On the other hand, DRS often failed to produce the plural ending in the naming task, particularly in singular-dominant plural targets, and failed to match when the words and pictures are for plural forms of singular-dominant nouns. This suggested an effect of plural-dominance on number production in aphasia.

The role of plural dominance on aphasia production in English was further investigated by comparing data form a group of 38 non-brain damaged speakers and two speakers with Broca’s aphasia and anomia (Biedermann et al., 2013). Both groups participated in a naming task of single and multiple objects. Based on analysis of errors and reaction time, it was found that singular-dominant plurals were responded to more slowly or with more errors compared to their singulars. Whereas no difference was found in reaction time or error rate between plural-dominant plurals and their singulars. The study suggested that production of number plural inflection is especially impaired in the case of singular-dominant nouns.

The effect of plural dominance on production in aphasia was also investigated in German (Lorenz & Biedermann, 2015). Two German speakers with Broca’s aphasia participated in a picture naming task of single and multiple objects, and an elicitation task where the researcher produced a spoken noun of a certain number either singular (e.g. ‘flower’) or plural (e.g. ‘leaves’) and the participants were asked to produce the same noun with the opposite number (e.g. ‘flowers’ and ‘leaf’ respectively). Plural nouns involved regular and irregular nouns of both singular-dominant or plural-dominant type. The results showed that both participants mainly produced number errors which consisted of an inability to add a plural affix with plural targets, or adding a plural affix with singular targets. Producing plural forms of singular-dominant nouns was more impaired than producing plural forms of plural-dominant nouns. However, specific difficulties with singular-dominant plurals were not present. This is unlike findings reported by Biedermann et al. (2013) who suggested particular impairment in the production of number plural inflection in the case of singular-dominant nouns. Another result in this showed that one participant showed a specific deficit with the production of regular plurals. The study indicated that both plural-dominance and regularity have an effect on aphasic production in German.

Another study which investigated the effect of plural-dominance on NP production in German was provided by Biedermann et al. (2018). The study analysed the production of a specific type of German plural, the *-n* plural, which can be predictable when added to feminine singular nouns ending in schwa, such as *Blume-n* ‘flowers’, and can be non-predictable in all other contexts. Five German speakers with anomia, two fluent and three non-fluent, took part in a picture naming task of single and multiple objects. The results across participants revealed a significant plural-dominance effect: a singular advantage was observed for singular-dominant nouns, but not for plural-dominant nouns. In other words, singular-dominant plurals were more error-prone than singular-dominant singulars, while no difference was observed between plural-dominant singulars and plurals. The results did not show a predictability effect.

Hatchard and Levien (2015) studied the effect of plural-dominance on number production in aphasia by comparing the use of singular versus plural nouns in a narrative task of *Cinderella* story. Twelve English speakers with aphasia, one with global, six with non-fluent, and five with fluent aphasia, and twelve non-brain damaged speakers participated in the study. Results showed an effect of plural-dominance on number production. While this study supported existing reports of a dominance effect in aphasia (e.g., Biedermann et al., 2012; 2013; 2018), it extended the findings to spontaneous speech.

1.3.4.2 Summary

The above review showed that plural-dominance has an effect on production of number in aphasia. The studies indicated that in picture naming singular-dominant plurals are more error-prone than singular-dominant singulars, whereas no difference has been observed between plural-dominant singulars and plurals. This result has been extended to spontaneous speech (Hatchard & Levien, 2015). There have been no usage-based studies which analysed production of Arabic in aphasia and agrammatism.

1.4 The morphology and syntax of Arabic noun phrase

This section explains the Arabic NP within a framework of relevant syntactic and morphological theories. The NP theories have been selected to provide adequate explanation for the agrammatic data outcome of the current study. A specific focus on linguistic theories, both morphological and syntactic, argued by prominent Arab and non-Arab linguists for the Arabic NP is highlighted.

This morpho-syntactic description of Arabic NP has been provided by linguists who adopt a generative approach (e.g. Benmamoun, 2000; Fassi-Fehri, 1999; Shlonsky, 2004). Linguists following the generative approach assume that children are born with an innate language capacity that provides them with language rules, or universal principles of grammar, and enables children to acquire a language (Chomsky, 1965; 1981; 1995). This was discussed in section (1.2.3.2). A description of Arabic NPs from a different perspective such as the perspective of Construction Grammar (Croft, 2001; Goldberg, 1995; Tomasello, 2009) is not available.

The current study examines production of NP by agrammatic speakers of Saudi Arabic (SA) which refers to a variety of Arabic used in Saudi Arabia. The Najdi dialect is one of the different regional dialects within SA and was selected for the present study. Najdi is spoken in the Najd region, which takes its name from the Najd plateau. The Najd region is located at the centre of the Arabian Peninsula and embraces cities such as Riyadh and Buraidah, as well as smaller towns and villages such as Sudair, Hotat Bani Tamim and Wadi ad-Dawasir.

The Najdi dialect was selected for this thesis because of four reasons. First, the researcher is a native speaker of Najdi and has knowledge about its rules and grammaticality judgement. Second, most residents of Riyadh where the study sample came from are native speakers of Nadji. Third, Najdi dialect has been studied by previous scholars, which provides a scientific background to the study framework (Ingham, 1994). Finally, Najdi was used instead of Modern Standard Arabic because Najdi is a colloquial variety used in daily communications, whereas Modern Standard Arabic is mostly used for formal written texts as in newspapers, books and instructions or in formal oral speeches and media. Ingham (1994) analysed the Najdi dialect and provided a detailed phonological, morphological and syntactic account upon which most of the following descriptions are based.

The content of the current section is presented in three subsections: noun morphology, NP syntax, the morphological and the syntactic theories of Arabic NPs.

1.4.1 Noun morphology

Traditionally, Arabic parts of speech are classified into *fiʕl* (verb), *ism* (noun as well as adjective) and *ħarf* (particle). The classification of the word classes into these three categories is based on their forms rather than their meaning. Because adjectives are inflected for gender, number and definiteness like nouns, adjectives and nouns are morphologically indistinguishable from each other in the traditional classification of Arabic parts of speech. Besides the fact that adjectives and nouns are morphologically indistinguishable, it is difficult to differentiate between them syntactically, such as when an adjective is functioning as a head in a NP (Ingham, 1994). However, nouns and adjectives are no longer inseparable from each other and they are considered by modern linguists as separate categories denoting different semantic features and belonging to different syntactic positions (Fassi-Fehri, 1999; Shlonsky, 2004).

1.4.1.1 Grammatical gender

Similar to Classical Arabic, nouns in SA are either masculine (*ka:tib* 'writer-M.SG') or feminine (*ka:tib-ah* 'writer-F.SG'), and the gender of a noun usually corresponds to its biological sex. When the biological sex in nouns is irrelevant, such as in the noun *tˀawlah* ('a table'), gender usually depends on the morphological form of the noun. That is, nouns are masculine unless they carry the suffixes *-ah* and *-t* that mark the feminine gender, as shown in the above examples *ka:tib* and *ka:tib-ah.* Yet some nouns, such as *ʕen* ('eye') and *ħijaz* ('Hijaz'), are feminine by convention although they do not carry the feminine suffixes. Some nouns, in contrast, carry *-ah* and *-t* suffixes but are considered masculine, for example *ʕalla:mm-ah* ('very knowledgeable person'; Ingham, 1994).

1.4.1.2 Grammatical number

In addition, nouns are singular, when they refer to a singular referent such as *ka:tib* (‘a writer’); dual, when they refer to a referent that consists of two parts such as *ka:tib-eən* (‘two writers’); or plural, when the referent is more than two such as *kuta:b* (‘writers’).

The suffix *-eən* refers to the masculine dual as in *ka:tib-eən* (writer-M.DUAL) while *-teən* marks the feminine dual as in *ka:tib-teən* (writer-F.DUAL). Plural nouns are either regular (sound) or irregular (broken). Plurality in regular plurals is marked by the suffix *-i:n* for masculine as in *mudaris-i:n* (teacher-M.PL) and *-a:t* for feminine such as *mudaris-a:t* (teacher-F.PL). Table 1.1 below demonstrates examples of SA dual and regular plurals.

Table 1.1: Saudi Arabic dual and regular plural exemplified through *mudaris* (teacher)

Gender	Singular	Dual	Plural
Masculine	*mudaris*	*mudaris -eən*	*mudaris -in*
Feminine	*mudaris -ah*	*mudaris -teən*	*mudaris -at*

Irregular plurals, on the other hand, are formed by lengthening the vowel in the singular form or by adding another vowel. Contrary to this, the vowel may also be substituted by a shorter one or the whole vowel may be deleted. Irregular plurals take different forms based on the number of consonants and vowels in the noun. The common irregular plural forms are illustrated in the following table (Ingham, 1994).

Table 1.2: Common Irregular Plurals in Saudi Arabic

Form	**Plural**	**Singular**
CiCCa:n	*ʃi:ba:n*	*ʃa:jib* (‘an old man’)
CaCa:Ci:n	*bala:di:n*	*balad* (‘a town’)
maCa:Ci:C	*maʁa:ti:r*	*miʁtir* (‘a light-coloured camel’)
CaCa:jiC	*ħama:jil*	*ħamu:lah* (‘a clan’)
CiCu:C	*siju:f*	*se:f* (‘a sword’)
aCCa:C	*atra:k*	*tirki* (‘Turkish’)
CiCa:Ci:C	*duwa:wi:n*	*diwan* (‘court’)
CCaC	*sˤwar*	*sˤu:rah* (‘a picture’)
CiCiC, CuCuC	*Ћumur*	*ħamar* (‘red’)
aCCiCah	*ʔdwijah*	*dwa* (‘medicine’)
C(i)Ca:C	*ridʒa:l*	*radʒa:l* (‘a man’)
CiCa:Cah	*niʃa:mah*	*naʃmi* (‘a valiant man’)

1.4.1.3 Definiteness inflection

Definiteness is considered a grammatical feature of NPs which distinguishes between entities in a given context. Identifiable entities in a given context are definite whereas entities which are not identifiable are indefinite. In Arabic, definiteness is morphologically marked. Definite is marked by a bound morpheme (prefix) *el/ʔl* (‘the’) as in *ʔl-ka:tib* (‘the male-writer’). Indefinite is usually marked by the absence of the definite article, and rarely by the suffix *-in* as in *kitab-in* (‘a book’). Both the definite prefix *el/ʔl* and the indefinite suffix *-in* does not inflect for gender or number.

The above sections have described noun morphology in Arabic. The next section presents the syntax of Arabic NP.

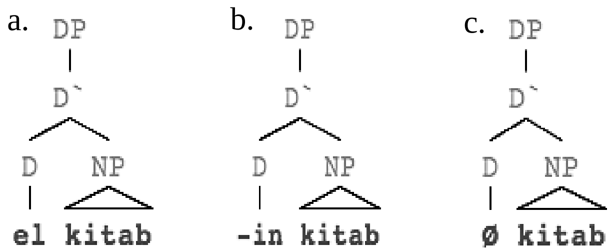
1.4.2 The syntax of the Arabic noun phrase

In SA, the simple NP consists of one actual noun such as *kitab* ('a book'). It may include different types of particles and bound elements such as the definite article, numerals and quantifiers.

1.4.2.1 Definiteness

Syntactically, the definite article *el/ʔl* occupies the position of the head in the determiner phrase (DP) in which NP is a complement (Figure 1.7, a.). Indefiniteness operates in the same way, although it is often phonologically absent in most Arabic dialects. In Najdi, indefiniteness is sometimes present as the suffix -*in*. Thus, the head of DP in the indefinite noun might be either occupied (Figure 1.7, b.) or null (Figure 1.7, c.) (Ingham, 1994; Shlonsky, 2004).

Figure 1.7: Definiteness in SA



The complex NP, on the other hand, consists of more than one nominal element (noun or adjective) where they are either in an appositional (adjectival) or a construct (possessive) relationship to the head noun. The different types of Arabic complex NP are introduced in the following section.

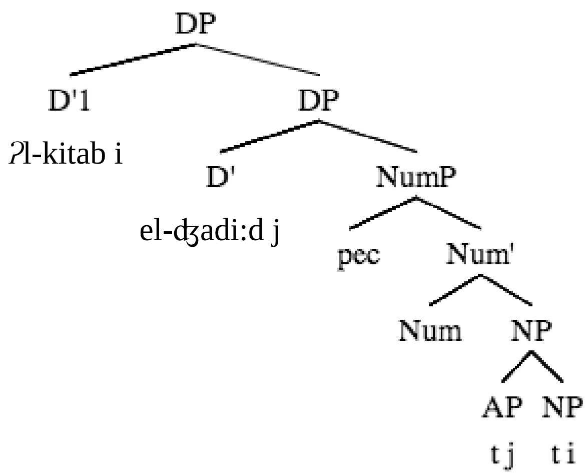
1.4.2.2 Adjectival NP

When the nominal elements are in an appositional relationship to the head noun, these elements are usually adjectives modifying the head nouns, as shown in (5) along with the syntactic tree in Figure 1.8 below (Ingham, 1994; Shlonsky, 2004).

(5)

ʔl-kitab el-ʤadi:d
det-book det-new
the new book

Figure 1.8: Adjectival modification of Arabic NP



When adjectives modify a head noun, they may occur before (6a) or after (6b) the head noun.

(6)

a. *ʔwwal madinah*
first city-F
the first city

b. *madinah ʤamil-ah*
City-F beautiful-F
a beautiful city

They must also agree with nouns in gender and number as well as definiteness (Ingham, 1994). The agreement between adjectives and nouns is illustrated in the following:

(7)

a. *ʔl-ka:tib* *el-gdi:m*
det-writer.M.SG det-old.M.SG
the old male-writer

b. *ʔl-ka:tib-ah* *el-gdi:m-ah*
det-writer-F.SG det-old-F.SG
the old female-writer

c. *ʔl-kuta:b* *el-gdi:m-i:n*
det-writer.M.PL det-old-M.PL
the old male-writers

d. *ʔl-ka:tib-a:t* *el-gdi:m-a:t*
det-writer-F.PL det-old-F.PL
the old female-writers

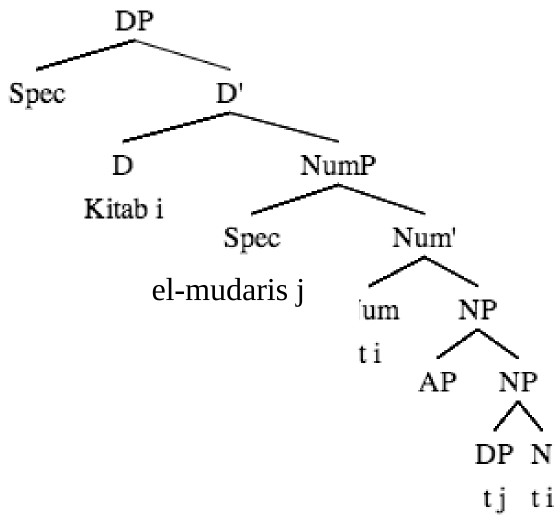
1.4.2.3 Construct state NP

When nominal elements are in a construct relationship to the head noun, the nominal elements and the head noun constitute a construct state. The construct state is a type of NP that corresponds to the genitive NP in English (e.g. 'the man's hat'). The head noun in the construct state is immediately followed by a genitive phrase to which it bears some relation, such as possessed-possessor or theme-source (Ingham, 1994; Mohammad, 1988; Ritter, 1991; Shlonsky, 2004). An example of the construct state can be seen in (8) and Figure 1.9 below.

(8)

kitab el-mudaris
book det-teacher
the teacher's book

Figure 1.9: Construct state



While the adjective serves as a modification to the head noun in (3), the construct state bears the meaning of possessiveness, that is, *kitab* (‘book’) is possessed by *ettaleb* (‘the student’). The construct state may also bear the meaning of attribution (e.g. *ʃaher elsˀum*, ‘the month of fasting’).

The construct state exhibits some salient properties. First, it consists of two nouns where the first noun is always the head of the NP. Second, the head noun and the complement in the construct state must be adjacent to each other. Modifiers cannot intervene between the noun and its complement in the construct state; see (9) below.

(9)

**Kitab el-ʤadi:d e-tˀaleb*
book Det-new Det-student

Third, the head noun of the construct state cannot be preceded by a determiner and it is always indefinite. Lastly, the two nouns in the construct state constitute one prosodic unit; they phonologically pattern with words rather than phrases (Benmamoun, 2000).

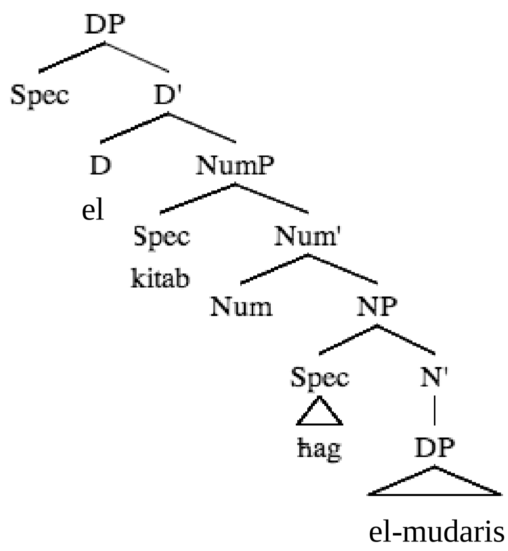
1.4.2.4 Non-construct state NP

The Arabic construct state is often contrasted with the non-construct state (sometimes called 'the free state'). The non-construct state consists of a head noun followed by a particle *ħag* ('of') and a modifying noun. The non-construct state is as exemplified in (10) and Figure 1.10 below.

(10)

el-kitab ħag el-mudaris
det-book of det-teacher
the teacher's book

Figure 1.10: Non-Construct state



The construct and the non-construct state are similar to each other regarding having the meaning of possessiveness. However, there are some notable differences between them. First, the non-construct state is cross-linguistically more familiar than the construct state, which is common in Semitic NPs. Second, in terms of adjacency, the head noun and the complement in the non-construct state are not adjacent to each other and separated by a particle, unlike the head noun and the modifying noun in the construct state. Third, the head noun of the non-construct state can be preceded by a determiner unlike the head noun in the construct state. In the non-construct state, moreover, the particle (*ħag*, 'for') agrees with the head noun in number and gender as shown in the examples below.

(11)

a. *kitab* *ħag* *elmudaress*
book.M.SG for.M.SG Det-teacher
the (male) teacher's book.

b. *kutub* *ħag-at* *elmudaress*
book.M.PL for.F.PL Det-teacher
the (male) teacher's books.

The morphology and syntax of Arabic NP has been described in the above sections. The next sections review relevant morphological and syntactic theories of Arabic NP.

1.4.3 Morphological and syntactic theories of Arabic noun phrase

In the following, the morpho-syntactic theories of gender and number nodes are first discussed and then dominant syntactic theories of Arabic NP are introduced.

1.4.3.1 The Bundling Model of gender and number

The hierarchical relationship between gender and number nodes in the agreement system is not straightforward. Hence, there are two different hypotheses regarding the morpho-syntactic structure of number and gender nodes: the Bundling Model (Carstens, 2000; 2003; Ritter, 1993) and the Splitting Model (Antón-Méndez et al., 2002; Carminati, 2005; Picallo, 1991).

Ritter (1993) and Carstens (2000; 2003) argued that gender and number are bundled together at one node, where all gender morphology is either hosted on the number head, as example (10) shows, or is expressed on the specifier within a number phrase, as presented in example

(11). According to this view, gender features do not project independently of number. In other words, the valuation of gender presupposes a valuation of number.

(12) [NumP . . . [Num{Number, Gender}]]

(13) [NumP XP{Gender} [Num{Number, Gender}]]

This view is based on three main arguments. First, gender and number information are usually combined in languages where the two features participate in agreement and are dependent on each other. Second, gender is lexically specified at the lexicon level. A given noun belongs to a specific gender regardless of its syntactic position. The noun leaves the lexicon with a gender, and this gender persists throughout its use. Unlike gender, number is specified within a given eventuality, where the number feature of a noun depends on its referent in a given situation. Number is tightly linked to event structure or argument structure, unlike gender. Since gender is not linked to argument structure, the bundling model argued that it is desirable to have its representation in syntax mediated by another grammatical feature, which is directly mapped into syntax. Third, the gender of inanimate nouns is uninterpretable where the gender projection cannot always have consistent semantic content. One important theoretical goal in the minimalist program (Chomsky, 1995) is to eliminate semantically inconsistent projections. The bundling model argued that eliminating the gender projection, which is semantically heterogeneous, would result in a more parsimonious theory.

1.4.3.2 The Splitting Model of gender and number

The Splitting Model (Antón-Méndez et al., 2002; Carminati, 2005; Picallo, 1991) argued that gender is dominated by number; however, gender morphology (GenP) is hosted on a nominal stem that heads its own projection as shown in (14) below.

(14) [NumP [GenP . . .]]

A main argument for the splitting model comes from the order of gender and number morphology in languages such as Spanish, where number and gender can be descriptively separated. The order of gender and number morphology in those languages is Stem-Gender-Number as example (15) illustrates (Fuchs, Polinsky & Scontras, 2015).

(15) a. [[libr]-[GenP o-] [NumP s]] ‘books’

b. [[libr]-[GenP o-] [NumP ø]] ‘book’

It can be seen in the above discussion that the exact morpho-syntactic representation of gender and number has remained arguable. The previous reports of morpho-syntactic models of gender and number representation were based on data taken from healthy speakers. The current Arabic aphasia data have the potential to contribute to a clearer morpho-syntactic representation of gender and number.

The syntactic theories of Arabic NP are discussed next.

1.4.3.3 N-raising Hypothesis

A dominant syntactic theory that explained the structure of Arabic NP is the N-raising Hypothesis (Ritter, 1991).

The universal base order for nominal elements within an NP is demonstrative, number, adjective and then noun. This is illustrated in the English NP ‘these three red apples’. However, in some structures of Arabic NP as well as Hebrew NP, the order of the elements within the NP is different. This can be seen in the example that has been mentioned earlier in (1) where the first element is a head noun and the second is a modifying adjective. In this NP, the adjective follows the noun rather than preceding it. To account for this language-specific feature within the NP universal structure, a noun-raising (N-raising) hypothesis (Ritter, 1991) has been proposed.

The N-raising hypothesis, proposed by Ritter (1991), stated that the noun is raised out of the NP to a position left of and above the adjectival field. This head position is identified as determiner^0 (D^0). The N-raising hypothesis is based on Abney's (1987) determiner phrase (DP) hypothesis which claimed that an NP is a complement of a DP.

While the N-raising hypothesis could explain how adjectives may follow nouns in some Semitic NPs, it fails to explain other Semitic NP structures. For example, there are some NP structures in Arabic as well as Hebrew where the head noun appears at the beginning of the NP and the other entire modifying elements appear to the left of the head noun in a mirrored order, as shown in example (16) below. The specific example (16, a.) shows the common type of Arabic NP with the adjective occurring postnominally, whereas (16, b.) illustrates adjectives occurring prenominally in a mirrored order.

(16)

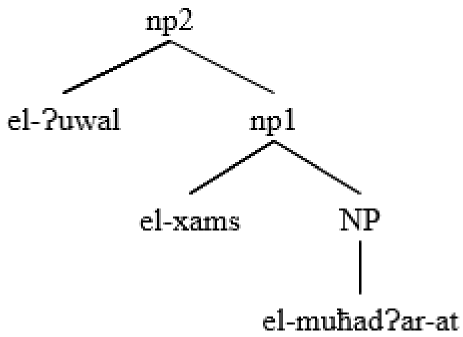
a. *el-muħadˀar-at el-xams el-ʔuwal*
Det-lecture-F.PL Det-five Det-first
the first five lectures

b. *ʔwwal xams muħadˀar-at*
first five lecture-F.PL
the first five lectures

By adopting the N-raising hypothesis, one can assume that the noun has been raised above all of the other elements within the NP. But how could one explain the mirrored order for the other elements? Cinque (1994) introduced another syntactic explanation for the order of nominal elements in Arabic as well as other languages.

Cinque's (1994) explanation accounted for NP structures in all languages. He argued that all adjectives and modifiers are generated as left specifiers of noun (N). He maintains that the order of the noun and the adjectives (whether adjectives are prenominal or postnominal) is then obtained through either raising the N or the NP to the left higher heads or specifiers. According to Cinque, in languages where adjectives occur prenominally, only the N is raised to the left. However, in languages such as Arabic where adjectives occur postnominally, the whole NP, not only the N, is raised. Cinque maintained that when the whole NP is raised, the NP pied-pipes adjectival phrases (AP) and places them in a mirrored order. Figure 1.11 illustrates the base NP structure presumed by Cinque for the sentence in (16, a.).

Figure 1.11: Cinque's base structure of Arabic NP



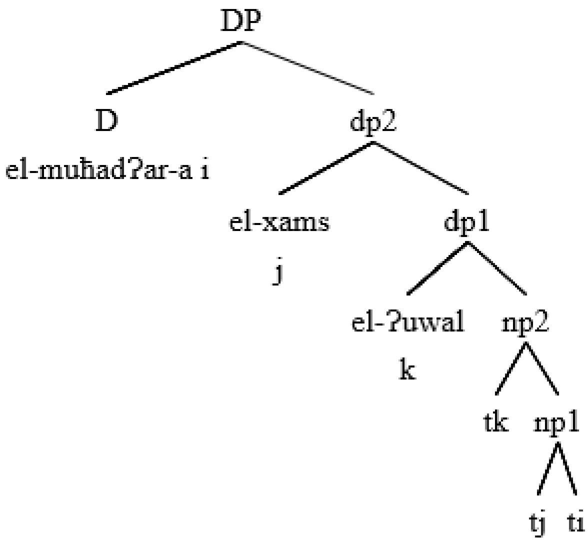
In this structure, the NP is raised to the nearest and lowest adjectival phrase (AP). The AP containing the NP is then raised to the above and nearest AP and so on.

Fassi-Fehri (1999) argued that Cinque's hypothesis does not adequately account for Arabic NP. He explained that the raising of NP occurs in languages where adjectives are postnominal. However, Fassi-Fehri maintained that adjectives in Arabic are essentially prenominal. He explained that the evidence, such as the existence of prenominal adjectives in Arabic, showed that adjectives essentially occur prenominally in Arabic rather than postnominally. According to Fassi-Fehri, the raising of the N rather than the raising of the whole NP adequately accounts for the structure of Arabic NP.

In order to account for the structure in (16), Fassi-Fehri postulated another independent AP (or A) raising besides the N-raising. He argued that this independent AP-raising is able to reorder the adjectives within the Arabic NP and explains the mirrored order. Fassi-Fehri added that this process is motivated by the fact that Arabic adjectives are highly inflected. They target DP to check features for agreements against a higher functional head, which is in this case D, where the N has been raised to.

According to Fassi-Fehri, N is raised to D, the Spec of DP. The highest AP moves to the Spec of dp1 targeting agreement there. Then AP2 moves to the Spec of the newly formed category (dp2) and so on. This process of adjectival movement is shown in Figure 1.12 below.

Figure 1.12: Fassi-Fehri's hypothesis of Adj-raising



Fassi-Fehri described how this process of Adj-raising operates in a nesting manner making multiple checking possible.

While Fassi-Fehri's (1999) argument that N-raising along with Adj-raising could explain the structure of Arabic NP, Shlonsky (2004), claimed that the N-raising hypothesis is inadequate for Arabic NP. Shlonsky claimed that Arabic NP as well as Hebrew, is Det initial rather than N initial. Since NP in Arabic is Det initial, Shlonsky argued that the raising of an N to a D position is blocked because this position is occupied by Det. Similar to Cinque (1994), Shlonsky claimed that such phenomena is best explained in terms of NP-raising: a phrasal movement.

1.4.3.4 Phrasal Movement Hypothesis

In the Phrasal Movement Hypothesis, Shlonsky (2004) argued that the whole NP is raised to the left of the modifiers moving from Spec to Spec. It then pied-pipes all the elements occurring on the right, resulting in either a reversed or a mirrored order of these elements.

The Phrasal Movement Hypothesis (Shlonsky, 2004) adequately explained the structures in (12). Shlonsky has elaborated on Cinque's proposal by describing how agreement operates within Arabic and Hebrew NP.

Nominal elements within Arabic NPs occur either before or after the head noun, as discussed above. Post-nominals must agree with the head noun, unlike pre-nominals which have the option to agree or not. In (17) the pre-nominal *xams* may agree with its head noun as in (a.) or may not, as manifested in (b.). However, if it occurs after the head noun, it must agree with the head noun as in (c.). If it does not agree as in (d.), the result is a syntactically ill-formed sentence.

(17)

a. *xams-at muħad*^{ʔ}*r-at*
five-F lecture-F.PL
five lectures

b. *el- xams muħad*^{ʔ}*r-at*
Def-five lecture-F.PL
the five lectures

c. *el-muħad*^{ʔ}*r-at el-xams-h*
Det-lecture-F.PL Det-five-F
the five lectures

d. **el-muħad^{ʔ}r-at* *xams*
Det-lecture-F.PL five
the five lectures

From a Phrasal Movement perspective, post-nominals are merged as specifiers of projections that contain a phonetically null head. Then XP-movement of the sister of the null head is triggered, resulting in agreement between nominals and the head. Pre-nominals, on the other hand, are merged as heads governing their complements and assigning a genitive case to their sister or to the specifiers of their sisters.

However, several researchers argued that the notion of head movement should not be rejected. In Irish, for example, Carnie and Harley (2000) and McCloskey (2005) rejected the phrasal movement and argued that head movement is what could account for the ultimate position of finite verbs. In addition, Lechner (2005) defended the head movement notion and maintained that head movement does affect meaning and hence cannot be placed entirely in the PF component. Furthermore, Pereltsvaig (2006) argued in support of head movement in Hebrew NPs. He maintained that a head movement analysis of Semitic NPs is preferable to a (remnant) phrasal movement analysis, proposed by Shlonsky (2004).

The N-raising (Ritter, 1991) and the Phrasal Movement (Shlonsky, 2004) have been developed on the basis of data of non-brain damaged speakers. Examining these hypotheses using aphasia data may provide important theoretical implications.

1.4.3.5 Construct state theories

The salient characteristic of the construct state, where the first element must not be preceded by any modifier and must be indefinite, has been the focus of much attention in Semitic syntax, triggering significantly different accounts (e.g. Almansour, 2011; Benmamoun, 2000; Borer, 1989; Ritter, 1991; Shlonsky, 2003, etc.). Among these accounts is the N-raising hypothesis that has been summarised above. The hypothesis stated that the construct N is moved to a Spec position. The N must be indefinite because the position to which this N has been moved is filled by an abstract case assigner (Dgen).

The Phrasal Movement Hypothesis also proposes a comprehensible explanation for the construct state. It argued that the NP in the construct state obligatory moves to the Sepc/D position. Then the definiteness feature is pied-piped to the highest nodes of the construct state NP combined with specifier-head agreement with (null) D.

Another notable account is given by Benmamoun (2000) who hypothesised that the nominal elements in the construct state merge post-syntactically. According to Benmamoun, the noun that carries the feature of (in)definiteness can spell-out the feature to another noun. That is, the (in)definiteness morpheme is in competition with a noun that carries the same feature.

1.4.4 Summary

The above sections have reviewed the morphology and syntax of Arabic NPs. The above morpho-syntactic description demonstrated the morphological richness and the syntactic complexity of Arabic NP. Analysis of production of such structure in aphasia and agrammatism could significantly inform morpho-syntactic theories of NP.

1.5 The present study

This study aims to increase knowledge of morpho-syntax in aphasia and of deficits within this system, specifically within the Arabic language which has a rich morpho-syntactic system. It will be achieved by exploring the production of NP by Arabic speakers with aphasia and agrammatism. This will add to existing knowledge of the condition agrammatism and will increase the knowledge base in this field including theoretical accounts of morph-syntax.

The study examines three types of NP in Arabic: the adjectival NP, the construct state NP and the non-construct state NP. New materials are developed specifically for the study based on the NP types and the generative morpho-syntactic descriptions and theories which are available for Arabic NP (Benmamoun, 2000; Fassi Fehri, 1999; Shlonsky, 2004).

The primary analysis is neurolinguistic which employs a range of morpho-syntactic theories of Arabic NP and agrammatism that are shown in the following list.

- Bundling Model (Carstens, 2000),
- Splitting Model (Carminati, 2005),
- N-raising Hypothesis (Ritter, 1991),
- Phrasal Movement Hypothesis (Shlonsky, 2004),
- Tree Pruning Hypothesis (Friedmann, 1994; Friedmann and Grodzinsky, 1997), and
- Distributed Morphology Hypothesis (Lee et al., 2005; Thompson et al., 2002).

These theories are relevant to the current investigation, because they discuss structures that will be examined in the current investigation, and could potentially account for the range of different morpho-syntactic errors which are likely to occur in the current study. Their application to NP production by Arabic speakers with agrammatism has not been examined yet however, and the current data have the potential to challenge these theories. By applying such theories, the thesis will be able to achieve the following aims:

- to investigate whether Arabic gender and number nodes are bundled in line with the Bundling Model (Carstens, 2000), or split as assumed in the Splitting Model (Carminati, 2005);
- to investigate whether the noun in Arabic NP undergoes a head movement as hypothesised in the N-raising Hypothesis (Ritter, 1991) or a phrasal movement as assumed in the Phrasal Movement Hypothesis (Shlonsky, 2004);
- to examine the effect of structural hierarchy claimed by Tree Pruning Hypothesis (Friedmann, 1994; Friedmann and Grodzinsky, 1997) on production of gender and number inflections; and
- to examine the effect of feature-to-morpheme mapping as argued by Distributed Morphology Hypothesis (Lee et al., 2005; Thompson et al., 2002) on production of gender, number and definiteness inflections.

The study also considers the data in the context of usage-based accounts of frequency and grammatical production (Gahl & Menn, 2016). Application of usage-based accounts to the study of aphasia is gaining increasing attention. This is the first study that examines Arabic aphasia from a usage-based perspective. In line with the evidence presented in section (1.2.3.3), usage-based accounts predict that frequency affects production of NP constructions and nouns. The study analyses lexical frequency and according to usage-based accounts it is predicted that lexical frequency will affect production accuracy in Arabic aphasia: low-frequency nouns or adjectives are more likely to elicit errors than high-frequency ones. Data for construction frequency of Arabic NP in non-brain-damaged or brain-damaged individuals are not available, hence the effect of construction frequency on NP production could not be examined in the current study. In addition, the ProGram theory (Boye & Harder, 2012) predicts impaired production of definiteness inflections, since inflections are grammatical items, and grammatical items are considered secondary for communication for speakers with agrammatism. The thesis will achieve the following aims by adopting the above usage-based theories:

- to investigate the effect of lexical frequency on production, and
- to examine if definiteness production is consistent with the ProGram theory predictions.

Finally, the data will be considered within the framework of psycholinguistic accounts of processing of grammatical gender and number. Word production models (e.g. Dell et al., 1997; Levelt et al., 1999) agree that gender is represented at an independent lemma/word level, but they disagree as to whether accessing gender at this level is sensitive to frequency. Data for the processing of grammatical gender in NP in Arabic aphasia are not available, and the current investigation will provide novel data to apply to existing theoretical accounts of gender processing. With regard to plural production, previous studies analysing the psycholinguistic processing of Arabic grammatical number showed differential processing of regular and irregular plural, with regular being more impaired than irregular in aphasia and agrammatism (Khwaileh, Body & Herbert, 2015; Safi-Stagni, 1995). The study extends the current knowledge base by examining the type of errors in Arabic regular plurals. The following aims will be achieved by considering psycholinguistic accounts of gender and number processing:

- to investigate if access of gender at the lemma/word level is sensitive to frequency, and
- to analyse the type of errors in the processing of number in regular plurals.

2. DEVELOPMENT OF THE NOUN PHRASE SUBTESTS

The primary aim of the study is to examine the production of noun phrase (NP) in the speech of Saudi Arabic speakers with agrammatism. In order to achieve this aim, four different linguistic subtests were developed. These subtests consist of a *Number and Gender Agreement Subtest*, *Definiteness Agreement Subtest*, *Construct State Subtest* and *Non-Construct State Subtest*.

The development of these subtests was fundamental. There have been no previously published subtests that have been designed for testing the production of Arabic NP in agrammatism specifically. If there have been available subtests developed for testing NP production by speakers with agrammatism in non-Arabic languages, the researcher could not adopt them because of the difference between the NP structure of those languages and the Arabic language.

This chapter introduces the methodology used to develop these four subtests. The methodology is presented in the following sections: 6.1 Design of the subtests, 6.2 Stimuli selection, 6.3 Materials and 6.4 Procedure. The chapter also presents a phase for conducting a name agreement test for the images used and this phase is in section 6.5 Name agreement test. The chapter ends with a summary that is shown in section 6.6.

2.1 Design of the Subtests

As explained previously, there are three types of Arabic NP. These types are the adjectival NP, the construct state NP and the non-construct state NP. The morphological and syntactic structure of these types of NP has been explained in Chapter Four.

Four subtests were developed for the study in order to test Arabic NP. The subtests were developed according to the NP type. Hence, the *Construct State Subtest*, which tested the construct state NP, and the *Non-Construct State Subtest*, which tested the non-construct state NP. As for the adjectival NP, there were two subtests developed to test this structure because this structure included two types of inflections: a prefix for definiteness and a suffix for number and gender. The subtests were the *Number and Gender Agreement Subtest*, which tested the production of the number and gender suffixes in both the noun and the adjective, and the *Definiteness Agreement Subtest*, which tested the production of the definiteness prefix in the noun and the adjective.

All subtests included 24 test items, except for the *Definiteness Agreement Subtest*, which included 18 test items only. In addition, all subtests consisted of two or four different conditions. Table 2.1 describes the number of items and the conditions in each subtest.

Table 2.1: Items and conditions in subtests

Subtest	**Items**	**Condition**	**Items in condition**
Number and gender agreement	24	Masculine Singular Feminine Singular Masculine Plural Feminine Plural	6 6 6 6
Definiteness agreement	18	Definite Indefinite	12 6
Construct State	24	masculine singular + masculine singular or feminine singular + feminine singular masculine singular + feminine singular or feminine singular + masculine singular	12 12
Non-Construct State	24	Masculine head noun Feminine head noun	10 14

The *Number and Gender Agreement Subtest* tested number and gender agreement in Arabic adjectival noun phrases. The Arabic adjectival noun phrase includes a head noun and a modifying adjective that must agree in gender and number with the noun. The agreement between the head noun and the modifying adjective was tested in four different conditions: the masculine singular condition, the feminine singular condition, the masculine plural condition and the feminine plural condition. The adjectival noun phrases that were investigated included the noun, the noun number and gender inflection, the adjective and the adjective number and gender inflection. Examples from (1) to (4) show each of the four conditions respectively.

(1)
mudarris $t^{ʕ}$*iwi:l*
teacher.M.SG tall.M.SG
tall (male) teacher

(2)
Mudarris-ah $t^{ʕ}$*iwi:l-ah*
teacher.F.SG tall.F.SG
tall (female) teacher

(3)
Mudarris-i:n $t^{ʕ}$*iwi:l:i:n*
teacher.M.PL tall.M.PL
tall (male) teachers

(4)
Mudarris-a:t $t^{ʕ}$*iwi:l-a:t*
teacher.F.PL tall.F.PL
tall (female) teachers

Items for this subtest can be found in Appendix A.

The *Definiteness Agreement Subtest* looked at the agreement between the head noun and the modifying adjective in terms of definiteness. The subtest consisted of two conditions: the definite condition and the indefinite condition. The definite noun phrases that were examined included the noun definite article, the noun, the noun number and gender suffix, the adjective definite article, the adjective and the adjective number and the gender suffix. On the other hand, the indefinite noun phrases included the noun, the noun number and gender suffix, the adjective and the adjective number and the gender suffix. Examples of a definite noun phrase and an indefinite noun phrase are as shown in (5) and (6) respectively.

(5)

ʔl-war:dah *ʔl-ħamrah*
Def-flower.F.SG Def-red.F.SG
The red flower

(6)

lambah *zargah*
Indef-light.F.SG Indef-blue.F.SG
A blue light

The items for this subtest are shown in Appendix B.

The *Construct State Subtest* aims to investigate the salient characteristics of the construct state, where the first element must not be preceded by any modifier and must be indefinite. All items in this subtest were singular. The construct state noun phrases that were investigated included an indefinite article, head noun, head noun gender and number suffix, definite article, modifying noun and gender and number suffix of modifying noun as shown in example (7).

(7)

saħab *ʔl-fustan*
zipper.M.SG Def-dress.F.SG
The dress zipper

There were two conditions in this subtest. The first condition included two nouns that had the same gender; that is, a noun phrase that has either a masculine singular plus a masculine singular noun, or a feminine singular plus a feminine singular noun. The second condition consisted of two nouns that have different genders; it consisted of either a masculine singular plus a feminine singular noun or a feminine singular plus a masculine singular noun. The test items for this subtest are shown in Appendix C.

The *Non-Construct State Subtest* aims to investigate the number and gender agreement between the head noun and the particle *ħag* in the non-construct state noun phrase. The structure that was investigated included a head noun, head noun gender and number suffix, *ħag*, *ħag* number and gender suffix, definite article, modifying noun, muddying noun number and gender suffix as example (8) illustrates.

(8)

lambah	*ħag-at*	*ʔl-ħamam*
light-F.SG	for-F.SG	Def-toilet.M.SG

The light of the toilet

The subtest included two conditions: the first condition had a masculine singular head noun and the second condition included a feminine singular head noun. Appendix D presents the items used in this subtest.

2.2 Stimuli selection

Stimuli consisting of nouns and adjectives were selected to develop the subtests. The nouns and adjectives were selected based on certain linguistic criteria. These criteria included grammatical gender, grammatical number, and concreteness. The stimuli were then matched according to length of phoneme, which is a linguistic variable, and frequency, which is a psycholinguistic variable. The criteria for the selection and matching of nouns and adjectives are explained below.

2.2.1 Grammatical gender

Gender was controlled in the current study because adjectives and nouns in Arabic are marked for gender. Half of the items in the first subtest, the *Number and Gender Agreement Subtest,* consisted of masculine nouns and adjectives and the other half consisted of feminine nouns and adjectives. In the other subtests, other variables such as grammatical number and concreteness were more important. Accordingly, not all the subtests had a similar number of masculine and feminine forms. To illustrate, the *Definiteness Agreement Subtest* included feminine items only, 12 definite feminine noun phrases and six indefinite feminine noun phrases. The *Construct State Subtest* included nine M SG + M SG, three F SG + F SG, five M SG + F SG and seven F SG + M SG noun phrases. The *Non-Construct State Subtest* items included ten items with M SG head nouns and 14 items with F SG head nouns.

2.2.2 Grammatical number

In the *Definiteness Agreement Subtest*, the *Construct State Subtest and* the *Non-Construct State Subtest*, all of the nouns and adjectives were singular forms (e.g. *ʤazmah suda:* 'shoe.F.SG black.F.SG'). The number was manipulated in the *Adjective-Noun Number and Gender Agreement Subtest* where agreement between number and gender inflections was tested. Half of the items in this subtest were singular forms (e.g. *mudarris tˤiwi:l* 'teacher.M.SG tall.M.SG') and the other items were plural forms (e.g. *mudarris-i:n tˤiwi:l-i:n* 'teacher.M.PL tall.M.PL'). Plural nouns and adjectives included regular forms only. Regular forms were selected because they are marked morphologically for gender unlike irregular forms. Irregular forms were excluded because production of the morphology was of prime interest.

2.2.3 Concreteness

Since all the nouns and adjectives had to be picturable in all subtests, all nouns and adjectives were concrete. All nouns were denoting humans, such as *mudaris* (teacher.M,SG), or objects, such as *lambah* (light.F.SG). Adjectives referred to visible characteristics such as adjectives denoting colours (e.g. *ʔswad* ‘black.M,SG’) or physical properties (e.g. *kibi:r-ah* ‘big-F.SG’).

2.2.4 Length and lexical frequency

Length refers to the number of phonemes in the word. Studies have shown that word length has an effect on word retrieval in healthy speakers (e.g. Santiago et al. 2000). Studies reported that words which were long were retrieved less accurately than shorter words in picture naming (Caplan, 1987; Nickels & Howard, 1995; Romani & Calabrese, 1998). The minimum length of the noun and adjective in the current study was four phonemes (e.g. *baab* ‘door’). Nouns and adjectives consisting of more than 11 phonemes were excluded.

Frequency is defined as the estimated occurrence of a word in a language and it has been found to have a significant effect on word retrieval in non-brain-damaged speakers and in aphasia as shown in section (1.2.3.3). The frequency values were taken from ARALEX which is a lexical database for Modern Standard Arabic (Boudelaa & Marslen-Wilson, 2010).

2.2.4.1 Matching of stimuli

Attention was paid to length and frequency while selecting the stimuli. In each subtest, nouns and adjectives were matched for frequency and length. However, some of the sets such as singular versus plural nouns were not matched due to the morphological system in Arabic.

Matching of stimuli was done by creating sets containing an equal number of masculine versus feminine nouns or adjectives; singular versus plural nouns or adjectives; or definite versus indefinite nouns or adjectives. Other sets included an equal number of masculine head nouns versus feminine head nouns; or masculine modifying nouns versus feminine modifying nouns. All sets were then matched for length and lexical frequency.

There were four sets in the *Gender and Number Agreement Subtest*. The sets included two noun sets and two adjective sets. All masculine nouns were matched with feminine nouns in one set and all singular nouns were matched with plural nouns in another set. The matching was first according to the frequency. The same sets were then matched based on length. The same method was replicated in adjectives. The matching of stimuli for the Gender and Number Agreement Subtest is shown in Appendix E.

In the Definiteness Agreement Subtest, all the singular, feminine nouns and adjectives were matched based on definiteness or indefiniteness. The subtest included two sets: definite versus indefinite nouns and definite versus indefinite adjectives. The two sets were first matched according to frequency and then according to length. Appendix F presents the matched sets of the Definiteness Agreement Subtest.

The matching of stimuli in the *Construct State Subtest* and the *Non-Construct State Subtest* was similar. All the singular nouns were classified based on the gender and being either a head or a modifier. There were two sets: a set for masculine head nouns versus feminine head nouns and another set for masculine modifying nouns versus feminine modifying nouns. Each set was first matched for frequency and then length. Appendix G and Appendix H show the matched stimuli of the Construct State Subtest and the Non-Construct State Subtest respectively.

The non-parametric Mann-Whitney U test was used to analyse pairs of stimuli in sets. Most of the data revealed non-significant differences. There were some statistically significant differences in the *Gender and Number Agreement Subtest*, the *Construct State Subtest* and the *Non-Construct State Subtest*. The differences between the frequency of singular and plural nouns, the frequency of singular and plural adjectives, and the length of singular and plural adjectives were statistically significant in the *Gender and Number Agreement Subtest*. The possible explanation is that plural forms are usually less frequent and they are phonologically longer in Arabic. In addition, the difference between the length of masculine head nouns versus feminine head nouns was also statistically significant in both the *Construct State Subtest* and the *Non-Construct State Subtest*. This can be explained by the fact that the masculine is phonologically shorter and they are considered default in Arabic and therefore occur more frequently. It can be seen that the statistically significant differences in the *Gender and Number Agreement Subtest*, the *Construct State Subtest* and the *Non-Construct State Subtest* were due to the nature of the Arabic language and cannot be avoided. However, the frequency and the length will be taken into account as possible.

2.3 Materials

2.3.1 Picture stimuli

Pictorial stimuli depicting the noun phrases were professionally drawn by an artist for the purpose of the current study. The pictures were coloured and were adult and culturally appropriate. All drawn pictures were scanned and configured to be 15.24 cm (width) by 11.43 cm (height). Each picture was inserted in a separate slide in *PowerPoint* (Microsoft Office, 2016). The background was set to be white. The pictures were presented on a laptop screen (Dell Inspiron 15 3000) with a resolution of 1,024 by 768 pixels.

2.3.2 Plural pictures

Pictures for plural noun phrases were formed by showing four pictures containing the same noun phrase on one screen. A sample of the pictures developed for plural noun phrases in the *Number and Gender Agreement Subtest* can be found in Appendix I.

2.4 Procedure

In all subtests, the participant was shown the pictures on a screen, was provided with spoken instructions, and was asked to provide a spoken response to describe the picture seen. In the *Definiteness Agreement Subtest*, the *Construct State Subtest* and the *Non-Construct State Subtest* the participant was shown two pictures where the researcher named the first one and asked the participant to name the second. In the *Definiteness Agreement Subtest* the participant was shown one picture and was asked to name something in the picture.

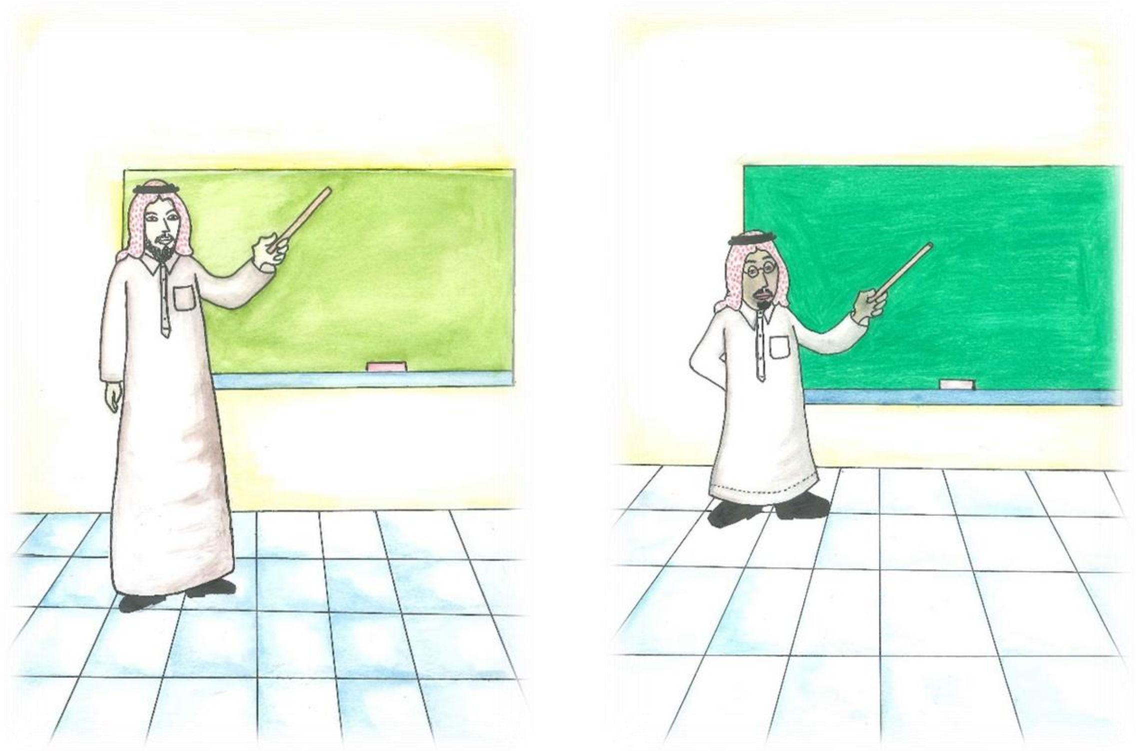
A demonstration item was presented first, and the researcher provided the expected response. Then two practice items were presented, and the participant was asked to respond. If the participant was unable to respond, the researcher provided a phonological cue which was the first phoneme of the noun. If the participant did not respond after the phonological cue, the researcher gave the spoken response.

After this the first set of stimuli were then presented. The participant was given 30 seconds to respond. If the participant did not give a response, the researcher gave a phonological cue. If the participant did not give a response after the phonological cue, the researcher provided the response and then moved to the next item.

All instructions were given in Arabic in all subtests. In the *Definiteness Agreement Subtest, The Construct State Subtest* and *The Non-Construct State Subtest* instructions were as follows: You will see two pictures. I will name the first picture and you will name the second picture. The instruction of *The Definiteness Agreement Subtest* was as follows: You will see a picture and I will ask you about something in the picture.

2.4.1 Elicitation technique in the number and gender agreement subtest

In the *Number and Gender Agreement Subtest*, the elicitation of the masculine singular and the feminine singular was done by showing each participant two pictures that had the same noun but antonymous adjectives (e.g. 'tall' and 'short'), or the same adjective but antonymous nouns ('male teacher' and 'female teacher'). The researcher named the first picture and then asked the participant to name the second picture. For example, the researcher showed the participant a picture of a male teacher that looked tall and said "tall (male) teacher" (9). Then the researcher showed the participant another picture of a male teacher who looked short then asked the participant to name that picture to elicit "short (male) teacher" (10). The pictures are shown below.



(9)

mudarris $t^{ʕ}$*iwi:l*

teacher.M.SG tall.M.SG

tall (male) teacher

(10)

mudarris gis^{ʕ}*i:r*
teacher.M.SG short.M.SG
short (male) teacher

As for the masculine plural and the feminine plural items, the procedure was the same. However, the picture that the researcher named and the picture that the participant had to name were not antonymous. The first picture showed a singular adjectival NP and the other picture showed the same NP but in plural form.

2.4.2 Elicitation technique in the definiteness agreement subtest

In the *Definiteness Agreement Subtest* the participant was shown a picture via a laptop screen and he/she was asked to name something in the picture. Because the definite article is used to refer to specific or particular nouns, the questions in the definiteness section included the name of the target item. For example, the participant was shown a picture of a girl smelling a red flower and holding another yellow flower. The participant was asked the following: ‘‘what is the flower that the girl is smelling?’’ The target response was ‘the red flower’’ (11). The picture is shown below.

(11)

el-wardah *el-ħamrah*
Det.flower Det.red
the red flower

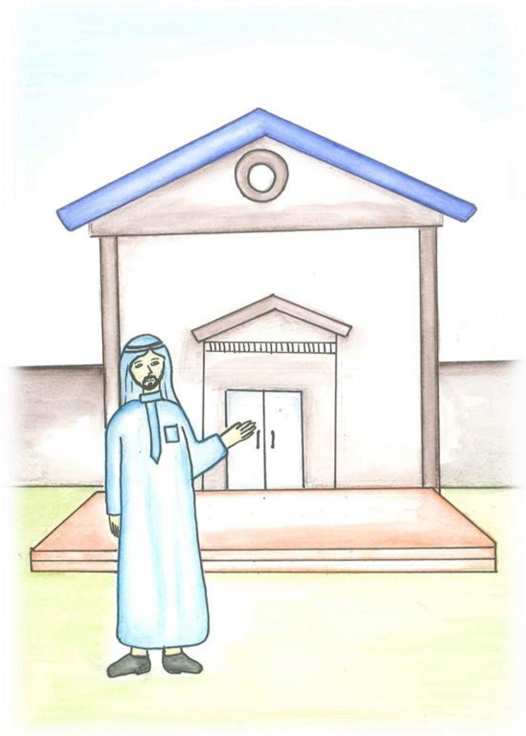
In the indefiniteness section the question did not include the name of the target item because indefinite articles are used to refer to non-specific or non-particular nouns. For example, the participant was shown a picture of a woman carrying a red bag with a green bag hanging behind her. The participant was asked the following: ‘‘what is the woman carrying?’’ The target response was ‘‘a red bag’’ (12). The picture was as follows:

(12)

ʃantʕah ħamrah
bag red
a red bag

2.4.3 Elicitation technique in the construct state subtest

The participant was shown a picture and the researcher named it. Then the participant was asked to name another picture that depicted exactly the same head noun as the first picture, and a modifying noun semantically related to the modifying noun of the first picture. To illustrate, a picture of a woman standing in front of a house was shown and the researcher named it by saying “the woman’s house” (13), then the participant was shown another picture showing a man standing in front of a house and was asked to name it. The expected response was “the man’s house” (14). The picture is shown in the following.



(13)

bayt *el-ħirmah*
house Det.woman
the woman’s house

(14)

bayt *er-riʤal*
house Det.man
The man’s house

2.4.4 Elicitation techniques in the non-construct state subtest

The procedure used in the *Non-construct State* subtests was exactly the same as the procedure used in the *Construct State Subtest*. To illustrate, a picture showing a cup filled with tea with a tea bag inside the cup was shown and the researcher named it saying ‘‘a cup of tea’’ (15). Another picture showing a cup filled with coffee with a print of coffee seeds on the cup and the participant was asked to name it. The response that the participant should have given was ‘‘a cup of coffee’’ (16). The following is the picture used for examples (15) and (16).

(15)

ku:b *ħag* *e ʃ- ʃahi:*
Cup.M.SG for.M.SG Det.tea
the cup of tea

(16)

ku:b *ħag* *e*l-*gahwah*
Cup.M.SG for.M.SG Det.coffee
the cup of coffee

2.4.5 Data recording and transcription

Data was recorded using a voice recorder application (version 20.1.86.12) built in Samsung Galaxy (S6 edge). The responses were transcribed by the researcher at the time of assessment using Arabic script. Afterward, the responses were transcribed again by the researcher using

IPA. The transcribed responses were entered into a data sheet which was designed with different variables reflecting participant information, elicitation variables and response types.

Two inter-examiners reviewed more than 20% of data entry for reliability of transcription and reliability of coding which both yielded more than 85% agreement.

2.4.6 Reliability

The data was transcribed and coded by the researcher immediately after the session. The data was coded again by the researcher for intra-rater reliability. The time between the first and the second coding was four months. 20% of data entry was checked for inter-rater reliability of transcription and reliability of coding by anther native speaker researcher.

2.4.7 Coding of lexical items

The data was coded for lexical, inflectional and agreement errors. Coding of lexical errors was based on the coding system developed by Dell et al (1997) and adapted by Herbert et al (2014). Appendix J presents the description of the codes used for lexical errors as proposed by Herbert et al. (2014).

2.4.8 Coding of inflections

As for inflectional errors, a coding system was developed for coding these errors. Inflectional errors were coded number errors, gender errors, or definiteness errors. Appendix K demonstrates the codes used for coding inflectional errors.

2.4.9 Coding of agreement

The agreement, which refers to the internal agreement between the inflections of the N and the Adj or the N and the particle *ħag* (for) within the NP produced, was coded as *correct* *agreement*, *grammatical not target,* or *ungrammatical*. These codes are explained in Appendix L.

2.5 Name Agreement

Name agreement data for the images used in the subtests was collected. Name agreement is defined as the degree to which participants produced the same name to a given picture (Alario & Ferrand, 1999; Bonin et al., 2003). Because the study is concerned with testing noun phrases and not separate nouns or adjectives, it was intended for the pictures designed to portray a noun and an adjective; a head noun and a modifying noun or a head noun; a particle (*hag*), and a modifying noun. In other words, the name agreement procedure that was carried out tested the agreement between the picture and the target noun phrases not only nouns.

2.5.1 Participants

2.5.1.1 Recruitment and ethics

20 participants were recruited for the name agreement test. The participants were recruited via an SMS that was sent from the researcher’s mobile phone. The SMS briefly showed the study and requested voluntary participation. If a person was interested in participating, an email containing the information sheet and a consent form that the person had to sign was sent. The information sheet and the consent form are in Appendices M & N. Ethical approval was obtained from the University of Sheffield prior to commencing the study.

2.5.1.2 Inclusion criteria

- Native Saudi Arabic speaking
- Aged 18 and above adults
- Has normal development of speech and language

- Has normal hearing and vision

2.5.2 Design

The name agreement test included the four subtests that are detailed in sections (6.1 and 6.2). All of the four subtests were combined into one test.

2.5.3 Material

The material of the name agreement test is described in section (6.3).

2.5.4 Procedure

Each participant was tested separately during one session. Each participant was asked to undergo the name agreement test at either the researcher or his/her own home. The participant was tested in a quiet room. The participant sat comfortably and was shown a picture on a laptop screen. He/she was asked to name the picture using a single complete noun phrase within 10 seconds. One demonstration item as well as to two practice items were given first, and feedback was given on the participant's performance.

2.5.4.1 Data recording and transcription

Data recording and transcription is explained in section (2.4.5) above.

2.5.4.2 Data coding

The data was coded based on the coding system developed by Khwaileh, Body and Herbert (2013). All responses that were named accurately within the allocated time were coded as correct. Other responses were coded according to the type of errors produced. The coding of errors is described by Khwaileh et al. as follows:

- Visual error: response visually related to the target picture; e.g. saying /mIrj ele/'apron' for /bç:rdæj e/ 'curtain'.
- Semantic error: response semantically related to the target picture; e.g. saying /ħeiwæn/ 'animal' for /kelb/ 'dog'.
- Phonological error: the erroneous response shares 50% or more phonemes with the target response, e.g. /tIlIfu:n/ 'telephone'→/tIlIfIzju:n/ 'television'
- Other error: responses that did not fit within any of the categories above.
- No response: failure to respond to the picture presented.

2.5.4.3 Reliability

Reliability checking was the same to the method explained in section (2.4.6) above.

2.5.4.4 Data analysis

Name agreement for each image was calculated as the percentage of the participants giving the same noun phrase for a given picture. An acceptable level of name agreement was set at 95%. Pictures with less than 95% name agreement were replaced.

2.5.5 Results

The full set of stimuli from all four tests included 90 items. 84 items (93.3%) had a name agreement of 100%, four items (4.4%) had a name agreement of 95%, and two items (2.2%) had a name agreement of less than 95%. The two items with agreement less than 95% were ‘‘a brown ruler’’ with a name agreement of 70% and ‘‘a green microphone’’ with a name agreement of 65%. These two items were redrawn and retested and the results of the retest revealed an agreement of 100%.

2.6 Summary

This chapter has introduced the method used for developing the NP subtests: *Number and Gender Agreement Subtest*, *Definiteness Agreement Subtest*, *Construct State Subtest* and *Non-Construct State Subtest*. The design, stimuli section, materials, and procedure used for the subtests' development have all been presented. Finally, the chapter concludes with the conduction of the name agreement subtest, which ensured that the pictorial stimuli portrayed the target NPs adequately.

The next chapter presents the pilot phase that was conducted prior to the main phase of testing Arabic NP in agrammatism.

3. PILOT STUDY

A pilot study was first conducted to test the reliability and validity of the instruments, the coding system and the test protocol.

3.1 Participants

The data was elicited from a participant with agrammatism (LS) and a control participant (NR) who matched the participant with agrammatism in age and gender.

3.1.1 Recruitment and ethics

LS was recruited from Sultan Bin Abdulaziz Humanitarian City (SBAHC) in Riyadh. She was contacted by her SLT and she was given an information sheet summarising the project's background, aims and the participant's role in the experiment. Participation was voluntary. After being given all the necessary information (see Appendix O), LS signed a consent form (see Appendix P) prior to commencing the study. This experiment was approved by the Departmental Ethics Committee of the Department of Human Communication Sciences at the University of Sheffield (see Appendix Q), and it was also approved by the ethics committee at SBAHC (see Appendix R).

NR was recruited by the researcher via personal contacts. An information sheet explaining the study was given and NR then signed a consent form prior to the study. The information sheet and the consent form were the same forms used for the participants with agrammatism (LS) and which are in Appendix O and Appendix P respectively. Ethical approval was obtained from the Department of Human Communication Sciences at the University of Sheffield (Appendix Q).

3.1.2 Inclusion criteria

The study inclusion criteria for the participant with agrammatism were as follows:

- Native Saudi Arabic monolingual speaker speaking Najdi which is the dialect of the central region of Saudi Arabia.
- Aged 18 years and above
- Righthanded
- Diagnosed by SLT with Aphasia with agrammatism as a result of a single stroke
- At least six months post onset
- Normal or corrected to normal hearing and vision
- No significant unintelligibility of speech (severe dysarthria or apraxia of speech)
- No history of speech and language impairment prior to the stroke
- No other neurological disorders
- No history of psychiatric disorders

The control person inclusion criteria were similar to those used in the name agreement test (see section 2.5.1.2).

3.1.3 Participants' details

The participant (LS) was a 60-year-old native SA monolingual female. She was right-handed and reported normal development of speech and language, and normal hearing and vision. According to her medical records and her speech language pathology (SLP), the participant sustained an acute ischaemic infarction at the left temporo-parietal region nine months prior to the date of testing. She presented with hemiplegia to her right side and was diagnosed with Broca's Aphasia. The SLP characterised her expressive language as consisting of mild anomia and very limited grammatical structure. LS was able to cooperate with the testing procedure and met the criteria outlined above.

NR was a SA female healthy participant. She was a right-handed 64-year-old monolingual speaker who had normal development of speech and language, and normal hearing and vision.

3.2 Design

The participants completed all four subtests in full. The assessment consisted of four sessions and each session was a given period of 45 minutes to ensure that the session was manageable for participants. A minimum period of two weeks elapsed between the sessions. The test items were distributed across sessions. The distribution was based on the subtest and the number of items in the subtest. The number of items in each session did not exceed 24 test items to avoid the participants becoming exhausted. The design of the sessions is shown in Table 3.1 below:

Table 3.1: Pilot test sessions

Session	Name of subtest	#Items
Session 1	Number & Gender Agreement (singular forms)	6
	Construct state	6
	Definiteness Agreement (definite forms)	6
	Non-construct	6
Session 2	Number & Gender Agreement (singular forms)	6
	Construct State	6
	Definiteness agreement (indefinite forms)	3
	Non-construct	6
Session 3	Number & Gender Agreement (plural forms)	6
	Construct State	6
	Definiteness Agreement (definite forms)	6
	Non-construct	6
Session 4	Number & Gender Agreement (plural forms)	6
	Construct State	6
	Definiteness agreement (indefinite forms)	3
	Non-construct	6

3.3 Materials

The materials used were those described in Chapter Tow and included all four subtests and the coding system.

3.4 Procedure

The participants were assessed individually. Appointments were made with each participant. LA was assessed in a quiet clinic room at SBAHC, and NR was assessed in a quiet room located in her house. LA's medical history and diagnosis were taken from the responsible SLT prior to assessment. The data was collected by the researcher.

The procedure used for each subtest was explained to each participant prior to testing. The instructions were standardised as described in Chapter Two. A demonstration item and two practice items were first introduced to ensure that the participant understood the task. Further instructions and practice items were provided if the participant did not understand the task, as detailed in Chapter Two

Participants were allowed to take a break when required. The computer-based tasks were administered by the researcher who sat next to the participant. After sitting comfortably, each participant was asked to name the picture that appeared on a white background. The procedures for each noun phrase subtest, as well as to their instructions, are presented in Chapter Two. The tests were administered as described in the previous chapter. All data were transcribed and coded as also described in Chapter Two. In addition, the participants provided feedback on the tests, and any difficulties with the test, such as not understanding the instructions, were noted. This is because the pilot test aimed to check that the tests are clear and straightforward to complete; that the participants knew what was expected of them; that instructions were clear, and that the tests were neither so hard that participants could not complete them at all, nor so easy that errors were made. In addition, the coding system was trialled to check that most of the responses and errors were accounted for.

3.5 Results of the pilot data

The first set of analyses looked at accuracy. The healthy participant did not make any errors. However, LS produced only eight correct responses (8.3 %). She produced five correct responses for the *Gender and Number Agreement Subtest* as in the following example:

8. *mudaris* *tˤiwi:l*
teacher.M.SG tall.M.SG
tall teacher

For the subtests *Definiteness Agreement Subtest*, *Construct State Subtest* and *Non-Construct State Subtest*, LS produced one correct response for each. These responses are exemplified in the following respectively:

9. *ʁitrah* *bajðˤa*
headscarf white
white headscarf

10. *miftaħ* *el-bajt*
key def-house
the house key

11. *ka:s* *ħag* *el-mu:jah*
glass for def-water
glass of the water

Error responses were analysed for meaningful patterns. Lexical, inflectional and agreement errors were analysed based on the coding system explained in Chapter Two. The codes can be found in Appendix J, Appendix K and Appendix L.

The analysis of errors revealed that some were common errors that can be found in people with agrammatism such as the use of fillers as in '*uhm'* and "don't know" responses as shown in the following example.

12. *ma ʔ-ʕrif-ha:*
    no 1st.SG-know.3rd.F.SG
    I don't know it.

L.S.' other incorrect responses showed different types of errors. The most common error category was lexical *no response*. Lexical *no response* occurs when only one part of the noun phrase is omitted. The omitted part can be either the head of the noun phrase, which is a noun, or the modifier of the noun phrase, which is either a noun or an adjective. The omission of the head nouns can be seen in the example '*ħamra*' (red) where the head noun is omitted in the NP '*wardah ħamra*' (red flower), and in '*el-riʤal'* (the man) where the head noun is omitted in '*bajt el-riʤal.*' (the man's house). On the other hand, modifier omission is shown in the example '*sam:aʕah'* (headset) where the modifying N is omitted in the noun phrase '*sam:aʕat el-ʤawal'* (the mobile's headset). Modifier omission is also present in the example *'lambah'* where the modifying Adj is omitted in '*lambah zarga*' (blue light).

The descriptive statistical analysis manifested that *no response* errors in head nouns were more than *no response* errors in the modifiers. Out of the 40 *no response* errors produced by LS, 23 (0.57) of the errors affected the head and 17 (0.43) affected the modifier.

The next common error pattern was *no responses* for the whole noun phrase. There were eight items that L.S. was unable to produce. One item in the *Number and Gender Agreement Subtest* and seven items in the *Non-Construct State Subtest.*

The third pattern was inflectional and agreement errors. An example of inflectional errors can be seen in (13):

13. *el-ʃan:tʕah el-bizran*
def-bag def-kids
the kids' the bag

The noun phrase in (13) was a Contract State noun phrase. The head noun in this type of Arabic noun phrase should be indefinite. However, LS produced an inflectional error and substituted the indefinite article with a definite article '*el'*.

Example 14 shows an agreement error produced by LS.

14. *galam ħ̠aðˤra*
pen.M.SG green-F.SG
(F) green (M) pen

In example (14), an inflectional error occurred in the adjective '*ħaðˤra'* where the adjective M SG inflection was substituted with a F SG inflection. Therefore, an *ungrammatical* error occurred due to the gender disagreement between the noun and the adjective.

Another example of agreement errors can be seen in (15). It was seen in the inflectional and agreement errors produced by LS that the production of the F PL was very impaired. In all the six items that tested feminine plural NP production, LS did not produce any item correctly.

Other lexical errors occurred in LS's production. However, those errors were not as common as other error types. Example (15) presents a semantic lexical error.

15. *ʔl-masˤah ʔl-ħamra*
def-table.F def-red.F
the red table.

In this example, L.S. correctly produced the agreement inflections for gender, number and definiteness in the noun phrase. However, the noun and adjective that she produced are semantically related to the noun and adjective in the target noun phrase. To illustrate, '*masˤah'* (table) is semantically related to the noun '*tˤa:wilah'* (table), and '*ħamra'* (red) is semantically related to the adjective '*bajjðˤa'* (white).

Example (16) below shows a lexical phonological error. In this example, the noun and adjective are correctly inflected for gender, number and definiteness. They are also the target nouns and adjective. However, LS substituted one phoneme in the adjective by another. She substituted the third phoneme *m* in the adjective by 'ðˤ,' resulting in '*ħaðˤra'* instead of '*ħamra'* (red).

16. *ʔl-tufaħah ʔl-ħaðˤra*
    def-apple.F def-red.F
    the red apple.

Example (17) illustrates a lexical visual error where L.S. substituted the 'bicycle's wheel' (*kafar el-sajkal)* with the 'wheelchair' (*ʕarabijah).*

17. *ʕarabijah*
    wheelchair.F
    wheelchair

3.5.1 Results of test instrument

The test instrument that was developed for the current study elicited all the target noun phrases in the four subtests form the control participant. As for the elicitation of these noun phrases from LS, LS produced only eight correct responses and all other responses involved different types of errors.

3.5.2 Results of the coding system

The coding system that was developed for the lexical, inflectional and agreement errors accounted for most of the errors produced by LS. There were some errors that the coding system did not account for. These errors were inflectional errors and agreement errors. More codes were added to account for types of errors. Amendments to the coding system is discussed in section 3.6.1 below.

3.5.3 Results of the test protocol

It was expected that the participants needed four sessions and each session required from 45 to 60 minutes. However, the participants in the pilot study completed each session within 20 to 30 minutes. This reflected that the number of sessions can be reduced and the time for each session can be shortened. Amendments to the test protocol are described below in section 3.6.2.

3.6 Discussion of the Pilot Study

The results of the control participant, where NR did not produce any error, helped to ensure the validity and the reliability of the test instrument. In other words, since NR did not produce any error, any error by LS is due to her agrammatism and not the test instrument. LS produced responses that were similar to the results obtained in previous studies on noun phrase production in agrammatism for speakers of non-Arabic languages. For example, Mondini et al (2005) examined the production of Italian noun phrases (prepositional compounds) and found that the production of noun phrase was mildly to severely impaired. Moreover, Herbert and Best (2010) tested the production of noun phrases (determiner plus noun) by an English speaker with agrammatism; the results of the case study showed that the participant's ability to produce noun phrase was impaired.

It was shown in lexical *no response* errors that the omission can affect either the head or the modifier and *no response* errors in head nouns were greater than the *no response* errors in the modifiers. This reveals that nouns in Arabic noun phrases may not be the first element in the syntactic tree although it may appear to be first on the surface.

LS was unable to name seven items in the *non-construct state subtest.* It should be noted that the syntactic tree of the non-construct state involves an imbedded determiner phrase (DP) that moves cyclically to check features from the above phrases, and therefore involves complex movement.

The production of F PL was very impaired. This was not reported in the few studies that have tested number and gender inflections (e.g. Luzzatti, 1996; Vigliocco & Zilli, 1999; Scarnà & Ellis 2010). The fact that the F PL is less common and M PL is usually produced for F PL forms in Saudi Arabic may explain the impaired production of the F PL in the current data.

The examples of the lexical errors in examples (15, 16 and 17) illustrate that lexical errors can occur in people with agrammatism. Lexical errors are common errors in the literature of agrammatism where most people with agrammatism exhibit some anomic features (Matzig, Druks, Masterson & Vigliocco, 2009).

3.6.1 Coding system amendment

More codes were added to account for inflectional and agreement errors. The codes that have been developed before for inflectional errors included number errors, gender errors, or definiteness errors. However, the inflectional errors were analysed in two stages based on the results from the pilot phase, and each stage had different codes. The first stage included the same codes that have been developed before and shown in Appendix K. The second stage of inflectional errors coding investigated the gender and number substitution errors specifically. The new codes for inflectional errors are presented in Appendix T.

The agreement errors have been coded before as *correct agreement, grammatical not target,* or *ungrammatical* (Appendix L). However, there were some errors in the pilot phase where agreement cannot be computed due to the omission of one of the lexical items and its inflections, or all the lexical items with their inflections. A code was added to account for this error type and is shown in Appendix T.

3.6.2 Test protocol amendment

One main aim of conducting the pilot study was to evaluate the test protocol. The time of the sessions, number of sessions and number of items in the sessions were amended based on the pilot study. It was expected that the test completion required four sessions and each session had to last from 45 to 60 minutes. However, each session was completed within 20 to 30 minutes. It was therefore possible to increase the number of test items in each session, and reduce the number of sessions accordingly. Instead of four sessions, the sessions were reduced to three sessions, and the test items in each session were increased to 30 items. As for the time of the sessions, the time was reduced to 30 to 45 minutes. The organisation of sessions that was used for completing the main experiment is described in detail in the following chapter.

3.7 Summary

The current chapter has presented the pilot phase conducted prior to the main phase of testing Arabic noun phrase production. The methodology and the results from the pilot study have been presented. Two participants were tested using subtests designed for testing noun phrase in Arabic. The results are in line with previous studies on testing noun phrase production in agrammatism among non-Arabic language speakers. The coding system and the test protocol were amended based on the pilot study. The next chapter shows the methodology used for testing Arabic noun phrases in agrammatism.

4. METHODS: MAIN EXPERIMENT

This chapter presents the methodology used for collecting the Arabic noun phrase data. It provides information about the participants, the materials, the research design, and the procedure followed for conducting the experiment.

4.1 Participants

Nine participants with agrammatism participated in the study.

4.1.1 Recruitment and ethics

Participants with aphasia were recruited from two hospitals in Riyadh: Sultan Bin Abdulaziz Humanitarian City (SBAHC) and King Fahad Medical City (KFMC). The participants were previous or current patients at the hospitals, and they were invited to participate by their allocated SLPs. Interested participants met the researcher and were given an information sheet. The participants were also allowed to ask for more information, and they each signed a consent form prior to commencing the study. The information sheet and the consent form of the pilot phase has been used for the main experiment and they are in Appendix O and Appendix P.

This study was ethically approved by three institutions. The study was first approved by the Departmental Ethics Committee at the Department of Human Communication Sciences at the University of Sheffield. It was also ethically approved by SBACH and KFMC which have their own ethics procedures. The ethical approval letters can be found in appendices Q, R and S.

4.1.2 Inclusion criteria

The inclusion criteria were the same criteria used in the pilot phase (see section 3.1.2).

4.1.3 Participants' details

The participants' details were obtained from their medical records with the assistance of the supervising SLT. Their details are summarised in Table 4.1 below.

Table 4.1: Participants with Agrammatism Background

N	Participant	Sex	Age	Hand	Time Post Onset in months	Hemiplegia	Aetiology	Location site	Education in years
1	**FA**	M	30	R	8	R	CVA	Left	12
2	**FE**	F	79	R	6	R	CVA	Left	6
3	**HA**	F	33	R	18	R	CVA	Left	16
4	**NO**	F	49	R	23	R	CVA	Left	6
5	**SA**	F	33	R	7	R	CVA	Left	16
6	**SI**	M	42	R	7	R	CVA	Left	16
7	**TA**	M	40	R	44	R	CVA	Left	16
8	**WA**	F	59	R	18	R	CVA	Left	14
9	**WI**	M	46	R	48	R	CVA	Left	12

Notes. M= male, F= female, R= right, CVA= cardiovascular accident.

4.2 Materials

The materials used in the main study were those described in Chapter Two. Furthermore, a set of Aphasia Assessment Subtests was used prior to commencing the main experiment. These subtests served to establish a profile for the participants' aphasia.

4.2.1 Aphasia assessment

The tests used to define the aphasia of each individual were selected from the Aphasia Assessment test (Alzahrani, 2003) used by SLTs in Riyadh for assessing aphasia in Arabic. The Aphasia Assessment test is an published test and it is an Arabic translation of selected assessments from the Western Aphasia Battery (WAB) (Kertesz,1982) and Boston Diagnostic

Aphasia Examination (BDAE) (Goodglass, Kaplan, Barresi, 2001) translated and adapted by Saadi Alzahrani. The test combines some of the subtests and items from the WAB and BDAE. The subtests and the items have been modified for cultural and linguistic purposes, such as replacing the Gregorian calendar in the WAB yes/no question subtest with the Islamic calendar. The test adopted the same scoring system of the WAB and the BDAE. The test does not include pictorial material, and so these have been added in the current study; also, there are no published Arabic norms for the developed test. It was not possible to adopt the norms provided by the WAB or BDAE because of the linguistic and cultural differences between Arabic and English and the several modifications that were done on the Arabic version. The test includes the following subtests:

- Spontaneous speech
- Auditory comprehension
- Simple and complex commands
- Word and phrase repetition
- Naming
- Sentence completion
- Verbal fluency
- Responsive naming
- Automatised sequence and recitation/ or melodic intonation
- Spoken letter/word to written letter/word matching
- Spoken words-written word matching
- Sentence reading and comprehension
- Picture stimulus- written word choice matching
- Writing

Table 4.2 shows the Aphasia Assessment subtests that were used for the current study.

Table 4.2: The Aphasia Assessment subtests used in the study

Modality	Name of subtest	Number of items
Cognition	Verbal fluency (animals)	1 task for 1 minute.
Receptive Language	Auditory comprehension	20
	Simple and complex commands	10
	Spoken word to picture matching	10
Expressive Language	Spontaneous speech task (interview)	6 questions
	Words & phrases repetition	15
	Naming of pictures	25
	Melodic intonation (*Surat Al-Fatiha– recitation of the Quran*)	1 chapter from the Quran with 7 verses (phrases/sentences)

All Aphasia Assessment stimuli consisted of free and payed pictures found over the internet. The pictures were coloured clipart images. All picture had white background and were with high resolution.

4.3 Design

4.3.1 Organisation of sessions

Test sessions and the items within sessions were organized in a way that voided priming of responses via previous exposure and ensured valid results. The testing consisted of three sessions with a period of two weeks minimum between the sessions. Each session lasted from 30 to 45 minutes. There were two to three Aphasia Assessment subtests and four to five noun phrase subtests in each session. The design of the administration of the tests is described in Table 4.3.

Table 4.3: Test sessions

Session	Name of test	Name of subtest	#Items
One	NP Test	Number & Gender Agreement (singular forms)	6
		Construct state	8
		Definiteness Agreement (definite forms)	12
		Non-construct	8
	Aphasia Test	Spontaneous speech task (interview)	6
		Auditory comprehension	10
		Simple and complex command	10
Two	NP Test	Number & Gender Agreement (singular forms)	6
		Construct State	8
		Definiteness agreement (indefinite forms)	3
		Non-construct	6
		Number & Gender Agreement (plural forms)	6
	Aphasia Test	Naming	25
		Spoken word to picture matching	10
Three	NP Test	Number & Gender Agreement (plural forms)	6
		Construct State	8
		Definiteness Agreement (indefinite forms)	3
		Non-construct	12
	Aphasia Test	Word & phrases repetition	15
		Verbal fluency (animals)	1
		Melodic intonation (*Surat Al-Fatiha)*	1

The noun phrase subtests were distributed across sessions based on the type of the subtest and the number of items in each session. That is, each session included parts from all the four developed subtests and the total number of noun phrase subtests items in each session was 29 to 34 items. Then, *the number and gender agreement subtest* and *the definiteness agreement subtest* were further distributed based on the condition, such as singular or plural and definite or indefinite. The Aphasia Assessment subtests were organised in order to assess a different language modality or aspect of language for each session.

4.4 Procedure

Assessment took place in clinic rooms at the SBAHC and KFMC in Riyadh. Appointments for the assessment sessions were arranged individually for each participant. Each participant was tested separately, and the participants' carers attended the session if they wished or the participant wished them to do so. The participants' medical history and details were taken from the carers and the responsible SLT in a session prior to the assessment session. The participant was not present during the collection of the medical history. All Data was collected by the researcher.

4.4.1 Test Administration

The procedure for each subtest in the noun phrase subtests and Aphasia Assessment subtests was explained to each participant prior to testing. Standardized instructions were used, and instructions were in Arabic. Each participant was given one demonstration item and two practice items; if the participant did not understand the task, further instructions and practice items were provided. The participant was informed that a break could be given when needed. The participant sat next to the researcher, and the researcher administered the tasks on the laptop.

4.4.1.1 Administration of Aphasia Assessment subtests.

The guidelines and instructions for the WAB (Kertesz,1982) were used for administering the Aphasia Assessment subtests. These guidelines and instructions have been translated into Arabic, along with the development of the Arabic version, by Alzharani (unpublished).

4.4.1.2 Administration of noun phrase subtests.

The administration of the noun phrase subtests followed the same administration procedures as used in the pilot phase. For all tests, the pictures were presented on a laptop screen (Dell Inspiron 15 3000) via PowerPoint (Microsoft Office, 2016). Each participant sat comfortably and was asked to name the picture that appeared on a white background. The presentation of the pictures was controlled by the researcher. The procedures for each subtest in NPS, as well as their instructions, were introduced in Chapter Three. A voice recorder application was used, as described in the pilot test.

4.4.2 Transcription and Coding of noun phrase subtests data

The responses were transcribed by the researcher in situ at the time of assessment using Arabic script. All responses were later transcribed using the international phonetic alphabet (IPA). The transcribed responses were entered into a data sheet. The data was then coded by the researcher using the coding system developed from the pilot phase and shown in Appendices J, K, L and T.

4.4.2.1 Reliability

20 % of the data was transcribed again by a linguist to check for transcription reliability. The sample included four to five responses from each of the four subtests taken form the data of five participants. The Inter-rater reliability was measured using percent agreement between raters method and the results yielded an agreement of 91%.

Inter-rater reliability of the coding was completed on 20% of the data by a second researcher. The second researcher was a native Saudi Arabic speaker, a linguist and familiar with coding spoken data. The second researcher coded the data independently. Similar to the sample taken for the transcription reliability, four to five responses were taken from each of the four subtests randomly form five participants' data. The results showed an agreement between raters that was greater than 85% with 93% agreement between them.

4.4.3 Transcription and scoring of aphasia assessment subtests data

The responses were transcribed by the researcher using Arabic script at the time of assessment. All responses were later scored by the researcher based on the scoring system provided by Alzahrani (unpublished) which was taken from the WAB and the BDAE. Data were analysed for severity of agrammatism.

4.4.3.1 Reliability

Transcription reliability was conducted by another linguist who transcribed 20 % of the data. The sample included two subtests, such as verbal fluency or naming of pictures, that were chosen randomly from each of the nine participants' data. Using percent agreement between raters method, the results yielded an agreement of 95%.

4.5 Summary

This chapter has presented the method used for collecting the NP data. The nine participants with agrammatism were tested using two different sets of materials. They were assessed using a set of Aphasia Assessment subtests to assess their aphasia. All participants then completed the set of four NP tests that were developed for the current study to test Arabic NP production in agrammatism.

The following chapters present the results of the study. Chapter Five lays the aphasia assessment results. The results of the linguistic subtests are provided in the subsequent chapters.

5. RESULTS OF THE APHASIA ASSESSMENT

This chapter presents the results of the aphasia assessment subtests. The chapter provides a description of the participants' aphasia syndrome and agrammatism.

The participants' medical history and the background information were provided by their speech language therapists based on the available language assessments as well as the neurologists' diagnosis. All participants were screened for inclusion criteria described in Chapter Four.

Aphasia was assessed using a set of language assessments available at clinics in Riyadh (Alzahrani, unpublished). Although the assessments provided scores, they were non-standardised assessments based on the Western Aphasia Battery (Kertesz,1982) and Boston Diagnostic Aphasia Examination (Goodglass and Kaplan, 1982). A description of the assessment was provided in Chapter Four (see section 4.2.1).

Prior to testing, all participants were diagnosed with fluent/non-fluent aphasia, except for TA who was diagnosed with both non-fluent aphasia and mild apraxia of speech. Participants' background details including sex, age, education, time post onset of stroke, aetiology and lesion site are in Chapter Four (4.1.3).

In the following, participants' aphasia is examined individually by describing the participant's fluency, severity and aphasia syndrome. A description of the participants' comprehension, repetition and naming is then provided followed by a description of the participants' agrammatism. The chapter concludes with a comparison among the participants' aphasia.

5.1 Aphasia fluency, severity and syndrome

Specific tasks form the Arabic version (Alzahrani, 2003) of the aphasia assessment have been selected for assessing participant's aphasia in the current study (see section 4.3.1). Most of the selected tasks form the Arabic version were based on the Western Aphasia Battery (WAB) (Kertesz,1982). WAB is a diagnostic tool for assessing linguistic and main non-linguistic skills in aphasia in adults. It provides information for the diagnosis of the aphasia syndrome besides identifying the aphasia lesion location. The tool is comprised of eight subscales: spontaneous speech, auditory verbal comprehension, repetition, naming and word finding, reading, writing, apraxia, constructional, visuospatial, and calculation tasks.

The Arabic version (Alzahrani, 2003) provided a scoring system and a translation of the guidelines and instructions. However, the methodology and the criteria for analysis of results were not provided. In the current study, determining aphasia fluency, severity and syndromes followed the same methodology and criteria established by the WAB (Kertesz,1982).

Fluency was determined by the results obtained from the interview task. The interview task consisted of six interview questions which were a translation of the interview questions in the WAB. Similar to the WAB (Kertesz,1982), responses in the current study were scored based on analysis of information content and analysis of fluency, grammatical competence, and paraphasias. For each participant, the proportion of the participant's score in the interview task was calculated, then the proportion was multiplied by 10. All results less than 4 were considered non-fluent aphasia, results above 4 were fluent.

Severity in the current study was measured by the sum of all subtest scores from the first part of the test similar to the WAB (Kertesz,1982). Then, the percentage of the sum was calculated and compared against the WAB criteria. Table 5.1 presents the WAB criteria for determining severity level.

5.1: Analysis of severity based on WAB

Score	Severity
0-25	Very severe
26-50	Severe
51-75	Moderate
76+	Mild

As for syndromes classification, the sum of the scores in each of the fluency, comprehension, repetition and naming tasks was calculated separately similar to the WAB (Kertesz,1982). The proportion of each sum result was calculated and then multiplied by 10. The results were checked against the criteria for classification of syndromes by WAB. These criteria are presented in Table 5.2.

5.2: Syndromes classification according to WAB

	Fluency	Comprehension	Repetition	Naming
Global	0 – 4	0 – 3.9	0 – 4.9	0 – 6
Broca's	0 – 4	4 – 10	0 – 7.9	0 – 8
Isolation	0 – 4	0 – 3.9	5 – 10	0 – 6
Transcortical Motor	0 – 4	4 – 10	8 – 10	0 – 8
Wernicke's	5 – 10	0 – 6.9	0 – 7.9	0 – 9
Transcortical Sensory	5 – 10	0 – 6.9	8 – 10	0 – 9
Conduction	5 – 10	7 – 10	0 – 6.9	0 – 9
Anomic	5 – 10	7 – 10	7 – 10	0 – 9

Table 5.3 demonstrates the participants' aphasia fluency, severity and syndrome based on the language assessment in Table 5.4.

Table 5.3: Participants' Aphasia fluency, severity and syndromes

Participant	Fluency	Aphasia Quotient	Syndrome
FA	fluent	moderate	Conduction
FE	Non-fluent	severe	Broca's Aphasia
HA	Non-fluent	moderate	Broca's Aphasia
NO	fluent	moderate	Conduction
SA	fluent	mild	Anomic
SI	Non-fluent	moderate	Broca's Aphasia
TA	Non-fluent	severe	Broca's Aphasia
WA	fluent	mild	Anomic
WI	Fluent	mild	Anomic

5.2 Participants' comprehension, repetition and naming ability

The participant's scores in comprehension, repetition and naming tasks were analysed.

FA was a fluent speaker with moderate conduction aphasia. He made few errors in sequential commands task and in yes/no question task due to structural complexity of utterances. He made an error in spoken words to picture matching task resulted from choosing a picture with a morphological distractor. FA reflected impairments in repetition task in repeating long and complex phrases. In terms of naming ability, FA made two no response errors and one semantic error. His performance in the verbal fluency task was very impaired, while his performance in the melodic intonation task was fairly spared.

FE's aphasia assessment results showed that she was a non-fluent speaker with severe Broca's aphasia. She made few errors in sequential commands task and yes/no questions resulted from difficulty in comprehending long and complex structures. She made errors in spoken words to picture matching and they consisted of two errors due to phonological distractors and one error due to a semantic distractor. FE reflected poor repetition ability when asked to repeat utterances with multiple phrases more than two. She also showed impairments in naming ability. In

Table 5.4: Results of the language assessments

Category	Task	n	Participants								
			FA	FE	HA	NO	SA	SI	TA	WA	WI
Fluency	Interview question	6	0.7	0.4	0.4	0.6	0.6	0.3	0.2	0.9	0.6
Comprehension	Sequential commands	10	0.6	0.5	0.9	0.9	1.0	0.6	0.8	1.0	0.9
	Yes/no questions	20	0.8	0.6	0.9	0.8	0.9	0.9	0.8	0.9	1.0
	Spoken words to picture matching	10	0.9	0.5	1.0	0.7	1.0	0.9	0.9	1.0	0.9
Repetition	Repetition of words and phrases	15	0.5	0.3	0.4	0.5	0.9	0.3	0.1	0.9	0.9
Naming	Naming of picture	25	0.8	0.4	0.9	1.0	0.9	0.9	0.4	0.9	0.9
	Animal naming fluency	-	0.2	0.1	0.2	0.2	1.0	0.3	0.0	0.7	0.6
	Melodic intonation	-	1.0	1.0	1.0	1.0	1.0	1.0	0	1.0	1.0

Not e. All scores represent % correct.

picture naming task, FE made nine no response errors. In the verbal fluency, her performance was severely impaired. FE performed well in the melodic intonation task.

HA was also a non-fluent speaker with Broca's aphasia. Her aphasia was moderate as reflected in her aphasia assessment results. HA's results in comprehension tasks indicated that she had a fairly intact comprehension. In contrary, her repetition was very impaired where she repeated only simple non-complex phrases were not able to repeat full sentences. Her naming ability was slightly impaired. In the naming of picture task, HA made three semantic errors. She showed a poor performance in the verbal frequency task and performed the melodic intonation task very well.

NO was a fluent speaker with moderate conduction aphasia. She made few comprehension errors in sequential commands and other errors in yes/no question task. In spoken words to picture matching task, NO's errors were due to visual distractors. NO's performance in repetition task involved some errors. In terms of naming ability, she made two no response errors and one semantic error. Her performance in the verbal fluency was very impaired, while her performance in the melodic intonation task was spared.

SA results showed that she was a fluent speaker with mild anomia. SA performed fairly well in all comprehension tasks. She made only one error in yes/no question task. SA was unable to repeat few sentences with complex syntax. Her naming ability reflected that she had an intact naming. She made only one phonological error in the naming of pictures task. In addition, SA performed very well in the verbal fluency and melodic intonation tasks.

SI had a non-fluent type of aphasia reflecting a moderate Broca's aphasia. SI's performance in the comprehension tasks indicated that he had a fairly intact comprehension. In contrary, he reflected impairments in repetition task where he repeated only simple phrases and was unable to repeat full sentences. His performance in the naming tasks included some errors. In the naming of picture task, he made one semantic and two no response errors. He showed an impaired performance in the verbal frequency task and an intact performance in the melodic intonation.

TA results showed that he was a non-fluent speaker with sever Broca's aphasia. TA reflected a fair comprehension ability in all comprehension tasks. However, TA's repetition was severely impaired. He was able to repeat single words and few phrases. He also made many errors in naming tasks. In picture naming task, TA made four no response errors, one semantic error and two phonological errors. In both the verbal fluency task and the melodic intonation task, TA's performance was severely impaired.

WA was a fluent speaker showing a mild a anomia. WA's performed fairly well in all comprehension tasks. Her repetition ability was fairly intact. WA made some errors in naming tasks. In picture naming task, WA made two semantic errors. Her performance in the verbal fluency was impaired. WA's performance in the melodic intonation task was spared.

Lastly, WI's performance in the aphasia assessment indicated that he was a fluent speaker with mild anomia. WI's comprehension was fairly intact. In Spoken words to picture matching, he made one error by choosing a semantic distractor. WI's reflected a fair repetition ability. In naming tasks, WI made only one semantic error in naming of pictures task. His performance in the verbal fluency was impaired whereas it was spared in the melodic intonation task.

This section has presented the results of the participant's scores in comprehension, repetition and naming tasks. The results demonstrated that the participants had varying degrees of impairments. The performance of the participants HA, SA, SI, TA, WA and WI reflected a relatively intact comprehension compared to the performance of the participants FA, FE and NO who made several comprehension errors. Only the participants SA, WA and WI had a fairly intact repetition ability. All other participants had difficulty with repetition of full long phrases and full sentences. The results of the naming ability indicated a slightly impaired naming ability in FA, HA, NO, SI, WA and WI. Naming in FE and TA was very impaired. SA had reflected an intact naming ability.

5.3 Participants' agrammatism

Participants' agrammatism was analysed. Participants' expressive language production in the interview task was analysed first in order to describe their agrammatic production. Agrammatic comprehension was then determined through the analysis of the comprehension of syntactic structure in sequential commands and yes/no question tasks.

The guidelines and criteria for the analysis of the interview task were based on WAB (Kertesz,1982). An extract from the responses of each participant is given. Pause length is shown in brackets. All participant's responses to the interview questions are presented with a gloss, and a translation of each turn is provided. The following extract presents a sample of FA's interview with the researcher (SH).

Extract 5.1: A sample of FA's answers in the interview task

SH: Where do you live?

FA: /rawdah (1) rawabi/

[feminine singular noun - feminine singular noun]

'rawdah (1) rawabi'

SH: Tell me a little why you are here? Or what seems to be the trouble?

FA: /ʔnjmja manʤlijah (2) wa ʤaltˤah/

[feminine singular noun - feminine singular noun - conjunctive particle - feminine singular noun] ‘sickle-cell amimia (2) and stroke’

FA’s expressive language was effortful and contained pauses. His speech was characterised by the use of simplified syntax; single words and two-word phrases formed the vast majority of his utterances. He used content words, mainly nouns, and few grammatical markers. FA’s production did not include any syntactic errors; however, he did not produce complex structures such as full sentences or passive constructions. FA’s responses were also interrupted by word finding difficulties.

As for comprehension of syntax, FA performed simple commands, and made few errors in comprehending complex commands with more than three arguments in sequential commands task. In the yes/no question task, he made a few errors resulting from difficulties in comprehending questions with passive constructions. Based on the analysis of these production and comprehension tasks, it can be seen that FA had agrammatic production and comprehension (Basso, 2003; Caramazza & Berndt, 1985; Saffran, Berndt & Schwartz, 1989).

Next, FE’s responses were analysed. A sample of these responses can be seen in Extract 5.2.

Extract 5.2: A sample of FE’s answers in the interview task

SH: How are you?

FE: /wa:llah im (12) wa:llah maʕa:lai/

[filler- im –filler – adverb]

‘well im (12) well fine’

SH: Have you been here before?

FE: /i:h (3) ʔna tinawa:mit/

[interjection – pronoun – past tense verb] ‘yes (3) I was’

SH: Where do you live?

FE: /i:h sakinah ba (14) ʔna saknitin (5) bi baiti ʤanu:b errijad/

[pronoun – present tense verb - phonological paraphasia - pronoun – present tense verb – preposition – singular masculine noun – adjective – singular masculine noun]

‘ yes I live in [phonological paraphasia] (14) I live (5) in my house, south Riyadh’

FE’s speech was non-fluent and effortful, containing fillers and pauses. Her speech contained paraphasia and her phrases were interrupted by word finding difficulties. FA used single words and short phrases and was able to produce a full sentence with simple syntax.

An analysis of FE’s agrammatic comprehension in the sequential commands task showed that she was able to comprehend simple and short structures. She had difficulty in comprehending long and complex structures with embedded clauses. In yes/no questions, FE made errors in comprehending passive constructions. It can be seen from the analysis of these features that FE had agrammatic production and comprehension (Basso, 2003; Caramazza & Berndt, 1985; Saffran, Berndt & Schwartz, 1989).

HA’s interview was examined. Extract 5.3 presents a sample of her responses.

Extract 5.3: A sample of HA’s answers in the interview task

SH: How are you?

HA: /ʔalħamdu lila:h (5) i:h i:h (4) maθalan (2) ʔah eljad (5) wi ʔrriʤil (12) maθalan (9) ʔah im im (2) ʔah(1) ʃismah/

[singular masculine noun - singular masculine noun – interjection – interjection – filler-ah – singular feminine noun- conjunction- singular masculine noun – filler – ah- im im – ah – adverb- singular masculine noun] ‘thanks to Allah (5), yes, yes (4) for example (2) ah the hand (5) and the leg (12) for example (9) ah im im (2) ah (1) what is it’

SH: Have you been here before?

HA: /i:h (13) qbil sabiʕ ʃuhu:r /

[interjection - adverb- adjective – plural feminine noun]

‘yes (13) seven months ago’

HA’s expressive language was non-fluent and effortful. Her speech contained many pauses and fillers. HA used content words mainly nouns and few phrases. Her phrases had simplified syntax and contained few grammatical markers. She did not produce any full sentences or complex structures. HA’s speech reflected word finding difficulties.

The analysis of HA’s responses in sequential commands and yes/no questions showed that HA made very few errors in comprehending difficult structures such as sentences with more than three arguments. It can be seen that the analysis of HA’s interview sample and revealed that HA had agrammatic production. However, HA’s responses in the comprehension tasks did not reflect features of agrammatic comprehension (Basso, 2003; Caramazza & Berndt, 1985; Saffran, Berndt & Schwartz, 1989).

The responses of NO were then examined. A sample of the responses can be seen in Extract 5.4.

Extract 5.4: A sample of NO’s answers in the interview task

SH: Where do you live?

NO: /fi: ʔaljamamah/

[preposition – feminine singular noun]

'in alyamamah'

SH: Tell me a little why you are here? Or what seems to be the trouble?

NO: /ʕaʃan ʔalmuxatˁabah/

[conjunction -feminine singular noun]

'because of communication'

NO's speech was effortful and included fillers. NO used simplified syntax. Her speech was characterised by few grammatical markers and by use of content words and short, simple phrases, mainly noun phrases. Her production did not include syntactic errors but complex structures such as full sentences or passive constructions were not present in her speech.

AS for NO's agrammatic comprehension, errors reflected her inability to comprehend utterances with complex argument structures, such as structures with more than two arguments. However, her errors were very few. These features, as seen in her interview sample and comprehension of syntax tasks, reflected that NO had agrammatic production and some aspects of agrammatic comprehension (Basso, 2003; Caramazza & Berndt, 1985; Saffran, Berndt & Schwartz, 1989).

Next, agrammatic features were investigated in SA's responses. A sample of her speech is in Extract 9.5.

Extract 5.5: A sample of SA's answers in the interview task

SH: Where do you live?

SA: /bi ʔssuwaydi/

[prepositin – singular feminine noun]

'in asswaidi'

SH: Tell me a little why you are here? Or what seems to be the trouble?

SA: /ʕaʃan ah um ʔtʕaladʒ min ʔaldʒaltˤah/

[conjunction – ah – um – future tense verb – pronoun- singular feminine noun]

'because ah um I get treatment for the stroke'

SA' s expressive language was fluent and effortful. It is characterised by simplified syntax and use of few grammatical markers. SA used phrases and sentences, but she did not use complex structures. SA showed some word finding difficulties.

The analysis of SA's responses in the sequential commands and yes/no questions indicated that SA had a fairly intact comprehension. She made only one error in yes/no question task. This error did not include a complex syntactic structure. It can be seen that SA had some features of agrammatic production only (Basso, 2003; Caramazza & Berndt, 1985; Saffran, Berndt & Schwartz, 1989).

The interview responses by SI were then analysed. Extract 5.6 provides a sample of his speech.

Extract 5.6: A sample of SI's answers in the interview task

SH: Where do you live?

SI: /ʔssalam/

[singular feminine noun]

'assalam'

SH: Tell me a little why you are here? Or what seems to be the trouble?

SI: /ʤaji:n (5) ʤaji:n (7) ah (2) ʔaltˤabi:b /

[present tense verb - present tense verb – ah - singular feminine noun]

'we come (5) we come (7) ah (2) communication'

SI's speech was non-fluent and effortful and included pauses. FA showed very simplified syntax. He used single words mainly content words and did not use more complex structures such as phrases or sentences. His speech indicated some word finding difficulties.

SI made errors in sequential commands task due to the complex structure that included embedded clauses. For the yes/no question task, SI made one error only, and this error was not due to a complex syntax. These features in both production and comprehension reflected that SI had agrammatic production and some aspects of agrammatic comprehension (Basso, 2003; Caramazza & Berndt, 1985; Saffran, Berndt & Schwartz, 1989).

TA's agrammatic features were examined in his responses in the interview task. A sample of his speech is shown in Extract 5.7.

Extract 5.7: A sample of TA's answers in the interview task

SH: Have you been here before?

TA: /ʔuh (14) ʔuh/

[audible breath- audible breath]

'oh (14) oh'

SH: Where do you live?

TA: /er (5) rijad/

[phonological paraphasia- singular masculine noun] ‘[phonological paraphasia] (5) Riyadh’

TA’s speech was non-fluent and very effortful containing pauses. His speech did not include phrases and he used only single words mainly nouns. TA’s speech included phonological paraphasias. TA’s sample indicated that he had agrammatic production (Basso, 2003; Caramazza and Berndt, 1985; Saffran, Berndt and Schwartz, 1989).

As for TA’s agrammatic comprehension, the analysis showed that errors were very few and they were due to difficulty in comprehending structures with more than two arguments. It can be seen based on the interview sample and the comprehension of syntax tasks that TA had agrammatic production and some aspects of agrammatic comprehension (Basso, 2003; Caramazza & Berndt, 1985; Saffran, Berndt & Schwartz, 1989).

An analysis of agrammatic features was then conducted for WA’s speech. A sample of his responses in the interview task is shown in Extract 5.8.

Extract 5.8: A sample of WA’s answers in the interview task

SH: Where do you live?

WA: /bi ħajil/

[preposition – singular feminine noun]

‘in Ha’il’

SH: Tell me a little why you are here? Or what seems to be the trouble?

WA: /mitragdah (2) ʕaʃan (2) ʔalʤaltˁah/

[present tense verb – interjection – singular feminine noun]

'I am being in hospital (2) because of (2) the stroke'

WA's speech was fluent. WA used phrases and full sentences with simple syntax. She showed the ability to use passive construction. However, her speech was very slow and contained pauses. WA did not reflect word finding difficulties.

In comprehension, WA made only one error in the yes/no question task. This error was not due to syntactic complexity. It can be seen that WA had some features of agrammatic production only (Basso, 2003; Caramazza & Berndt, 1985; Saffran, Berndt & Schwartz, 1989).

Lastly, WI's responses were analysed for agrammatism. Extract 5.9 demonstrates a sample of his responses.

Extract 5.9: A sample of WI's answers in the interview task

SH: Have you been here before?

WI: /marah (1) ʕamaljah (1) ʤiraħah (2) ah ah xalas minha jumi:n (2) ʔaw θalaθ ah ju:m/

[adverb - singular feminine noun- singular feminine noun- ah- ah- past tense verb – preposition- adjective- preposition- adjective- singular masculine noun]

'once (1) operation (1) surgery (2) ah ah I finish form it two days (2) or three day'

SH: Where do you live?

WI: /wal:a:h bagi alħin ana fi: algasi:m/

[filler – adverb- adverb- pronoun- preposition- single masculine noun]

'well still now I am in Qassim'

WI's expressive language was telegraphic. His speech contained short pauses and filler. It was characterised by the use of simplified syntax; single words and short phrases formed the vast majority of his utterances. WI also used few grammatical markers. He showed some ungrammatical structures resulting from disagreement between adjectives and nouns.

As for agrammatic comprehension, WI made only one error in the sequential commands task. WI was not able to perform a command with complex syntax. The analysis of WI's interview and comprehension tasks indicated that he had agrammatic production only (Basso, 2003; Caramazza & Berndt, 1985; Saffran, Berndt & Schwartz, 1989).

This section has presented the findings from the interviews, sequential commands and yes/no questions tasks conducted with the participants to discover their level of agrammatism. Overall, features of agrammatic production were present in all participants, although participants differed with regard to the number of features that appeared in their speech. This reflected that the degree of agrammatism production severity varied among the participants. As for agrammatic comprehension, the features were not present in all participants; and when they were present, they varied in degree of severity.

5.4 Classification of participants based on severity of Aphasia

Z-scores were computed for raw scores of the language assessments data set. Table 5.5 shows the results of the Z-scores.

Table 5.5: Z-scores of the results of the language assessments

Subtest	FA	FE	HA	NO	SA	SI	TA	WA	WI
Interview question	0.65	0.34	0.34	0.58	0.58	-0.89	-1.5	1.87	0.58
Sequential commands	-0.86	-1.81	0.69	0.69	0.89	-0.86	-0.21	0.89	0.69
Yes/no questions	-0.16	-2.28	0.69	-0.16	0.69	0.69	-0.16	0.69	1.12
Spoken words to picture matching	0.11	-2.26	0.78	-0.91	0.78	0.11	0.11	0.78	0.11
Repetition of words and phrases	-0.22	-0.68	-0.48	-0.22	1.19	-0.68	-1.44	1.17	1.36
Naming of picture	-0.13	-1.71	0.28	0.81	0.75	0.34	-1.66	0.57	0.75
Animal naming fluency	-0.39	-0.86	-0.39	-0.55	1.93	-0.24	-1.17	1	0.69
Melodic intonation	0.33	0.33	0.33	0.33	0.33	0.33	-2.66	0.33	0.33

Z-scores reflected that participants fell into two groups: a group (Group I) with the participants SA, WA and WI whose scores were above average in most subtests, and another group (Group II) that included all other participants with scores below average in either all or most of the subtests.

The difference between Group I and Group II was statistically tested. Due to the small size of the sample, the non-parametric Mann- Whitney test was used to test for significant difference. Table 9.6 shows the mean and the standard deviations for Group I and Group II scores within and across subtests. The results of Mann- Whitney is in Table 9.7.

Table 5.6: Mean and the standard deviations for groups' scores in language assessments

Test/Subtest	Group	N	Mean	Std. Deviation
Interview questions	group I	3	10.67	2.89
	group II	6	6.50	2.59
Sequential commands	group I	3	98.67	2.31
	group II	6	73.83	19.63
Yes/no questions	group I	3	58.00	1.73
	group II	6	49.17	6.91
Spoken words to picture matching	group I	3	19.33	1.15
	group II	6	16.83	3.31
Repetition of words and phrases	group I	3	92.33	3.21
	group II	6	35.83	13.69
Naming of picture	group I	3	73.00	1.73
	group II	6	55.33	18.40
Animal naming fluency	group I	3	15.33	4.16
	group II	6	3.67	2.25
Melodic intonation	group I	3	2.00	0.00
	group II	6	1.67	0.82
Total (across subtests)	group I	3	369.33	3.21
	group II	6	242.83	51.67

Table 5.7: Mann- Whitney results for the difference between groups' scores within and across language assessments

Test/Subtest	Group	N	Mean rank	Sum of ranks	*z. value*	p. value
Interview questions	group I	3	10.67	2.89	1.583	0.114
	group II	6	6.50	2.59		
Sequential commands	group I	3	98.67	2.31	2.213	0.027*
	group II	6	73.83	19.63		
Yes/no questions	group I	3	58.00	1.73	2.343	0.019*
	group II	6	49.17	6.91		
Spoken words to picture matching	group I	3	19.33	1.15	1.336	0.181
	group II	6	16.83	3.31		
Repetition of words and phrases	group I	3	92.33	3.21	2.343	0.019*
	group II	6	35.83	13.69		
Naming of picture	group I	3	73.00	1.73	1.556	0.120
	group II	6	55.33	18.40		
Animal naming fluency	group I	3	15.33	4.16	2.334	0.020*
	group II	6	3.67	2.25		
Melodic intonation	group I	3	2.00	0.00	0.707	0.480
	group II	6	1.67	0.82		
Total	group I	3	369.33	3.21	2.334	0.020*
	group II	6	242.83	51.67		

Note. * refers to p</= 0.05

Table 5.7 shows that there were no statistically significant differences between average scores of Group I and Group II in interview question, spoken words to picture matching, naming of picture, and melodic intonation task. However, there were statistically significant differences between the two groups in sequential commands, yes/no questions, repetition of words and phrases, and animal naming fluency task. In addition, the difference between the scores of the two groups across subtests was statistically significant. The results of the main experiment by

Group I and Group II were analysed separately. This independent analysis helps for a better description and illustration of the language deficit in SA.

5.5 Summary

The chapter has presented the results of the aphasia language assessments. The aphasia syndromes and agrammatism have been described. Participants had varying degrees of impairments across subtests. Participants were classified into two groups based on their scores: Group I with mild aphasia and Group II with severe to moderate. Although statistically significant differences were not shown within all subtests, the difference between the two groups across subtests was statistically significant.

The results of the two groups in *The Number and Gender Agreement Subtest* are shown in the next chapter.

6. RESULTS OF NUMBER AND GENDER AGREEMENT SUBTEST

The group results in the four linguistic subtests are presented in Chapter Six through Chapter Nine. The participants were divided into two groups: Group I which included three participants with mild aphasia and Group II that consisted of six participants who showed moderate to severe aphasia. Group assignment is described in Chapter Five. In each data chapter there are two sections: analysis of Group I (participants with mild aphasia) and analysis of Group II (participants with moderate to severe aphasia). In the analysis of Group I section, the overall accuracy of the group is first shown then each participant's errors were presented separately. In the analysis of Group II section, the group's overall accuracy is presented then the errors made by Group II were classified into inflectional, agreement and lexical errors.

The group results in the first subtest, the *Number and Gender Agreement Subtest*, are shown in this chapter. The subtest required producing a noun and an adjective that agreed in number and gender inflections (*N+Infl & Adj+Infl*). Chapter Two provides details about the structure of the noun phrase, the categories and the number of items in the *Number and Gender Agreement Subtest*.

All the data presented in this chapter were non-normally distributed. The non-parametric alternative to the one-way ANOVA with repeated measure Friedman's ANOVA test was used to test for differences between the categories, M SG, F SG, M PL and F PL. The comparison of paired categories such as masculine versus feminine, were conducted using Wilcoxon two-sample tests and two-tailed values of p are reported throughout. One-sample chi-square was used to evaluate categorical differences in nominal variables having two or more independent categories such as correct versus incorrect responses or semantic versus phonological errors.

6.1 Group I overall accuracy

The overall accuracy of Group I was first analysed. Table 6.1 demonstrates the correct responses produced by Group I.

Table 6.1: Group I correct responses

Participant	M SG (N-M.SG + Adj-M.SG) **(n=6)**	F SG (N-F.SG + Adj-F.SG) **(n=6)**	M PL (N-M.PL + Adj.M.PL) **(n=6)**	F PL (N-F.PL + Adj-F.PL) **(n=6)**
SA	5	6	6	6
WA	6	6	6	5
WI	6	6	5	5
Total	**17/18**	**18/18**	**17/18**	**16/18**

It can be seen from the Table 6.1 that Group I made four errors in total.

6.2 Group I errors analysis

Errors produced by Group I were then analysed. Analysis of errors involved the types of the lexical, inflectional and agreement errors. Coding of the lexical, inflectional and agreement errors are in Appendix J, Appendix K, Appendix L and Appendix T.

The participant SA made one *phonologically related non-word* (PRNW) error in the M SG. WA made three errors. WA made one inflectional error in the F PL category where the adjective F PL inflection was substituted with a M PL inflection. The substitution of the F PL with the M PL resulted in *ungrammatical* error where the adjective inflection disagreed with the noun inflection. WI made also three errors. WI made one PRNW error in the M PL and one inflectional substitution error of the adjective F PL inflection with a M PL inflection. The inflectional substitution resulted in an *ungrammatical* error.

It can be seen that lexical errors made by Group I were only two errors and they were both PRNW error type. In addition, inflectional errors made up only two errors, and they both occurred in the F PL category and involved the substitution of the adjective F PL inflection with a M PL inflection. For example, WI produced *mumariðʕ-a:t zaʕla:n-ni:n* (nurse-F.PL angry-M.PL) for *mumariðʕ-a:t zaʕla:n-a:t* (nurse-F.PL angry-F.PL). It can also be seen that inflectional errors are present in the F PL only. The agreement errors were only two errors, and both were *ungrammatical* errors type due to wrong assignment of adjective inflection.

6.2.1 Summary of group I errors

The overall accuracy data revealed that there were only four errors that Group I produced. The analysis of errors showed that errors involved two PRNW lexical errors and two inflectional substitution errors consisting of substituting the F PL with M PL inflection which is a gender substation error. There were two *ungrammatical* errors resulted from wrong adjective inflections.

6.3 Group II overall accuracy

The first analysis of Group II results targeted the overall accuracy of all the participants in the group as shown in Table 6.2.

Table 6.2: Group II correct responses

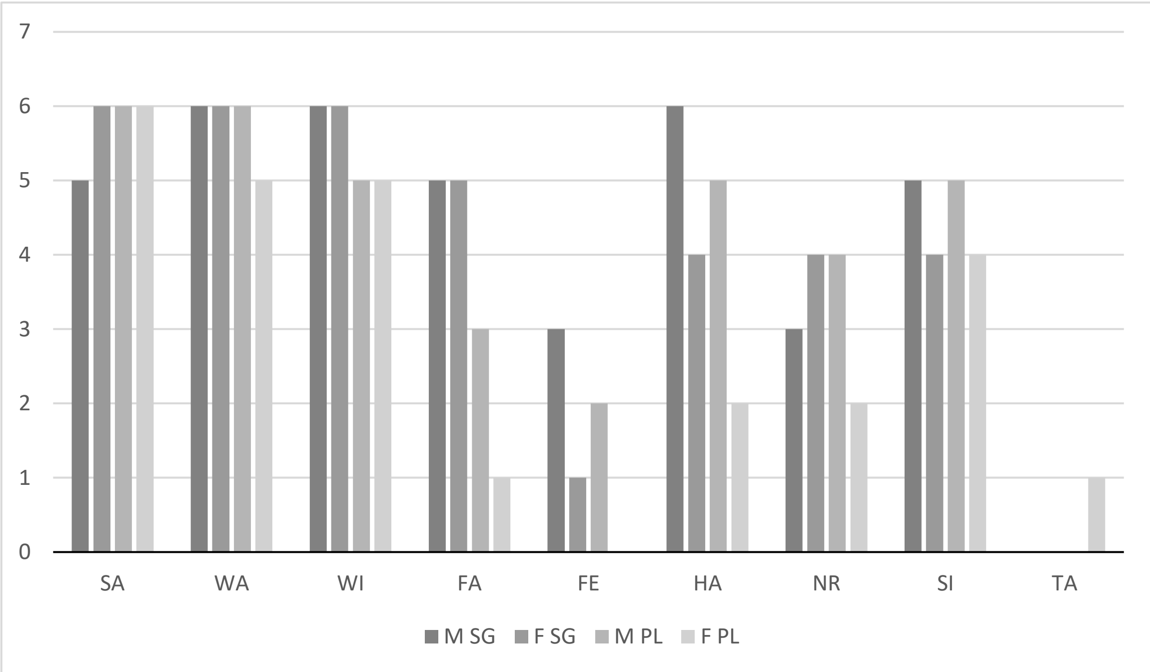
Participant	M SG (N-M.SG + Adj-M.SG) **(n=6)**	F SG (N-F.SG + Adj-F.SG) **(n=6)**	M PL (N-M.PL + Adj.M.PL) **(n=6)**	F PL (N-F.PL + Adj-F.PL) **(n=6)**
FA	5	5	3	1
FE	3	1	2	0
HA	6	4	5	2
NR	3	4	4	2
SI	5	4	5	4
TA	0	0	0	1
Total	**22/36**	**18/36**	**19/36**	**10/36**

It can be seen in the above table that the F PL category was the most impaired category.

The non-parametric Friedman's ANOVA test was used to test for significant differences between the categories, M SG, F SG, M PL and F PL. The statistical analysis using Friedman's ANOVA Test was not significant (χ^2 (3) =5.83, p=0.1203).

Group I and Group II overall accuracy data were compared. The data are shown in Figure 6.1

Figure: 6.1: Overall Accuracy of Group I (SA, WA and WI) and Group II (FA, FE, HA, NR, SI and TA) in the number and gender agreement subtest



The above graph illustrates that there was an overlap between the two groups. For example, FA from Group II performed similarly to SA from Group I in the M SG condition. HA from Group II also performed similarly to WA and WI from Group I in the M SG. In addition, HA and SI's performance was similar to WI's performance in the M PL.

Pearson's chi-square was used to analyse the overall accuracy data of both Group I and Group II. The correct and the incorrect responses by each group were analysed for each category. The analysis showed insignificant difference between the correct and the incorrect responses in the M SG category (X^2 (1) = 6.646, p = 0.010). However, the difference was significant in the F

SG condition (X^2 (1) = 13.500, p = 0.000), the M PL condition (X^2 (1) = 9.575, p = 0.002) and the F PL condition (X^2 (1) = 17.951, p = 0.000).

Table 6.4 and Table 6.5 shows the overall accuracy of Group II based on number and gender to determine whether there is a number or gender effect. As the tables show, feminine was more affected than masculine (Table 6.3) and plural was more affected than singular (Table 6.4). This was similar to data from Group I.

Table 6.3: Group II overall gender accuracy

Participant	Masculine **(n=12)**	Feminine **(n=12)**
FA	8	6
FE	5	1
HA	11	6
NR	7	6
SI	10	8
TA	0	1
Total	**41/72**	**28/72**

Table 6.4: Group II overall number accuracy

Participant	Singular **(n=12)**	Plural **(n=12)**
FA	10	4
FE	4	2
HA	10	7
NR	7	6
SI	9	9
TA	0	1
Total	**40/72**	**29/72**

Differences between masculine and feminine and singular and plural were statistically analysed using the non-parametric Wilcoxon two-sample test. The result of the statistical analysis based on Wilcoxon revealed no significant difference in accuracy between masculine and feminine targets (z= -1.897, two tailed *p*=0.58), and no significant difference in accuracy between singular and plural targets (z= -1.625, two tailed *p*=0.104).

All the insignificant results above may be due to small sample sizes. In addition, there is a large variation within the sets. This can be seen in the performance of FE and TA which was different from the performance of the other participants in the same group.

6.3.1 Summary of Group II overall accuracy

The overall accuracy data for Group II show that the F PL was the most impaired category. The difference between the correct and the incorrect responses by each group was statistically significant in all categories except for the M SG category. In addition, the data show that there was higher accuracy for masculine than for feminine and for singular than for plural forms. This was also found in data of Group I.

6.4 Group II error analysis

The errors produced by Group II were analysed across participants. The inflectional, agreement and lexical errors produced by Group II were analysed separately.

6.4.1 Inflectional errors

The first error analysis concerned the noun and adjective inflectional errors. Noun and adjective inflectional errors consisted of *substitution of gender*, *substitution of number* and *substitution of number and gender*. Coding of inflectional errors is in Appendix K and Appendix T. Table 6.5 and Table 6.6 show the inflectional errors in nouns whereas Table 6.7 and Table 6.8 illustrate the inflectional errors that affected the adjectives.

Table 6.5: Group II noun inflectional errors irrespective of lexical errors

Type of response	**M SG** (N-M.SG) (n=36)	**F SG** (N-F.SG) (n=36)	**M PL** (N-M.PL) (n=36)	**F PL** (N-F.PL) (n=36)
Correct noun inflections	33	30	27	20
Substitution of gender	3	6	2	9
Substitution of number	0	0	7	6
Substitution of gender & number	0	0	0	1
Total	36	36	36	36

As can be seen in Table 6.5, the singular form inflections were more preserved than the plural form inflections, and substitution of gender errors were found in both masculine and feminine forms, but they were more prevalent in feminine forms. It can also be seen that there were more errors of gender than of number. The data in the table also show that the M SG was the least affected category whereas the F PL was the most affected category.

One sample chi-square test was used for noun inflectional errors to test for significant difference between the errors *substitution of gender*, *substitution of number* and *substitution of number and gender*. The statistical analyses using one sample chi-square revealed significant results (χ^2 (2) = 16.294, p=.000).

Table 6.6 shows the type of noun inflectional errors by looking at the type of inflectional substitution.

Table 6.6: Group II types of noun inflectional errors

Type of substitution	**M SG** (N-M.SG) (n=36)	**F SG** (N-F.SG) (n=36)	**M PL** (N-M.PL) (n=36)	**F PL** (N-F.PL) (n=36)
Substitution with M SG	-	6	7	1
Substitution with F SG	3	-	0	9
Substitution with M PL	0	0	-	6
Substitution with F PL	0	0	2	-

The table illustrates that substitution with M SG was prevalent whereas substitution with F PL was rare. It can also be seen that substitution with the less inflected form was common. That is, Group II tended to substitute the F SG with M SG, M PL with M SG and F PL with F SG. Group II substituted the M SG with the F SG and the M PL with the F PL; however, this type of substitution was uncommon.

The types of noun inflectional substitution errors were analysed using one sample chi-square tests. One sample chi-square showed significant differences between the types of noun inflectional substitution errors (χ^2 (3) = 8.588, p=.035).

Adjective inflectional errors were also investigated. The data are presented in Table 6.7 and Table 6.8.

Table 6.7: Group II adjective inflectional errors irrespective of lexical errors

Type of response	M SG (Adj-M.SG) (n=36)	F SG (Adj-F.SG) (n=36)	M PL (Adj-M.PL) (n=36)	F PL (Adj-F.PL) (n=36)
Correct noun inflections	31	28	25	14
Substitution of gender	5	8	2	11
Substitution of number	0	0	9	9
Substitution of gender & number	0	0	0	2
Total	36	36	36	36

The pattern of the adjective inflectional errors is similar to the pattern of the noun inflectional errors. The F PL was the most affected category and substitution of the F PL with the M PL was the most common error type.

Table 6.8 demonstrates that there were more adjective gender errors than adjective number errors and F PL inflections were the most impaired inflections.

Difference between the errors *substitution of gender*, *substitution of number* and *substitution of number and gender* was tested using one sample chi-square test. The difference between these categories was statistically significant (χ^2 (2) = 21.733, p=.000).

The types of adjective inflectional substitution were examined. The data are shown in Table 6.8.

Table 6.8: Group II types of adjective inflectional errors

Type of substitution	**M SG** (Adj-M.SG) (n=36)	**F SG** (Adj-F.SG) (n=36)	**M PL** (Adj-M.PL) (n=36)	**F PL** (Adj-F.PL) (n=36)
Substitution with M SG	-	8	9	1
Substitution with F SG	5	-	0	10
Substitution with M PL	0	0	-	10
Substitution with F PL	0	0	2	-

Similar to the types of noun inflectional errors, where substitution with M SG was prevalent, substitution with M SG was also the most dominant inflectional error type in adjectives. Moreover, Group II tended to substitute with the less inflected form similar to noun inflectional errors.

The one-sample chi-square was also used to analyse the difference between the types of adjective inflectional errors presented in Table 16. The one sample chi-square showed significant difference between the categories (χ^2 (3) = 11.217, p=.011).

6.4.1.1 Summary of inflectional errors

It can be seen from the above data that the M SG and F SG inflections were generally more preserved than the M PL and F PL inflections in both the noun and adjective inflectional errors. The F PL was the most affected category. It can also be seen that there were more gender substitution errors than number substitution errors and difference was statistically significant using one sample chi-square. Moreover, the most common substitution error type was substitution with the M SG whereas substitution with the F PL was uncommon. This was also statistically significant using one-sample chi-square. Group II tended to substitute with the less inflected form in both noun and adjective inflectional errors.

It can be seen that the F PL was the most affected categories in both groups. Data from Group I show that inflectional errors occurred in the F PL category only.

6.4.2 Agreement errors

Agreement refers to the internal agreement between the inflections of the noun and the adjective within the NP produced. Agreement was coded as *correct agreement, grammatical not target, ungrammatical* or *not able to compute (NTC)*. Coding of agreement is in Appendix L and Appendix T.

The first type of analysis of Group II agreement errors concerned the overall agreement across the four categories (Table 6.9).

Table 6.9: Group II overall agreement across four categories

Type of response	**M SG** (N-M.SG + Adj-M.SG) (n=36)	**F SG** (N-F.SG + Adj-F.SG) (n=36)	**M PL** (N-M.PL + Adj.M.PL) (n=36)	**F PL** (N-F.PL + Adj-F.PL) (n=36)
Correct agreement	27	24	22	10
Grammatical not target	3	6	6	11
Ungrammatical	0	0	5	11
Not able to compute	6	6	3	4
Total	36	36	36	36

The above table shows the overall agreement across the four categories for the participants in Group II. The table illustrates that the M SG was the most preserved category. The M SG and the F SG did not involve *ungrammatical* errors and the *ungrammatical* errors occurred only in the M PL and the F PL. It can also be seen that the F PL was the most impaired category. Errors in the F PL included *grammatical not target, ungrammatical* and *not able to compute*. The *grammatical not target* and *ungrammatical* error types were the most frequent agreement error types in the F PL category.

The results of the overall agreement presented in Table 6.10 were statistically analysed. One-sample chi-square test was used to analyse the results for each category: the M SG category, the F SG category, the M PL category and the F PL category. The statistical analysis yielded significant results in the M SG (χ^2 (3) =48.000, p=.000), F SG (χ^2 (3) =34.889, p=.000) and M PL (χ^2 (4) =40.389, p=.000). However, the results were insignificant in the F PL category (χ^2 (3) =3.778, p=.286).

The *grammatical not target* errors were then analysed. These errors refer to phrases that are not target phrases but where the noun and the adjective inflections agree. The analysis considered the inflections as well as the lexical items; it examined whether there were lexical errors as well as inflectional errors. The analysis revealed that the g*rammatical not target* phrases produced in errors did not involve any lexical errors (+ N and + Adj). All errors consisted of producing noun and adjective inflections that were not target (-T AGR) but the inflections agree with each other (+Int. AGR). For example, TA produced *mumariðʕ-i:n zaʕla:n-ni:n* (nurse-M.PL angry-M.PL) for *mumariðʕ-a:t zaʕla:n-a:t* (nurse-F.PL angry-F.PL).

The types of the inflectional substitution in the *grammatical not target* phrases was also examined. The types of inflectional substitution are in Table 6.10.

Table 6.10: Group II types of grammatical not target responses

Type of substitution	**M SG** (N-M.SG + Adj-M.SG) (n=36)	**F SG** (N-F.SG + Adj-F.SG) (n=36)	**M PL** (N-M.PL + Adj.M.PL) (n=36)	**F PL** (N-F.PL + Adj-F.PL) (n=36)
Substitution with M SG	-	6	6	0
Substitution with F SG	3	-	0	6
Substitution with M PL	0	0	-	5

The data in Table 6.11 show that the singular target noun phrases, M SG and F SG, had always gender substitution errors where all M SG inflections were substituted with F SG inflections and all F SG inflections were substituted with M SG inflections. It can also be seen that all substitution errors in the M PL category were number substitution errors. All M PL inflections were substituted with the M SG inflections. However, the F PL category involved both gender substitution errors, when they were substituted with the M PL inflections, and number substitution errors, when they were substituted with the F SG inflections. The analysis of the above data also demonstrates that the F PL category was the most affected category and substitution with the F PL never occurred.

The third analysis of the agreement errors concerned the *ungrammatical* phrase, phrases where noun and adjective inflections are not target inflections and they disagree internally. In addition to looking at the agreement between the noun and adjective inflections, each response was analysed by examining whether the response involved a noun lexical error, a noun inflectional error, an adjective lexical error or/and an adjective inflectional error. The data are shown in Table 6.11.

Table 6.11: Group II type of ungrammatical phrase

Error	**M PL** (N-M.PL + Adj.M.PL) (n=36)	**F PL** (N-F.PL + Adj-F.PL) (n=36)
N gender and number inflection	0	4
Adj gender and number inflection	2	6
Noun & N gender and number inflection	1	0
N gender and number inflection & Adj gender and number inflection	1	1
Noun & Adj gender and number inflection	1	0
Total	5/36	11/36

Note. omission or substitution error. N= noun. Adj= adjective.

The table demonstrates that the most frequent agreement errors were due to producing incorrect adjective inflections. Moreover, ungrammatical errors did not occur in the M SG and F SG and the F PL was the most affected category.

The results of the type of *ungrammatical* phrase presented in Table 6.12 were analysed using one-sample chi-square. The results of the statistical test using one-sample chi-square showed significant difference (χ^2 (4) = 10.875, p=.028).

The fourth type of agreement analysis focused on the type of number and gender disagreement errors. It looked at whether the disagreement errors were due to wrong number inflection or wrong gender inflection (Table 6.12).

Table 6.12: Group II type of number and gender disagreement errors

Type of substitution	**M PL** (N-M.PL + Adj.M.PL) (n=36)	**F PL** (N-F.PL +Adj-F.PL) (n=36)
Substitution of gender	0	6
Substitution of number	4	4
Substitution of gender & number	1	1

The above table shows that most agreement errors were due to wrong assignment of number.

One-sample chi-square was used to analyse the data for Group II type of number and gender disagreement errors presented in Table 18. The results of the statistical test yielded insignificant results (χ^2 (2) = 3.500, p=.174).

6.4.2.1 Summary of agreement errors

The F PL was the most impaired category in the overall agreement data for Group II. The most frequent errors were *grammatical not target* and *ungrammatical* error. All *grammatical not target* errors did not involve any lexical errors and most *ungrammatical* errors were due to incorrect adjective inflections. The analysis of gender and number disagreement errors showed that most disagreement errors resulted from wrong assignment of number not gender. In addition, there was higher accuracy for masculine than for feminine and for singular than for plural forms.

Like Group II, Group I agreement data showed that the two existing *ungrammatical* errors occurred in the F PL category. These errors were due to wrong assignment of adjective inflections. Unlike Group II, disagreement errors were due to wrong assignment of gender not number in Group I.

6.4.3 Lexical errors

The last analysis of errors involved lexical errors irrespective of any other error type. Appendix J presents the codes for the lexical errors. Noun lexical errors are shown in Table 6.13.

Table 6.13: Group II categories of the Noun lexical errors irrespective of inflections

Type of response	M SG (N-M.SG) (n=36)	F SG (N-F.SG) (n=36)	M PL (N-M.PL) (n=36)	F PL (N-F.PL) (n=36)
Correct noun	33	33	33	35
PRNW	0	1	2	1
No response	3	2	1	0
Total	36	36	36	36

Note. PRNW = phonologically related non-word. NR = no response.

As the table shows, noun lexical errors consisted of only two types of error: *phonologically related non-word* (PRNW) and *no response*.

One sample chi-square was used to analyse the result of the noun lexical errors presented in Table 6.14. The results of the one-sample chi-square of noun lexical errors were significant (χ^2 (1) = .400, p=.527).

Adjective lexical errors were analysed. Adjective lexical errors are presented in Table 6.14.

Table 6.14: Group II categories of the Adjective lexical errors irrespective of inflections

Type of response	M SG (Adj-M.SG) (n=36)	F SG (Adj-F.SG) (n=36)	M PL (Adj-M.PL) (n=36)	F PL (Adj-F.PL) (n=36)
Correct adjective	27	30	33	31
Semantic	0	1	0	0
Formal	1	0	0	0
Unrelated	2	1	1	0
Description	2	2	0	0
PRNW	0	0	0	1
No response	4	2	2	4
Total	36	36	36	36

Note. PRNW = phonologically related non-word. NR = no response.

The above table illustrates that adjective lexical errors consisted of six types of lexical errors. *No response* errors were frequent errors in adjectives.

Adjective lexical errors were analysed using one-sample chi-square. The one-sample chi-square tests did not show significant result for adjective lexical errors (χ^2 (5) = 23.696, p=.000).

The data show that there were more adjective lexical errors than noun lexical errors. One-sample chi-square was used to test the difference between noun lexical errors and adjective lexical errors. The result of the statistical analysis was insignificant (χ^2 (1) = .136, *p*=.712).

6.4.3.1 Summary of lexical errors

It can be seen from the above data that no response errors were the most commonly occurring lexical errors in both nouns and adjectives. There were more adjective lexical errors than noun lexical errors. However, the result was statistically insignificant. Unlike Group II, Group I produced two lexical errors and both were PRNW errors.

6.5 Outliers in Group II

Two participants in Group II sometimes performed differently form the group performance in the *Number and Gender Agreement Subset*. Whereas the F PL was the most impaired category in the overall accuracy data of Group II, all categories were almost equally impaired in the overall accuracy data of TA. Group II data showed that gender was more impaired than number; however, there were more number substitution errors than gender substitution errors in TA and FE's data. Unlike Group II, FE produced more noun lexical errors than adjective lexical errors.

6.6 Summary

This chapter presented the group results of the *Number and Gender Agreement Subtest*. The results of Group I were first analysed. The overall accuracy data illustrate that Group I made four errors in total, two of which were inflectional errors in the F PL category.

Errors produced by Group II were then analysed. The first analysis concerned the overall accuracy. The overall accuracy data of Group II showed that the F PL was the most impaired category. As for the noun and adjective inflectional errors, the singular form (M SG and F SG) inflections were generally more preserved than the plural form (M PL and F PL) inflections. The substitution with M SG was common whereas substitution with F PL was rare and the statistical analysis using one-sample chi-square was significant. In addition, the gender was more impaired than number and the difference was statistically significant using one sample chi-square. Inflectional substitutions with the less inflected form were prevalent.

The agreement and lexical errors data show that the F PL was the most impaired category and the most frequent errors in the F PL were *grammatical not target* and *ungrammatical* error. All *grammatical not target* errors consisted of producing correct lexical items but the noun and adjective inflections were not target. The *ungrammatical* errors were present in the plural forms only (M PL and F PL). The analysis of the *ungrammatical* errors revealed that most errors in this type resulted from incorrect adjective inflections. In addition, wrong assignment of number was the most frequent error type in the analysis of the number and gender disagreement errors. As for the lexical errors, adjective lexical errors were more than noun lexical errors.

In the overall accuracy data and the analysis of inflectional errors data of both groups, the F PL was the most impaired category. Moreover, there was higher accuracy for masculine than for feminine and for singular than for plural forms.

The following chapter shows the group results in the *Definiteness Agreement Subtest*.

7. RESULTS OF DEFINITENESS AGREEMENT SUBTEST

This chapter shows the group results of the second subtest, *Definiteness Agreement Subtest*. In this subtest participants were asked to produce a noun and an adjective that agreed in definiteness inflections, whether definite (Def.) (***Def-N + Def-Adj***) or indefinite (Indef.) (***Indef-N + Indef-Adj)***. The structure of the noun phrase, the conditions and the number of items in current subtest are explained in Chapter Two.

All of the data in this chapter was non-normally distributed. Pearson's chi-square was used to test the relationship between two categorical variables such as the condition (Def./Indef.) and the score (correct/incorrect).

7.1 Group I overall accuracy

The correct and incorrect responses produced by Group I were first analysed. Group I overall accuracy is presented in Table 7.1.

Table 7.1: Group I correct responses

Participant	**Def. F SG** **(Def-N-F.SG + Def-Adj-F.SG) (n=12)**	**Indef. F SG** **(Indef-N-F.SG + Indef-Adj-F.SG) (n=6)**
SA	10	4
WA	6	5
WI	8	4
Total	**24/36**	**13/18**

As shown in Table 7.1, the group performance in the Indef. condition was slightly more preserved than the performance in the Def. condition. Pearson's chi-square was used to test the difference between the conditions by analysing the correct and the incorrect responses in each condition. The analysis showed insignificant difference between them (X^2 (1) = 0.172, p = 0.679).

7.2 Group I Errors Analysis

The errors produced by Group I were analysed. The analysis focused on the types of the lexical, inflectional and agreement errors. Coding of lexical, inflectional and agreement errors is in Appendix J, Appendix K, Appendix L and Appendix T The errors made by each person are shown separately. The following table shows SA's production (Table 7.2).

Table 7.2: SA types of lexical, inflectional and agreement errors in the definite and Indefinite targets

Category	Item	DEF	N	Infl	DEF	Adj	Infl	AGR
Definite. F SG	1	T	T	T	T	T	T	T
	2	T	T	T	T	**PRNW**	T	T
	3	T	T	T	T	T	T	T
	4	T	T	T	T	T	T	T
	5	T	T	T	T	T	T	T
	6	T	T	T	T	T	T	T
	7	T	T	T	T	T	T	T
	8	T	T	T	T	T	T	T
	9	T	T	T	T	T	T	T
	10	T	T	T	T	T	T	T
	11	T	T	T	T	**Miscel**	T	T
	12	T	T	T	T	T	T	T
Indefinite F SG	1	T	T	T	T	T	T	T
	2	T	T	T	T	T	T	T
	3	T	T	T	T	T	T	T
	4	T	T	T	T	T	T	T
	5	T	T	T	T	**Semantic**	T	T
	6	**Def**	T	T	**Def**	T	T	**GNT**

Note. DEF = definiteness inflection. Infl = gender and number inflection. AGR= agreement. PRNW = phonologically related non-word. Miscel= miscellaneous which means naming a part of the target object. Def= definite article. GNT= grammatical not target.

SA generally made very few errors and half of them were lexical errors. In the Def. condition, SA made only adjective lexical errors. In the Indef. condition, SA made an adjective lexical error, inflectional errors and an agreement error. The inflectional errors were substitution of the indefinite article with the definite article. The agreement error consisted of *grammatical not target* error where the noun and adjective agree with each other, but the inflections are not the target inflection. *Grammatical not target* error produced by SA was due to the production of noun and adjective definiteness inflections that were not target. Although SA produced *grammatical not target phrase*, it can be seen that agreement was not impaired in SA's production.

Errors produced by WA were then analysed. Table 7.3 demonstrates WA's production.

Table 7.3: WA types of lexical, inflectional and agreement errors in the definite and Indefinite targets

Category	Item	DEF	N	Infl	DEF	Adj	Infl	AGR
Definite F SG	1	**Indef**	T	T	**Indef**	T	T	**GNT**
	2	T	T	T	T	T	T	T
	3	T	T	T	T	T	T	T
	4	T	T	T	T	T	T	T
	5	T	T	T	T	T	T	T
	6	**Indef**	T	T	**Indef**	T	T	**GNT**
	7	**Indef**	T	T	**Indef**	T	T	**GNT**
	8	T	T	T	T	T	T	T
	9	T	T	**M SG**	**Indef**	T	**M SG**	**ungrammatical**
	10	T	T	T	T	T	T	T
	11	**Indef**	T	T	**Indef**	T	T	**GNT**
	12	**Indef**	T	T	**Indef**	T	T	**GNT**
Indefinite F SG	1	T	T	T	T	T	T	T
	2	T	T	T	T	T	T	T
	3	T	T	T	T	T	T	T
	4	T	T	T	T	T	T	T
	5	T	T	T	T	**Semantic**	T	T
	6	T	T	T	T	T	T	T

Note. DEF= definiteness inflection. Infl = gender and number inflection. AGR= agreement. Indef = indefinite article. M SG= masculine singular. GNT = grammatical not target.

It can be seen from the above table that WA produced more errors in the Def. condition than errors in the Indef. condition. All errors made in the Def. condition were inflectional errors and agreement errors. Most inflectional errors consisted of substitution of the definite article with the indefinite article. Most agreement errors were *grammatical not target* errors. All *grammatical not target* errors were due to noun and adjective definiteness inflections that were not target inflections. There was only one adjective lexical error in the Indef. condition. Similar to SA it can be seen that agreement was mainly spared in WA's production.

Finally, the last individual error analysis involved analysing the errors produced by WI. The production of WI is presented in Table7.4.

Table 7.4: WI types of lexical, inflectional and agreement errors in the definite and indefinite targets

Category	Item	Def	N	Infl	Def	Adj	Infl	AGR
Definite F SG	1	**Indef**	T	T	T	T	T	**ungrammatical**
	2	**Indef**	T	T	**Indef**	T	T	**GNT**
	3	T	T	T	T	T	T	T
	4	T	T	T	T	T	T	T
	5	T	T	T	T	T	T	T
	6	T	T	T	T	T	T	T
	7	T	T	T	T	T	T	T
	8	T	T	T	**Indef**	T	T	**ungrammatical**
	9	T	T	T	T	T	T	T
	10	T	T	T	T	T	T	T
	11	T	T	T	T	T	T	T
	12	T	T	T	**Indef**	T	T	**ungrammatical**
Indefinite F SG	1	T	T	T	T	T	**M SG**	**ungrammatical**
	2	T	T	T	T	T	T	T
	3	T	T	T	T	T	T	T
	4	T	T	T	T	T	T	T
	5	T	T	T	T	T	T	T
	6	T	T	T	**NR**	**NR**	**NR**	**NR**

Note. DEF= definiteness inflection. Infl = gender and number inflection. AGR= agreement. Indef = indefinite article. GNT= grammatical not target. M SG= masculine singular. NR= no response.

Table 7.4 illustrates that inflectional and agreement errors were prevalent. Most inflectional errors consisted of substituting the definite article with the indefinite article. It can also be seen that most agreement errors were *ungrammatical* errors due to incorrect definiteness inflections. These errors led to impaired agreement production unlike SA and WA who showed spared agreement production in general.

7.2.1 Summary of group I errors

Group I overall accuracy data showed that the Def. had higher accuracy than the Indef. condition. However, the statistical analysis showed insignificant difference between the two conditions. The analysis of errors data revealed that the most commonly occurring errors produced by Group I were inflectional errors. Most inflectional errors were a substitution of the definite article with the indefinite article. This resulted in agreement errors whether *grammatical not target* or *ungrammatical*. All *grammatical not target* errors were due to nontarget definiteness inflections, not number and gender inflections. *Grammatical not target* errors were more frequent than *ungrammatical* errors in the production of SA and WA only. This illustrates that SA and WA maintained agreement largely while producing inflectional errors. However, WI did not maintain agreement and most of the agreement errors were *ungrammatical* errors. Most *ungrammatical* errors resulted from non-target adjective inflection. In addition, there were no noun lexical errors produced by Group I. All Lexical errors were adjective lexical errors only.

It can be seen that Group I performance in the *Number and Gender Agreement Subtest* was more preserved than the performance in the *Definiteness Agreement Subtest*. As for gender and number substitution errors, both subtests included only gender substitution errors.

7.3 Group II overall accuracy

Analysis of errors produced by Group II begins by examining the overall accuracy of all the participants in the group (Table 7.5).

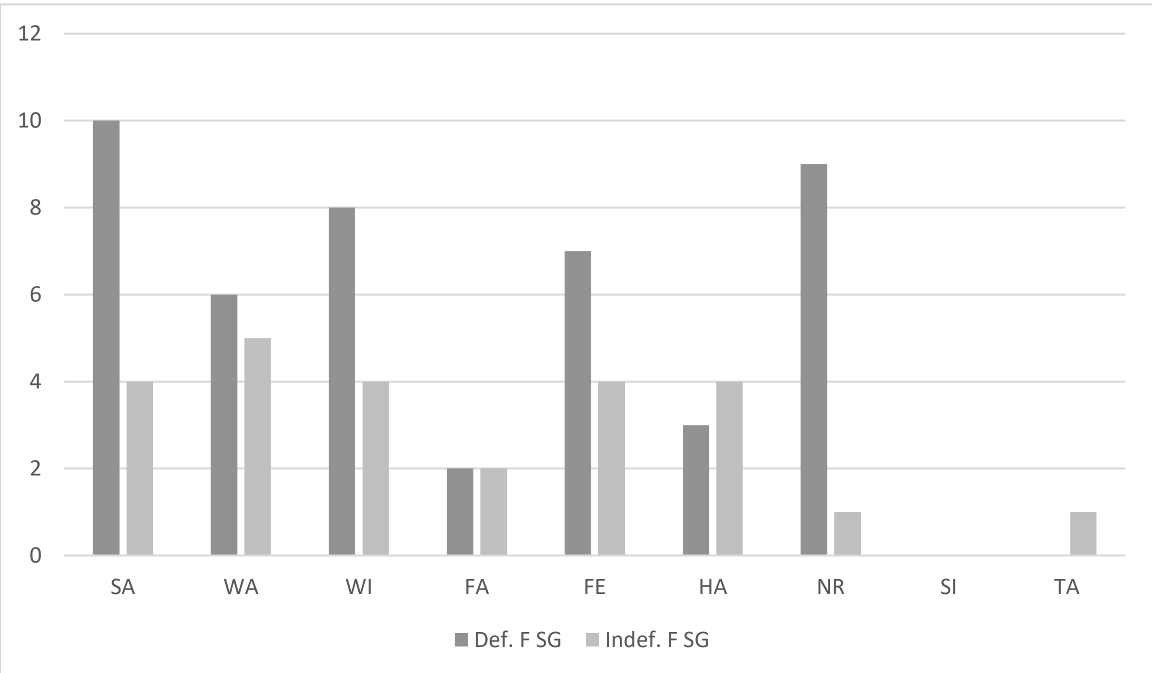
Table 7.5: Group II correct responses

Participant	Def. F SG (Def-N-F.SG + Def-Adj-F.SG) n=12	Indef. F SG (Indef-N-F.SG + Indef-Adj-F.SG) n=6
FA	2	2
FE	7	4
HA	3	4
NR	9	1
SI	0	0
TA	0	1
Total	**21/72**	**12/36**

It can be seen from Table 7.5 that the total number of errors in both conditions was high. However, the Def. condition was slightly more impaired than the Indef. condition in Group II. The difference between the conditions was analysed using Pearson's chi-square. The statistical analysis revealed insignificant difference between the two conditions (X^2 (1) = 0.196, p = 0.658). This is similar to Group I overall accuracy data.

The overall accuracy of both groups was analysed. The data are shown in Figure 7.1.

Figure:7.1: Overall Accuracy of Group I (SA, WA and WI) and Group II (FA, FE, HA, NR, SI and TA) in the definiteness agreement subtest



It can also be seen from the Graph that there was an overlap between the groups. FE performed better than the participants WA and WI from Group I in the Def. condition, and similar to the participants SA and WI from Group I in the Indef. condition. NR performed better than WA and WI from Group I in the Def. condition only. HA's performance in the Indef. only was also similar to the performance of SA and WI from Group I.

Group I and Group II data were statistically analysed. For each condition, the correct and the incorrect responses by each group were analysed using Pearson's chi-square. The results revealed significant difference in both the Def. condition ($X^2(1) = 13.886$, $p = 0.000$) and the Indef. condition ($X^2(1) = 7.299$, $p = 0.007$). This showed that the Def. was statistically more impaired than the Indef. in both groups.

7.3.1 Summary of group II overall accuracy

It was seen from the data that Group II performance in the Def. was slightly more preserved than the performance in the Indef. The difference was statistically insignificant. However, the difference between the correct and the incorrect responses by each group was statistically significant in each condition. Similar to Group II, Group I had higher accuracy in the Def. than in the Indef. condition but the statistical analysis showed insignificant results.

7.4 Group II errors analysis

Errors produced by Group II were then analysed. The errors were analysed across participants. The inflectional, agreement and lexical errors produced were analysed separately.

7.4.1 Inflectional errors

The first analysis of errors focused on noun and adjective inflectional errors. Inflectional errors were analysed irrespective of lexical errors. Noun and adjective inflectional errors consisted of *substitution of definiteness inflection*, *substitution of gender and number inflection* and *no response*. Inflectional errors are defined in Appendix K and Appendix T. Table 7.6 and Table 7.7 demonstrate noun inflectional errors whereas adjective inflectional errors are shown in Table 7.8 and Table 7.9.

Table 7.6: Group II noun inflectional errors irrespective of lexical errors

Category	**Def. F SG** **(Def-N-F.SG) (n=72)**	**Indef. F SG (Indef-N -F.SG) (n=36)**
Correct noun inflection	31	29
Substitution of Definiteness	9	2
Substitution of gender	4	2
Substitution of gender & number	1	0
No Response	27	3
Total	72	36

Note. No response= no response of definiteness, gender & number inflections due to the omission of the whole noun and its inflections or the whole adjective and its inflections.

Table 7.6 shows that the group produced 41 (0.57) noun inflectional errors in the Def. condition and 7 (0.19) noun inflectional errors in the Indef. This shows that the Def. category was more impaired than the Indef. The table also shows that the most commonly occurring noun inflectional error was *no response.* It also shows that *substitution of definiteness* inflection errors were more frequent than *substitution of gender* and *substitution of gender and number* errors. *Substitution of definiteness* errors in the Def. condition were more than *Substitution of definiteness* errors in the Indef. In other words, Group II tend to substitute Def. with Indef. inflections. This type of substitution is toward the less inflected form. It can also be seen that there were more gender substitution errors than number substitution errors.

The correct and the incorrect responses in each condition were analysed using Pearson's chi-square test. The result revealed that there was a difference between number of correct and incorrect responses across conditions with the Indef. condition showing greater accuracy (X^2 (1) = 13.669, p = 0.000).

As for gender and number substitution errors, the data are presented in Table 7.7.

Table 7.7: Group II types of noun gender substitution and noun gender and number substitution errors

Type of substitution	Def. F SG (Def-N-F.SG) (n=72)	Indef. F SG (Indef-N -F.SG) (n=36)
Substitution with M SG	4	2
Substitution with M PL	1	0

The data show that substitutions to M SG inflections were prevalent. Substitution with M SG is toward the less inflected form.

The second inflectional error analysis considered the adjective inflectional errors produced by Group II. These errors are presented in Table 7.8.

Table 7.8: Group II adjective inflectional errors irrespective of lexical errors

Category	Def. F SG (Def-Adj-F.SG) (n=72)	Indef. F SG (Indef-Adj -F.SG) (n=36)
Correct adjective inflection	22	16
Substitution of Definiteness	35	0
Substitution of gender	10	14
No response	5	6
Total	72	36

Note. No response = no response of definiteness, gender & number inflections due to the omission of the whole noun and its inflections or the whole adjective and its inflections.

The Def. was moderately more impaired than the Indef. condition. Unlike the noun inflectional errors where *no response* errors were the most frequent errors, the most commonly occurring adjective inflectional error was *substitution of definiteness* inflection. All *substitution of definiteness* errors were in the Def. condition. This is similar to noun inflectional errors where there where Group II substituted toward the less inflected form by producing Indef. instead of Def. inflections. Moreover, *substitution of gender* errors were common errors, and the data did not include substitution of number errors.

Pearson's chi-square test was used to test the difference between the conditions. The results of the statistical analysis showed insignificant difference between them (X^2 (1) = 2.030, p = 0.154).

The types of the gender substitution errors in adjectives were analysed in Table 7.9.

Table 7.9: Group II types of adjective gender substitution errors

Type of substitution	**Def. F SG** **(Def-Adj-F.SG) (n=72)**	**Indef. F SG** **(Indef-Adj -F.SG) (n=36)**
Substitution with M SG	10	14

All adjective gender substitution errors involved substitution with the M SG inflection.

7.4.1.1 Summary of inflectional errors

As the above data show, Group II produced more adjective inflectional errors than noun inflectional errors. Noun inflectional errors in the Def. condition were more than errors in the Indef. Adjective inflectional errors in the Def. were also more frequent than errors in the Indef.; however, the difference was not shown clearly. In addition, the data show that *substitution of definiteness* errors were more frequent than other substation errors in nouns. *Substitution of definiteness* errors were the most frequent errors in adjective. The *substitution of definiteness* errors were mainly definite to indefinite substitutions. Definite to indefinite substitutions is toward a less inflected form. The data also showed that substitutions with the M SG was common in the *number and gender substitution* errors. Substitutions with the M SG is also toward the less inflected form. Similarly, Group I's data showed that most *substitution of* *definiteness* errors were toward the less inflected form where definite was substituted with indefinite inflections. In addition, gender substitution errors were more than number substitution errors.

7.4.1.2 Inflectional errors across subtests

Substitutions with the less inflected forms was a frequent error in the *Number and Gender Agreement Subtest*. Participants in the *Number and Gender Agreement Subtest* tended to substitute F SG with M SG, M PL with M SG and F PL with F SG. Similar to the *Number and Gender Agreement Subtest,* there were more gender substitution errors than number substitution errors in the current subtest.

7.4.2 Agreement errors

In the *Definiteness Agreement Subtest,* agreement refers to the internal agreement between the noun and the adjective inflections in terms of definiteness as well as number and gender. Agreement was coded as *target*, *grammatical not target*, *ungrammatical*, *omission* and *not able to compute*. Coding of agreement is in Appendix L and Appendix T. Table 7.10 shows the result of the overall agreement produced by Group II.

Table 7.10: Group II overall agreement

Category	**Def. F SG** (Def-N-F.SG + Def-Adj-F.SG) (n=72)	**Indef. F SG** (Indef-N-F.SG + Indef-Adj-F.SG) (n=36)
Correct agreement	23	16
Grammatical not target	6	0
Ungrammatical	12	12
NTC	31	8
Total	72	36

Note. Correct agreement= inflections and agreement are target, lexical items may or may not be target. NTC = not able to compute when the response involves omission of the noun with its inflections, the adjective with its inflections or the noun and the adjective with their inflections.

The data in Table 7.10 shows that the Def. category involved slightly more errors than the Indef. in Group II. In both the Def. and the Indef. conditions, there were many *not able to compute* (NTC) responses. NTC occurred when a noun with its inflections were not produced, the adjective with its inflections were not produced or both the noun and the adjective with their inflections were not produced. Agreement errors also consisted of *grammatical not target* and *ungrammatical* errors. There were more *ungrammatical* errors than *grammatical not target* errors in both conditions. The statistical analysis showed no difference between the (X^2 (1) > = 1.625, p = 0.202).

The second analysis of agreement errors considered the *grammatical not target* phrases. These errors refer to phrases that are not target phrases but the noun and the adjective inflections agree. The analysis considered the inflections as well as the lexical items; it examined whether there were lexical errors as well as inflectional errors. The results are shown in Table 7.11.

The *grammatical not target* errors in Group II occurred only in the Def. condition. Four errors involved noun and adjective definiteness inflections that were not target (- N Def. and - Adj Def.) but all other elements were correct. Two errors consisted of noun and adjective definiteness inflections that were not target, and noun and adjective number and gender inflections that were not target (- N Def., - N Gen & Num, - Adj Def. and - Adj Gen & Num) and all other elements were correct. It can be seen that all *grammatical not target* errors involved correct noun lexical items and adjective lexical items and mainly definite to indefinite substitutions in both nouns and adjectives.

The *ungrammatical* phrases produced by Group II were then examined. These errors refer to phrases where noun and adjective inflections are not target inflections and they disagree internally. The analysis involved examining the agreement between the noun and adjective inflections as well as lexical and inflectional errors in nouns and adjectives. Table 7.11 presents the data of the *ungrammatical* phrases produced by Group II.

Table 7.11: Group II types of ungrammatical phrases

Error	**Def. F SG** (Def-N-F.SG + Def-Adj-F.SG) (n=72)	**Indef. F SG** (Indef-N-F.SG + Indef-Adj-F.SG) (n=36)
Adj definiteness inflection	5	0
Adj gender and number inflection	0	12
Adj definiteness inflection & Adj gender and number inflection	2	0
N gender and number inflection	1	0
N definiteness inflection & Adjective	1	0
Noun & Adj definiteness inflection	2	0
Noun, N gender and number inflection, Adj definiteness inflection & Adj gender and number inflection	1	0
Total	12/72	12/36

Note. Erorr= omission or substitution error. Adj = adjective. N = noun.

As can be seen from Table 7.11, most *ungrammatical* phrases in the Def. condition involved errors in adjective definiteness inflection. All *ungrammatical* phrases in the Indef. condition were due to errors in the adjective gender and number inflection. The data show that errors in adjective inflection were the main reason for the production of *ungrammatical* phrases in both the Def. and the Indef. condition.

7.4.2.1 Summary of agreement errors

It can be seen from the agreement data that the difference between the number of errors in the Def. condition and the errors in the Indef. condition is moderate with the Def. having more errors. *Ungrammatical* errors were more frequent than *grammatical not target* errors in both conditions. Most *grammatical not target* errors produced by Group II were due to production of incorrect definiteness inflections resulting in definite to indefinite inflectional substitutions in both nouns and adjectives. The *ungrammatical* errors were mainly due to errors in adjective inflection, whether definiteness inflection or gender and number inflection, in both the Def. and the Indef. condition. The *grammatical not target* and *ungrammatical* errors produced by Group II are similar to data by Group I.

7.4.2.2 Agreement errors across subtest

Similar to *grammatical not target* errors in this *Definiteness Agreement Subtest*, *grammatical not target* errors in the *Number and Gender Agreement Subtest* were also due to production of adjective inflections that were not target whereas all other elements were target. In addition, most *ungrammatical* errors in the *Number and Gender Agreement Subtest* resulted from incorrect adjective inflections similar to *ungrammatical* errors in current subtest.

7.4.3 Lexical errors

Lexical errors were analysed separately. Coding of lexical errors is shown in Appendix J. Group II data encompassed both noun and adjective lexical errors. The noun lexical errors are shown in Table 7.12.

Table 7.12: Group II types of the noun lexical errors irrespective of inflections

Category	**Def. F SG** (Def-N-F.SG) (n=72)	**Indef. F SG** (Indef-N -F.SG) (n=36)
Correct noun	42	31
Semantic	2	2
Unrelated	1	0
No response	27	3
Total	72	36

Data in Table 7.13 demonstrates that the Def. was more impaired than the Indef. In both conditions, it can be seen that *no response* errors were frequent errors.

Pearson's chi-square was used to test the difference between the number of the correct and incorrect responses and the type of condition. The statistical analysis revealed significant results (X^2 (1) > = 8.454, p = 0.004) with the Indef. having greater accuracy.

Adjective lexical errors were then analysed. Table 7.13 presents the lexical errors that affected the adjectives.

Table 7.13: Group II types of the adjective lexical errors irrespective of inflections

Category	Def. F SG (Def-Adj-F.SG) (n=72)	Indef. F SG (Indef-Adj -F.SG) (n=36)
Correct adjective	59	27
Semantic	6	2
PRNW	2	0
No response	5	7
Total	72	36

Note. PRNW = phonologically related non-word.

The data in Table 7.14 illustrates that the Indef. was more impaired than the Def. in adjectives unlike nouns. Similar to noun lexical errors, *no response* errors were prevalent errors in the adjective def. and Indef. condition.

The correct and the incorrect responses in the Def. and the Indef. condition were tested using Pearson's chi-square. The test showed significant results (X^2 (1) > = 0.714, p = 0.398) with the Def. condition being more accurate.

7.4.3.1 Summary of lexical errors

It can be seen that Group II made both noun lexical errors and adjective lexical errors. In addition, the Def. was more impaired than the Indef. in nouns whereas the Indef. was more impaired than the Def. in adjectives. Noun lexical errors were more frequent than adjective lexical errors in the Def. condition, and less frequent than adjective lexical errors in the Indef.

condition. However, noun lexical errors were more prevalent than adjective lexical errors across the two conditions. While Group II produced both noun and adjective lexical errors, Group I lexical errors were found in adjectives only.

7.4.3.2 Lexical errors across subtests

The lexical data in the Definiteness Agreement Subtest is different form the lexical data in the *Number and Gender Agreement Subtest.* In the *Number and Gender Agreement Subtest,* adjective lexical errors were more frequent than noun lexical errors.

7.5 Outliers in Group II

There were no clear outliers observed in Group II's results. Participants in Group II did not produce marked different patterns of errors.

7.6 Summary

The analysis of Group I errors showed that the most commonly occurring errors were inflectional substitution errors. Most inflectional errors involved substituting the definite with the indefinite inflection. This resulted in agreement errors whether *grammatical not target* or *ungrammatical*. All *grammatical not target* errors were due to nontarget definiteness inflections, not number and gender inflections. There were more *grammatical not target* errors than *ungrammatical* errors in the production of SA and WA only. SA and WA maintained agreement mainly while producing inflectional errors unlike WI whose most agreement errors were *ungrammatical* errors. Finally, all lexical errors produced by Group I were found in the adjectives only.

Group II's overall accuracy scores revealed that the Def. condition was slightly more impaired than the Indef. condition. The tendency to produce impaired Def. structures was also seen in the analysis of errors data. In the inflectional errors, the Def. category was more impaired than the Indef. in noun, and slightly more impaired than the Indef. in adjectives. In the analysis of agreement errors, there were moderately more errors in the Def. category than errors in the Indef. In the lexical errors, the Def. was more impaired in noun lexical errors. However, the Indef. was more impaired than the Def. condition in adjective lexical errors. condition.

Group II produced more adjective inflectional errors than noun inflectional errors. S*ubstitution of definiteness* inflection was a prevalent error. All S*ubstitution of definiteness* errors were mainly definite to indefinite substitutions. Moreover, *ungrammatical* errors were more prevalent than *grammatical not target* errors in the agreement data. Most *grammatical not target* errors were due to substitution of the definite inflections in nouns and adjectives with the indefinite inflections. The *ungrammatical* errors were mainly due to inflectional substitution errors in adjectives. Furthermore, noun lexical errors were more frequent than adjective lexical errors across conditions.

It can be seen that both groups produced slightly more errors in the Def. condition than errors the Indef. condition. Substitution of the definite inflection with the indefinite was common in both groups. Most *grammatical not target* errors in both groups were due to nontarget definiteness inflections. However, whereas Group I made only adjective lexical errors, Group II made both noun lexical errors and adjective lexical errors and noun lexical errors were more frequent across conditions.

Similar to the *Number and Gender Agreement Subtest,* most substitutions in the *Definiteness Agreement Subtest* were toward the less inflected form. The definite was substituted with the indefinite inflections, and the F SG was substituted with M SG inflections. Gender substitution errors were more than number substitution errors in the current subtest. Furthermore, all *grammatical not target* errors produced in the current subtest consisted of producing correct lexical items but the noun and adjective inflections were not target. Most *ungrammatical* errors resulted from incorrect adjective inflections not noun inflections. Unlike the *Number and Gender Agreement Subtest*, noun lexical errors were more frequent than adjective lexical errors in the *Definiteness Agreement Subtest*.

The next chapter shows the group results in the *Construct States Subtest*.

8. RESULTS OF CONSTRUCT STATE SUBTEST

This chapter presents the group results of the third subtest, *Construct State Subtest*. Participants in this subtest were asked to produce two nouns, a head noun and a modifying noun (*Indef+N+Infl & Def+N+Infl*). Unlike the *Number and Gender Agreement Subtest* and the *Definiteness Agreement Subtest*, the head noun and the modifying noun did not have to agree in number, gender or definiteness. However, the first head noun must be indefinite, while the modifying noun can be either definite or indefinite, and nothing could intervene between the two nouns.

There were two conditions in this subtest. The first condition included two nouns that had the same gender (*Same gender singular nouns*) and the second condition consisted of two nouns that have different genders (*Different gender singular nouns*). Chapter Two provides details about the noun phrase structure, conditions and number of items in the current subtest.

Like all data from the other subtests, the data in this chapter was non-normally distributed. The non-parametric Wilcoxon two-sample test with two-tailed values of p were used to compare between the two conditions. For testing the relationship between nominal variables having two or more independent categories, one-sample chi-square was used throughput.

8.1 Group I overall accuracy

The correct and incorrect responses produced by Group I are presented in Table 8.1.

Table 8.1: Group I correct responses

Participant	Same gender singular nouns (Indef-N-M.SG/F.SG + Def-N-M.SG/F.SG) (n=12)	Different gender singular nouns (Indef-N-M.SG/F.SG + Def-N-F.SG/M.SG) (n=12)
SA	11	10
WA	11	12
WI	11	11
Total	**33/36**	**33/36**

Table 8.1 shows that Group II made very few errors. The group made six errors in total. Both conditions have an equal number of errors.

8.2 Group I errors analysis

The analysis of Group I errors involved the lexical, inflectional and agreement errors produced. The coding of errors is presented in Appendix J, Appendix K, Appendix L and Appendix T. The analysis showed that all errors made by Group I were lexical errors. There were two lexical errors in the head nouns and five modifying noun lexical errors. Head noun lexical errors included one *no response* error and one *miscellaneous* error in the first condition, *Same gender singular nouns* condition. Lexical errors in the modifying nouns included two *semantic* errors and one *phonologically related non-word* error in the first condition, and two *phonologically related non-word* in the second condition, *different gender singular nouns* condition. Lexical errors in the first condition were more frequent than errors in the second condition in both the head and modifying nouns.

8.2.1 Summary of group I errors

The data showed that Group I's performance in the two conditions was similar. All errors produced by Group I were lexical errors. The first condition, *Same gender singular nouns* condition, was more impaired than the second condition, *different gender singular nouns* condition, in both the head and the modifying nouns.

Whereas Group I produced inflectional errors in the *Number and Gender Agreement Subtest* and the *Definiteness Agreement Subtest*, all errors produced in the *Construct State Subtest* were lexical errors.

8.3 Group II overall accuracy

Table 8.2: Group II correct responses

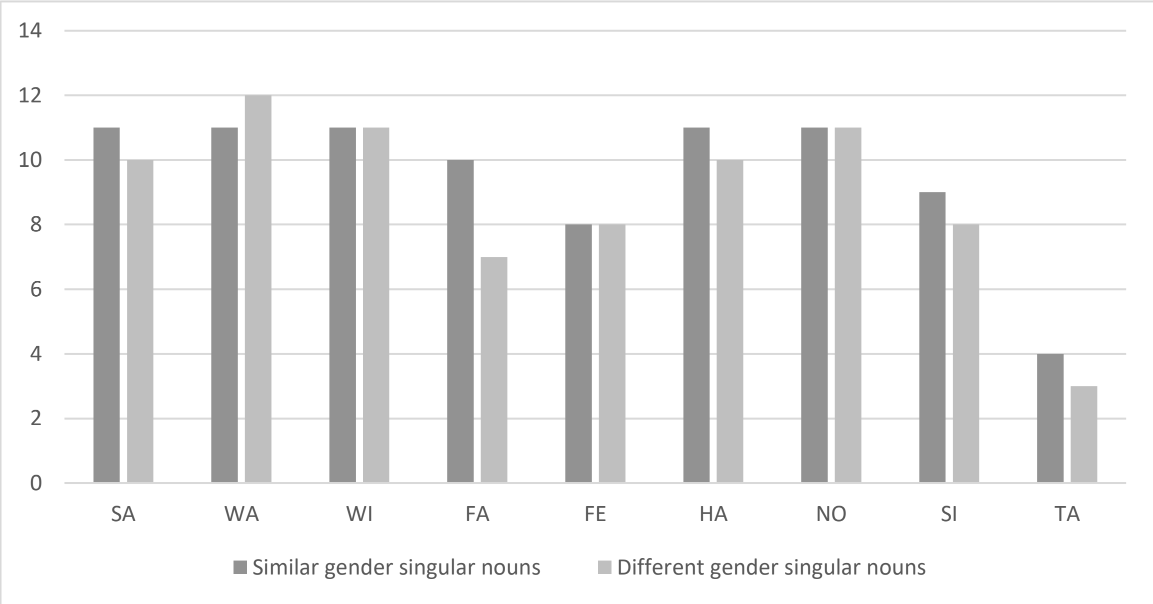
Participant	Same gender singular nouns (Indef-N-M.SG/F.SG + Def-N-M.SG/F.SG) (n=12)	Different gender singular nouns (Indef-N-M.SG/F.SG + Def-N-F.SG/M.SG) (n=12)
FA	10	7
FE	8	8
HA	11	10
NO	11	11
SI	9	8
TA	4	3
Total	**53/72**	**47/72**

Group II's performance in the second condition was slightly more impaired than their performance in the second condition.

The results of the overall accuracy data of Group II was statistically analysed. The difference between the two conditions was tested using Wilcoxon two-sample test. The result of the statistical analysis revealed no significant difference in accuracy between the two conditions (z= -1.890, two tailed p=0.059).

Group I and Group II overall accuracy data are shown Figure 8.1.

Figure:8.1: Overall Accuracy of Group I (SA, WA and WI) and Group II (FA, FE, HA, NR, SI and TA) in the construct state subtest



The data showed that some participants in Group II performed similarly to participants in Group I. This can be seen in FA's performance in the first condition only and HA and NR's performance in both conditions. The statistical analysis illustrated that the *different gender singular nouns* condition was more impaired than the *Same gender singular nouns* condition in both groups.

Group I and Group II overall accuracy data were statistically analysed using Pearson's chi-square. For each condition, the correct and the incorrect responses by each group were analysed. The analysis revealed significant difference in both the first condition (X^2 (1) = 4.823, p = 0.028) and the second condition (X^2 (1) = 9.428, p = 0.002). In other words, there was a statistically significant difference between the accuracy of the first condition and the second condition with the first condition being more accurate in both groups.

8.3.1 Summary of group II overall accuracy

The data showed that the second condition, *different gender singular nouns* condition, was slightly more impaired than first condition, *Same gender singular nouns* condition, in Group II. This was different from Group I's data where the group performed similarly in the two conditions. In each condition, the difference between the correct and the incorrect responses by each group was statistically significant.

8.4 Group II errors analysis

Errors produced by Group II were analysed across participants. The inflectional, agreement and lexical errors produced by Group II were analysed separately.

8.4.1 Inflectional errors

Group II produced inflectional errors in both conditions. The inflectional errors that affected the head nouns were first analysed. Table 8.3 presents the head noun inflectional errors. Appendix K and Appendix T illustrate the coding of inflectional errors.

Table 8.3: Group II head noun inflectional errors irrespective of lexical errors

Category	**Same gender singular nouns** (Indef-N-M.SG/F.SG + Def-N-M.SG/F.SG) n=72	**Different gender singular nouns** (Indef-N-M.SG/F.SG + Def-N-M.SG/F.SG) n=72
Correct inflections of head noun	62	54
Substitution of Definiteness	1	3
No response	9	15
Total	72	72

The above table shows that Group II performed slightly better in the *Same gender singular nouns* condition. Inflectional errors in the head nouns did not involve any gender or number substitution errors. The most commonly occurring error was *no response*. However, all *no response* errors were due to omission of the lexical items. *Substitution of definiteness* errors existed. Definiteness substitution in the head nouns was indefinite to definite substitution.

One sample chi-square test was used to test for significant difference between the error categories *substitution of definiteness* and *no response* across conditions. The statistical analyses using one sample chi-square revealed significant results with the *no response* error being the most frequent error type (χ^2 (1) = 14.286, p=.000).

The inflectional errors that affected the modifying nouns were then examined. The results of the modifying noun inflectional errors are shown in Table 8.4.

Table 8.4: Group II modifying noun inflectional errors irrespective of lexical errors

Category	**Same gender singular nouns** (Indef-N-M.SG/F.SG + Def-N-M.SG/F.SG) n=72	**Different gender singular nouns** (Indef-N-M.SG/F.SG + Def-N-M.SG/F.SG) n=72
Correct inflections of modifying noun	63	56
Substitution of Definiteness	2	9
Substitution of gender	2	1
Substitution of gender & number	1	0
No response	4	6
Total	72	72

Like head noun inflectional errors, the data from Table 8.4 show that Group II's performance in the *Same gender singular nouns* condition was better than the performance in the *different gender singular nouns* condition. Unlike head noun inflectional errors, the data show that Group II produced some gender and number errors in the modifying noun inflections and gender errors were more than number errors. Yet, the common inflectional errors in the modifying nouns were *substitution of definiteness*. Definiteness substitution in the modifying nouns was definite to indefinite substitution.

The one sample chi-square test was used to test the difference between the error categories *substitution of definiteness, substitution of gender, substitution of gender and number* and *no response* across conditions. The results of the statistical analyses showed significant difference between them and *substitution of definiteness* was the most frequent error type (χ^2 (3) = 11.960, p=.008).

As for the type of gender and number substitution errors in the modifying nouns. the data are shown in Table 8.6.

Table 8.5: Group II types of modifying noun substitution of gender and substitution of gender and number errors

Category	Same gender singular nouns (Indef-N-M.SG/F.SG + Def-N-M.SG/F.SG) n=72	Different gender singular nouns (Indef-N-M.SG/F.SG + Def-N-M.SG/F.SG) n=72
Substitution with M SG	1	1
Substitution with F SG	1	0
Substitution with M PL	1	0

Table 8.5 shows that gender and number substitution errors involved substitution with the M SG, F SG and M PL only and very few instances of this were recorded.

8.4.1.1 Summary of inflectional errors

In both head noun inflectional errors and modifying noun inflectional errors, Group II performance in the first condition, *Same gender singular nouns* condition, was more spared than their performance in the second condition, *different gender singular nouns* condition. *No response* errors were common inflectional errors in the head nouns; however, all *no response* errors resulted from omission of the lexical items. *Substitution of definiteness* inflection errors existed in the head nouns and they were indefinite to definite substitutions. *Substitution of definiteness* inflection errors existed in the modifying nouns and they were frequent errors. Definiteness substitutions in the modifying nouns were toward the less inflected form and they were definite to indefinite substitutions. The data included some gender and number substitution errors and gender errors were more than number errors. Unlike Group II, the data showed that Group I did not produce inflectional errors.

8.4.1.2 Inflectional errors across subtests

Definite to indefinite substitutions were toward the less inflected form and were also prevalent in the *Definiteness Agreement Subtest*. Substitutions with less inflected form was also common in the *Number and Gender Agreement Subtest.* Similar to both the *Definiteness Agreement Subtest Number and Gender Agreement Subtest*, gender substitution errors in the current subtest were more than number substitution errors.

8.4.2 Lexical errors

Coding of lexical errors is shown in Appendix J. The lexical errors that affected the head nouns are shown in Table 8.6.

Table 8.6: Group II types of head noun lexical errors irrespective of inflections

	Same gender singular nouns (Indef-N-M.SG/F.SG + Def-N-M.SG/F.SG) n=72	**Different gender singular nouns** (Indef-N-M.SG/F.SG + Def-N-M.SG/F.SG) n=72
Correct head noun	62	54
Semantic	0	2
URNW	0	1
Miscellaneous	1	0
No response	9	14
Description	0	1
Total	72	72

Note. URNW= unrelated non-word.

Table 8.7 illustrates that accuracy in the first condition was higher than accuracy in the second condition. *No response* errors were common lexical errors in the head nouns.

The difference between the errors categories *semantic, unrelated non-word, miscellaneous, no response* and *description* was statistically tested across conditions using one sample chi-square. The analyses using one sample chi-square showed significant difference between them (χ^2 (4) = 67.714, p=.000).

The lexical errors that occurred in the modifying nouns were then examined and are shown in Table 8.7.

Table 8.7: Group II types of modifying noun lexical errors irrespective of inflections

	Same gender singular nouns (Indef-N-M.SG/F.SG + Def-N-M.SG/F.SG) n=72	**Different gender singular nouns** (Indef-N-M.SG/F.SG + Def-N-M.SG/F.SG) n=72
Correct modifying noun	60	58
Semantic	7	5
Unrelated	1	0
PRNW	0	1
URNW	0	1
Miscellaneous	1	1
No response	3	4
Description	0	2
Total	72	72

Note. PRNW = phonologically related non-word. URNW= unrelated non-word.

Similar to the lexical errors in the head nouns, the first condition was more preserved than the second condition. Unlike head noun lexical errors, *semantic* errors were common lexical errors in the modifying nouns.

The difference between the lexical errors was tested using one sample chi-square. The results of one sample chi-square showed significant difference between the lexical error types (χ^2 (6) = 28.923, p=.000).

The data showed that there were almost equal numbers of head noun lexical errors and modifying noun lexical errors.

8.4.2.1 Summary of lexical errors

It can be seen from the data that the performance of Group II in the first condition, *Same gender singular nouns* condition, was more spared than the group's performance in the second condition, *different gender singular nouns* condition. In addition, *no response* errors were common errors in the head nouns whereas *semantic* errors were frequent errors in the modifying nouns.

Whereas the first condition was more spared than the second condition in Group II, Group I's first condition was more impaired than the second condition in both the head and modifying nouns.

8.4.2.2 Lexical errors across subtests

While either the noun or the adjective had higher accuracy than the other in the *Number and Gender Agreement Subtest* and the *Definiteness Agreement Subtest*, the number of head noun lexical errors and modifying noun lexical errors were almost equal in the current subtest.

8.5 Outliers in Group II

Clear outliers were not observed in Group II's results, and no marked different patterns of errors were produced by the participants in the group.

8.6 Summary

The results of the *Construct State Subtest* were presented in this chapter. Group I's results were first shown and then the results of Group II were introduced.

The overall accuracy data for Group I showed that Group I produced very few errors and the numbers of the correct responses in each condition were equal. The analysis of errors by Group I revealed that all errors were lexical errors. The first condition, *Same gender singular nouns* condition, was more impaired than the second condition, *different gender singular nouns* condition, in both the head and modifying nouns.

Group II overall accuracy data showed that the first condition, *Same gender singular nouns* condition, was more preserved than the second condition, *different gender singular nouns* condition. This was also seen in the analysis of errors data n Group II. To illustrate, the accuracy in the first condition was higher than accuracy of the second condition in both the head and modifying noun inflectional errors. The first condition was also more spared than the second condition in the analysis of both the head and modifying noun lexical errors.

Group II head noun inflectional errors included *Substitution of definiteness* errors where were indefinite inflections were substituted with definite inflections. *Substitution of definiteness* inflection errors were frequent errors in the modifying nouns. All definiteness substitutions in the modifying nouns were definite to indefinite substitutions. Moreover, *no response* errors were common head noun lexical errors whereas the most prevalent lexical errors in the modifying nouns were *semantic* errors.

Group I and Group II differed in the overall accuracy data and in the analysis of errors data. Whereas Group I's errors in both conditions were equal, Group II's errors in the second condition were more frequent than errors in the first condition. Group I did not produce inflectional errors unlike Group II. Group I produced lexical errors like Group II. However, Group I's lexical errors were more prevalent in the first condition than in the second condition unlike Group II.

Most of the inflectional errors in *Construct State Subtest* consisted of inflectional substitution errors in the definite inflection where definite was substituted with the indefinite form. Definite to indefinite substitutions were also frequent inflectional errors in the *Definiteness Agreement Subtest.* Definite to indefinite substitutions is toward the less inflected form and substitutions with less inflected forms were commonly occurring inflectional errors in the *Number and Gender Agreement Subtest* and the *Definiteness Agreement Subtest*. Like the *Number and*

Gender Agreement Subtest and the *Definiteness Agreement Subtest*, gender substitution errors were more than number substitution errors in the current subtest.

The next chapter shows the group results in the *Non-Construct State Subtest*. The results are discussed in Chapter Ten.

9. RESULTS OF NON-CONSTRUCT STATE SUBTEST

The group results in the fourth subtest which is the *Non-Construct State Subtest* are shown in this chapter. Participants were asked to produce a noun phrase that consisted of a head noun, a particle (***ħag*** 'for') and a modifying noun (***Indef-N-Infl + ħag-Infl + Def-N-Infl***). In this type of noun phrase, the particle must agree with the head noun in number and gender. Chapter Two presents the noun phrase structure, conditions and number of items.

Like all other tests, the data in this chapter was non-normally distributed. Pearson's chi-square was used to test the relationship between two categorical variables such as accuracy in terms of correct and incorrect.

9.1 Group I overall accuracy

The overall accuracy of Group I was first analysed. Group I overall accuracy is presented in Table 9.1.

9.1: Group I correct responses

Participant	M SG (Indef-N-M.SG + ħag-M.SG + Def-N-M.SG/F.SG) (n=10)	F SG (Indef-N-F.SG + ħag-F.SG + Def-N-M.SG/F.SG) (n=14)
SA	8	14
WA	10	13
WI	9	11
Total	**27/30**	**38/42**

Table 9.1 shows that there were few errors made by Group I. It can also be seen that the two conditions had the same proportion of errors.

9.2 Group I errors analysis

The errors made by each person were analysed separately. The analysis considered the types of the lexical, inflectional and agreement errors produced. Coding of errors is in Appendix J, Appendix K, Appendix L and Appendix T.

SA made only two inflectional errors and two agreement errors. The inflectional errors occurred in the particle (*ħag*). The masculine singular inflections were substituted with the feminine singular inflection. The agreement errors were *ungrammatical* errors. This type of error was due to gender substitution in the particle.

WA produced one lexical error only. This error was a modifying noun *semantic* error in the feminine singular condition.

The errors produced by WI were then analysed. Table 9.2 and 9.3 present WI's production.

Table 9.2: WI types of lexical, inflectional and agreement errors in M SG targets

Category	*item*	*N1*	*Infl*	*ħag*	*Infl*	*Def*	*N2*	*Infl*	*Agreement*
M SG	1	T	T	T	T	T	T	T	T
	2	T	T	T	T	T	T	T	T
	3	T	T	T	T	T	T	T	T
	4	T	T	T	T	T	T	T	T
	5	T	T	T	T	T	T	T	T
	6	T	T	T	T	T	T	T	T
	7	T	T	T	T	T	T	T	T
	8	T	T	T	T	T	T	T	T
	9	T	T	T	**F SG**	T	T	T	**Ungrammatical**
	10	T	T	T	T	T	T	T	T

Note. Infl = gender and number suffix. Def = definiteness prefix. Indef.= indefinite prefix. T= target.

Table 9.3: WI types of lexical, inflectional and agreement errors in the F SG targets

Category	*Item*	*N1*	*Infl*	*Hag*	*Infl*	*Def*	*N2*	*Infl*	*Agreement*
F SG	1	T	T	T	**M SG**	T	T	**M SG**	**Ungrammatical**
	2	T	T	T	T	T	T	T	T
	3	T	T	T	T	T	T	T	T
	4	T	T	T	T	T	T	T	T
	5	T	T	T	T	T	T	T	T
	6	T	T	T	T	T	T	T	T
	7	T	T	T	T	T	T	T	T
	8	T	T	T	**M SG**	T	T	T	**Ungrammatical**
	9	T	T	T	T	T	T	T	T
	10	T	T	T	T	T	T	T	T
	11	T	T	T	T	T	T	T	T
	12	T	T	**NR**	**NR**	**NR**	**NR**	**NR**	**NTC**
	13	T	T	T	T	T	T	T	T
	14	T	T	T	T	T	T	T	T

Note. Infl = gender and number suffix. Def = definiteness prefix. NR = no response.

WI made inflectional, lexical and agreement errors. Most errors were in the feminine singular condition. Inflectional errors were substitution of the gender inflections in the particle. This type of inflectional error resulted in *ungrammatical* errors.

9.2.1 Summary of Group I errors

It can be seen from the above data that most errors produced by Group I were inflectional and agreement errors. Most inflectional errors were substitution of the gender inflections in the particle. All agreement errors were *ungrammatical* errors and substitution of the gender inflections in the particle was a main reason for *ungrammatical* errors. The data showed three lexical errors two of which occurred in the modifying nouns.

9.3 Group II overall accuracy

The overall accuracy of all participants in Group II was examined. Table 9.4 shows the overall accuracy data.

Table 9.4: Group II correct responses

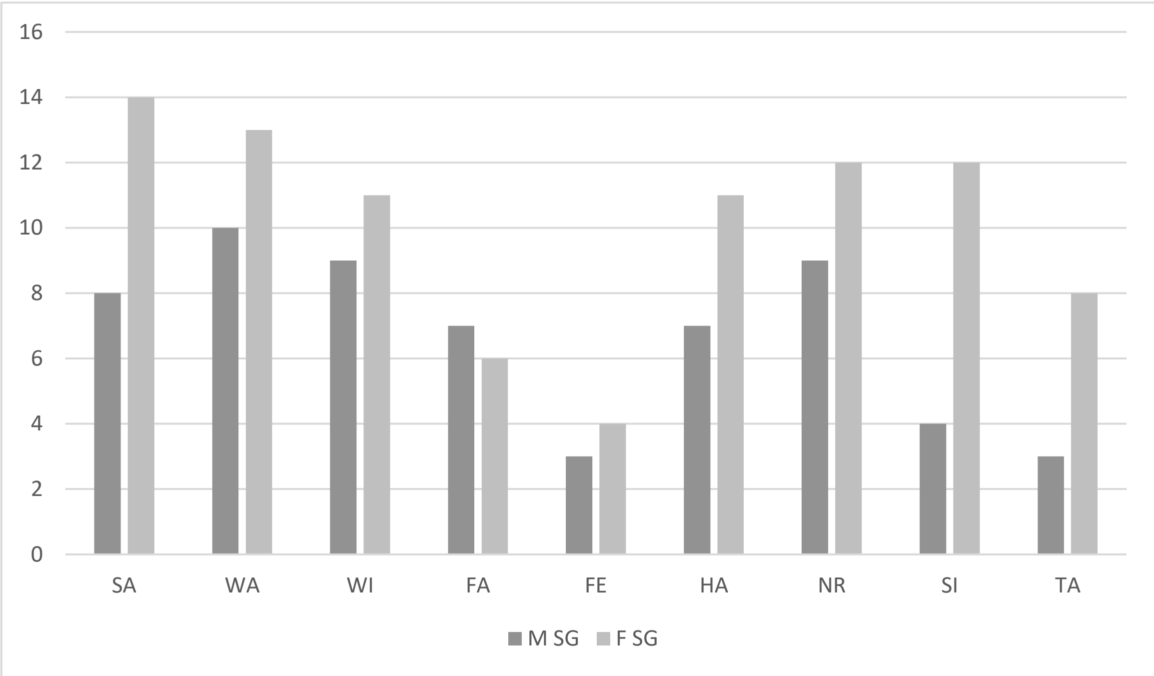
Participant	M SG (Indef-N-M.SG + ħag-M.SG + Def-N-M.SG/F.SG) (n=10)	F SG (Indef-N-F.SG + ħag-F.SG + Def-N-M.SG/F.SG) (n=14)
FA	7	6
FE	3	4
HA	7	11
NR	9	12
SI	4	12
TA	3	8
Total	**33/60**	**53/84**

The data in Table 9.4 showed that Group II showed higher accuracy in the F SG condition. This is different from Group I's overall accuracy data where the group performed similarly in the two conditions.

The difference between the two conditions in Group II was analysed using Pearson's Chi-square. The analysis showed insignificant difference between them ($X^2(1) = 0.954$, $p = 0.329$).

Figure 9.1. shows Group I and Group II overall accuracy data.

Figure: 9.1: Overall Accuracy of Group I (SA, WA and WI) and Group II (FA, FE, HA, NR, SI and TA) in the non-construct state subtest



The above graph shows that some participants in Group II performed similarly to participants in Group I. This can be seen in NR's performance in the M SG condition and HA, NR and SI's performance in the F SG condition.

Group I and Group II data were statistically analysed using Pearson's chi-square. For each condition, the correct and the incorrect responses by each group were analysed. The analysis showed significant difference in both the M SG condition ($X^2(1) = 11.025$, $p = 0.001$) and the F SG condition ($X^2(1) = 10.464$, $p = 0.001$). This revealed that the M SG was statistically more impaired than the F SG in both groups.

9.3.1 Summary of Group II overall accuracy

While Group I performed similarly in the M SG and the F SG condition, Group II's performance in the F SG was more preserved. The difference between the correct and the incorrect responses by each group was statistically significant in each condition.

9.4 Group II Errors Analysis

The errors that Group II produced were analysed across participants. The inflectional, agreement and lexical errors produced were analysed separately.

9.4.1 Inflectional errors

The inflectional errors were first analysed irrespective of any other errors such as agreement errors. The inflectional errors that affected the head nouns, the particle *ħag* and the modifying nouns are introduced from Table 9.5 to Table 9.9. The codes of inflectional errors are shown in Appendix K and Appendix T.

Table 9.5: Group II head noun inflectional errors irrespective of lexical errors

Type of response	**M SG** (Indef-N-M.SG) (n=60)	**F SG** (Indef-N-F.SG) (n=84)
Correct noun inflection	52	75
No response	8	9
Total	60	84

It can be seen from Table 9.5 that Group II produced a small number of inflectional errors in the head nouns. It can also be seen that the group's performance in the two conditions were similar. In addition, Group II produced only one type of inflectional errors which was *no response* error.

The correct and the incorrect responses in each condition were analysed using Pearson's chi-square test. The result revealed that there was no significant difference between the two conditions ($X^2(1) = 0.231$, $p = 0.631$).

Table 9.6 presents the inflectional errors that affected the particle.

Table 9.6: Group II *ħag* inflectional errors irrespective of lexical errors

Type of response	M SG (ħag-M.SG) (n=60)	F SG (ħag-F.SG) (n=84)
Correct particle inflection	41	77
Substitution of gender	15	2
No response	4	5
Total	60	84

The above table illustrates that the group produced more errors in the M SG condition. The table also showed that most errors produced by Group II were substitution of gender errors. In addition, the difference between the accuracy of the two conditions was tested using Pearson's chi-square test. The results of the statistical analysis showed the M SG was significantly more impaired (X^2 (1) = 12.879, p = 0.000).

The types of gender substitution errors produced by Group II in the particle are presented in Table 9.7.

Table 9.7: Group II types of *ħag* gender substitution errors

Type of substitution	**M SG** (ħag-M.SG) (n=60)	**F SG** (ħag-F.SG) (n=84)
Substitution with M SG	-	2
Substitution with F SG	15	-

Data in Table 9.7 shows that substitution of the M SG with the F SG inflection was prevalent. Substitution of M SG with F SG is toward a more inflected form; that is, the M SG inflection which is phonologically absent was substituted with the F SG inflection which is phonologically present.

The inflectional errors of the modifying nouns are shown in Table 9.8.

Table 9.8: Group II modifying noun inflectional errors irrespective of lexical errors

Type of response	M SG (Def-N-M.SG/F.SG) (n=60)	F SG (Def-N-M.SG/F.SG) (n=84)
Correct noun inflection	55	69
Substitution of Definiteness	3	4
Substitution of gender	0	8
Substitution of gender & number	0	1
No response	2	2
Total	60	84

Unlike the inflectional errors produced in the particle, Group II produced more errors in the F SG condition. Moreover, substitution errors were prevalent errors in the modifying nouns. Substitution errors consisted of *substitution of definiteness*, *substitution of gender* and *substitution of gender and number*. *Substitution of definiteness* involved producing indefinite instead of definite inflection. There were four *no response* errors produced by Group II in the modifying noun inflections.

Pearson's chi-square test was used to test the difference between the two conditions. The results showed no difference in terms of accuracy between the two conditions (X^2 (1) = 2.654, p = 0.103).

The types of the modifying nouns substitution errors are introduced in Table 9.9.

Table 9.9: Group II types of modifying noun gender substitution and number and gender substitution errors

Type of substitution	F SG (Def-N-M.SG/F.SG) (n=84)
Substitution with M SG	6
Substitution with F SG	2
Substitution with M PL	1

Table 9.9 shows that substitution errors occurred only in the F SG condition. It also shows that substitutions of gender were more frequent than substitution of gender and number, and substitutions with the M SG was dominant.

9.4.1.1 Summary of inflectional errors

Group II produced different types of inflectional errors in the head noun, the particle and the modifying noun. The head nouns involved *no response* errors only and the number of errors were similar in the two conditions. *Substitution of gender* errors were prevalent errors in the particle and most errors occurred in the M SG condition involving substituting the M SG with the F SG inflections. This type of substitution is toward the more inflected form which is unlike common types of substitutions in the previous subtest. The most commonly occurring errors in the modifying nouns were also substitution errors; however, there were more errors in the F SG condition. In addition, the most frequent type of substitution errors in the modifying nouns consisted of *substitution of definiteness* and *substitution of gender*. These types were substitutions toward the less inflected form which is common in the previous subtest. Whereas Group II produced different types of inflectional errors, most inflectional errors produced by Group I were *gender substitution* errors in the particle.

9.4.1.2 Inflectional errors across subtests

Substitution of gender and *substitution of definiteness* errors were prevalent errors in the *Non-Construct State Subtest*. All substitution errors in the particle were M SG to F SG substitutions involving a substitution toward the more inflected form. This was an uncommon type of substitutions in all previous subtests. Substitutions in the previous subtests were toward the less inflected form; the definite was substituted with the indefinite inflections, and the F SG was substituted with M SG inflections. However, all substitution errors in the modifying nouns were toward the less inflected form. This was in line with data from all other previous subtests.

In addition, there were more gender errors than number errors in the current subtest and this was also similar to data from previous subtests.

9.4.2 Agreement errors

Agreement in *the Non-Construct State Subtest* refers to the internal agreement between the head noun and the particle gender and number inflections. Coding of agreement is described in Appendix L and Appendix T. Table 9.10 shows the result of the overall agreement produced by Group II.

Table 9.10: Group II overall agreement

Type of response	**M SG** (Indef-N-M.SG + ħag-M.SG + Def-N-M.SG/F.SG) (n=60)	**F SG** (Indef-N-F.SG + ħag-F.SG + Def-N-M.SG/F.SG) (n=84)
Correct agreement	41	75
Ungrammatical	15	3
Not able to compute	4	6
Total	60	84

Note. Correct agreement= inflections and agreement are target, lexical items may or may not be target. Not able to compute = not able to compute when the response involves omission of the noun with its inflections, the adjective with its inflections or the noun and the adjective with their inflections.

The table shows that the M SG condition involved more errors than the F SG condition. The table also illustrates that the most occurring agreement error type was *ungrammatical* error.

The result of the agreement was analysed. The analysis using Pearson's chi-square showed significant difference between the two conditions (X^2 (1) = 9.809, p = 0.002).

Table 9.11 demonstrates the types of *ungrammatical* phrases produced by Group II.

Table 9.11: Group II type of ungrammatical phrase

Error	**M SG** (Indef-N-M.SG + ħag-M.SG + Def-N-M.SG/F.SG) (n=60)	**F SG** (Indef-N-F.SG + ħag-F.SG + Def-N-M.SG/F.SG) (n=84)
***ħag* gender and number inflection**	12	3
Head noun, **Head noun gender and number inflection,** ***& ħag* gender and number inflection**	3	0
Total	15/60	3/84

Note. Error= omission or substitution error.

It can be seen from Table 9.11 that most errors occurred due to wrong inflection production in the particle (- *ħag* Infl**)**.

9.4.2.1 Summary of agreement errors

The data showed that agreement in the M SG condition was more impaired than agreement in the F SG condition. Most agreement errors were *ungrammatical* errors due to production of non-target inflection in the particle. This is similar to data from Group I were all *ungrammatical* errors resulted from substitution of gender inflections in the particle.

9.4.2.2 Agreement errors across subtests

While most *ungrammatical* errors in the *Number and Gender Agreement Subtest* and *Definiteness Agreement Subtest* were due to incorrect adjective inflections, most *ungrammatical* errors in the current subtest resulted from non-target inflections in the particle. It can be seen that the *ungrammatical* errors in all subtests were not due to wrong inflections in the head nouns. In other words, most *ungrammatical* errors in all subtests resulted from inflectional errors in either the adjective or the particle but not the head noun.

9.4.3 Lexical errors

The last analysis of errors concerned the lexical errors produced by Group II. Group II produced both head noun and modifying noun lexical errors. Coding of lexical errors is shown in Appendix J. Table 9.12 presents the head noun lexical errors.

Table 9.12: Group II head noun lexical errors irrespective of inflections

Type of response	M SG (Indef-N-M.SG) (n=60)	F SG (Indef-N-F.SG) (n=84)
Correct head noun	52	73
Unrelated	0	1
PRNW	0	1
URNW	0	1
No response	8	8
Total	60	84

Note. PRNW = phonologically related non-word. URNW = unrelated non-word.

It can be seen from Table 9.12 that the group performed similarly on the two conditions. Most errors in the head nouns were *no response* errors.

The data of the head noun lexical errors were analysed. The statistical analysis using Pearson's chi-square revealed insignificant difference between the accuracy of the two conditions (X^2 (1) = 0.002, p = 0.967).

Table 9.13 shows the lexical errors that occurred in the modifying nouns.

Table 9.13: Group II modifying noun lexical errors irrespective of inflections

Type of response	M SG (Indef-N-M.SG) (n=60)	F SG (Indef-N-F.SG) (n=84)
Correct modifying noun	46	66
Semantic	12	14
URNW	0	1
Miscellaneous	0	1
No response	2	2
Total	60	84

Note. URNW = unrelated non-word.

Like errors in the head nouns, the group produced similar number of errors in both conditions. Unlike head noun lexical errors, the most commonly occurring errors were *semantic* errors.

The correct and the incorrect responses in the M SG and the F SG condition were tested using Pearson's chi-square. The test showed insignificant difference between the conditions (X^2 (1) > = 0.073, p = 0.786).

9.4.3.1 Summary of lexical errors

The data showed that the group produced more errors in the modifying nouns. *No response* errors were dominant errors in the head nouns and the most commonly occurring errors in the modifying nouns were *semantic* errors. Similarly, most of the lexical errors by Group I were modifying noun lexical errors.

9.4.3.2 Lexical errors across subtests

In the *Number and Gender Agreement Subtest,* there were more adjective lexical errors than noun lexical errors. In contrary, the *Definiteness Agreement Subtest* included more noun lexical errors than adjective lexical errors. The head nouns lexical errors and the modifying nouns lexical errors were almost equal in accuracy level in the *Construct State Subtest*. There were more modifying noun lexical errors than head noun lexical errors in the *Non-Construct State Subtest*. Both the current subtest and *Number and Gender Agreement Subtest* showed higher lexical accuracy in the head nouns. It can be seen that head nouns were more intact than modifying adjectives or nouns across subtests.

9.5 Outliers in Group II

The data did not show clear outliers in Group II's results.

9.6 Summary

The overall accuracy data of Group I revealed that the group performed similarly in the two conditions. In the analysis of errors data, it was seen that the most commonly occurring errors produced by Group I were inflectional and agreement errors. Most inflectional errors were *gender and number substitution* errors that occurred in the particle. All agreement errors were *ungrammatical* errors resulted from gender and number substitution in the particle.

Group II produced more errors in the M SG condition. Group II produced different types of inflectional, agreement and lexical errors. The head nouns inflectional errors involved *no response* errors only and substitution errors were prevalent errors in the particle and the modifying nouns. Substitution with F SG inflection was prevalent type of substitution in the particle whereas substitution with the M SG was common in the modifying nouns. Most agreement errors by Group II were *ungrammatical* errors due to wrong inflections of the particle. There were more agreement errors in the M SG condition than errors in the F SG condition. In addition, Group II produced more lexical errors in the modifying nouns than lexical errors in the head nouns. *No response* errors were common head noun errors whereas *semantic* errors were the most commonly occurring errors in the modifying nouns.

Whereas Group I's performance in the two conditions was similar in the overall accuracy data, the M SG were more impaired than the F SG in Group II. Most of Group I's inflectional errors occurred in the particle only; however, Group II produced different inflectional errors in the head noun, the particle and the modifying noun. Most agreement errors by both groups were *ungrammatical* errors due to wrong inflections of the particle, and most of the lexical errors by both groups were modifying noun lexical errors.

Unlike previous subtests, all inflectional substitution errors in the particle in the *Non-Construct State Subtest* were toward the more inflected form were the M SG was substituted with the F

SG. Similar to most common type of substitutions in previous subtests, all inflectional substitution errors in the modifying nouns were toward the less inflected form. There were more gender errors than number errors in the current subtest and this was in line with data from all other previous subtests. Like all other subtests, the *ungrammatical* errors in the current subtest were not due to wrong inflections in the head nouns. In addition, the lexical data showed that both the current subtest and *Number and Gender Agreement Subtest* showed higher lexical accuracy in the head nouns.

The results of the four subtests are discussed in following chapter.

10. DISCUSSION

This study has examined NP production by adult Arabic speakers with aphasia and with varying levels of morpho-syntactic production deficits. The study explored the lexical, inflectional and agreement production in three different NP types in Arabic. The study aimed to analyse the data in light of the relevant morpho-syntactic theories of Arabic NP and agrammatism, psycholinguistic theories of gender and number processing and usage-based theories of agrammatism. Nine people took part in expressive language tasks devised specifically for the investigation.

The participants were classified into two groups based on their aphasia assessment results and the diagnosis provided by their speech and language therapists. The first group included participants with mild aphasia, whereas the second group included participants with moderate to severe aphasia. The classification of the two groups was also supported by their results in the current investigation. Group I produced very few lexical, inflectional and agreement errors across subtests compared to Group II who showed higher degrees of impairment at all three levels. It should be noted that an overlap between the two groups was sometimes present in the performance of some of the groups' members within some subtests.

While Group I produced fewer errors than Group II across subtests, the two groups showed similar patterns of impairments as summarized in the following:

- number was better retained than gender
- greater impairment in feminine than in masculine
- greater impairment in plural than in singular
- feminine plural was the most impaired category
- greater impairment in definite than in indefinite

- most ungrammatical phrases were due to nontarget adjective inflections or particle inflections

However, the two groups sometimes performed differently within a subtest. In the *Construct State Subtest*, Group I did not produce inflectional errors, unlike Group II. Group I's lexical errors in the same subtest were more prevalent in the first condition (M SG head noun), than in the second condition (F SG head noun), unlike Group II. In the *Non-construct State Subtest*, most of Group I's inflectional errors occurred in the particle only; however, Group II produced different inflectional errors in the head noun, the particle and the modifying noun.

In the following, the findings across groups are discussed taking into consideration a range of various theoretical stances: morpho-syntactic, usage-based and psycholinguistic. The chapter begins with a discussion of the data in the context of morpho-syntactic theories which include the Bundling Model (Carstens, 2003) and the Splitting Model (Carminati, 2005) for the representation of gender and number and the N-raising Hypothesis (Ritter, 1991) and the Phrasal Movement Hypothesis (Shlonsky, 2003) which deal with the syntax of Arabic NP. Morpho-syntactic theories of agrammatism particularly the Tree Pruning Hypothesis (Friedmann,1994; Friedmann & Grodzinsky,1997) and Distributed Morphology Hypothesis (Dickey et al., 2008; Lee et al., 2008; Thompson et al., 2002) are also considered in the first section. The effect of frequency on production (Bybee, 2007) and the ProGram theory (Boye & Harder, 2012) as argued for by usage-based accounts is then discussed. Finally, the results are examined within the Weaver ++ model (Levelt et al., 1999) and the Dual Mechanism accounts (Kiparsky, 1982; Pinker and Ullman, 2002) which deal with the psycholinguistic processing of gender and number.

The chapter also discusses the assignment of the participants to groups and the development of the coding system. The chapter ends with conclusions followed by the limitations and recommendations of the study.

10.1 Morpho-syntactic accounts

This section discusses the results from the view point of morpho-syntactic theories of number and gender, syntactic theories of Arabic NP and theories of agrammatism. Applications of these theories in the current study might contribute to the understanding of such theories as well as provide useful implications to assessment and intervention in aphasia.

This section is divided into four main subsections: overall production of number and gender, inflectional errors, agreement errors and lexical errors. In the inflectional errors, the number, gender and definiteness errors are discussed independently.

10.1.1 Overall production of gender and number

The overall production of gender and number across all the subtests and across all elements of the different NPs including noun, adjective and particle is discussed in this section. The gender and number errors are discussed together because they morphologically appear in one inflection. Because gender and number are different grammatical units, they will also be discussed independently in section (10.1.2).

The current study is the first study that reports results for the overall production of number and gender within NP in agrammatism. The group results across subtests showed that gender errors were more prevalent than number errors. These errors were inflectional errors that occurred in different lexical items, including head nouns, modifying nouns or adjectives, and the particle *ħag.* For example, where the target includes a head noun inflected for gender and number and an adjective inflected for the same, the errors typically involved gender errors with the adjective, but retention of gender and number for the head noun (e.g. /*mudarris-ah* t^{ς}*iwi:l*/ 'teacher.F.SG tall.M.SG').

While this was the pattern across conditions and subtests, most of the items across subtests were singular items which do not allow for a clear comparison between gender and number inflections. This is because Arabic M SG is bare which does not clearly indicate about gender and number production, and gender in the Arabic F SG is hypothesised to be part of the noun at the lexicon rather than an inflection added to it at the syntax (Fassi-Fehri, 1989; 1993). Since Arabic M SG is bare and the F SG gender is assumed to be lexically assigned, the difference between gender and number errors can be best tested in the plural condition, which is present in the *Gender and number Agreement Subtest*. Both gender and number in the plural conditions are present. In the plural condition, gender was better preserved than number where participants retained the gender but substituted number. This suggests that gender was better preserved than number in the current data. This result can be explained in the context of the Bundling Model (Carstens, 2003) and the Splitting Model (Carminati, 2005).

10.1.1.1 Morpho-syntactic representation of gender and number in Arabic

The Bundling Model (Carstens, 2003) and the Splitting Model (Carminati, 2005) are morpho-syntactic models of the representation of gender and number. The Bundling Model claims that gender is lexically specified, and all gender morphology is either hosted on the number head or is expressed on the specifier within a number phrase. The Splitting Model assumes that a number phrase dominates the gender phrase, and gender morphology is represented in a separate node hosted on a nominal stem and heads its own projection. Both models claim that the number node is higher than the gender which is either hosted by or positioned in a sperate node under the number node. Being higher in the syntactic tree suggests that it is more complex and thus more impaired in agrammatic production according to some syntactic accounts of agrammatism (Friedmann, 1994; Friedmann & Grodzinsky, 1997). This can explain the current pattern where gender was better retained than number.

While both views agree that number is higher than gender, the Bundling Model (Carstens, 2003) assumes that gender is lexically assigned unlike the Splitting Model (Carminati, 2005). Since gender was preserved unlike number in the production of the Arabic speakers with agrammatism, this might indicate that gender is lexical because retrieval processing is usually spared in agrammatism, unlike morpho-syntactic processing. Since the current data indicate that gender is lexical, this supports the Bundling Model of gender and number which assumes that gender is lexical.

It can be seen that the results of the overall production of gender and number supports the morpho-syntactic hypothesis which argues that gender and number are bundled within a number phrase. The current study is the first study which analyses aphasic data in the context of the Bundling Model and the Splitting Model.

Neurolinguistic theories of agrammatism, namely the Tree Pruning Hypothesis (TPH; Friedmann, 1994; Friedmann & Grodzinsky, 1997) and the Distributed Morphology Hypothesis (DMH; Lee et al., 2005; Thompson et al., 2002), could also explain the overall production of gender and number as discussed in the following section.

10.1.1.2 The role of syntax and morphology in the overall production of gender and number

The pattern of errors where gender was better retained than number can also be explained within the context of neurolinguistic theories of agrammatism. According to the TPH (Friedmann, 1994; Friedmann & Grodzinsky, 1997), higher nodes are more difficult to project for people with agrammatism than lower nodes.

Since number is higher as suggested by the Bundling Model (Carstens, 2003) and the Splitting Model (Carminati, 2005), it is more likely to be impaired than gender, which is lower as TPH predicts.

While the data supported the view that structural hierarchy has an effect on agrammatic production, as reported in previous investigations of agrammatism (Benedet et al., 1998; Burchert, Swoboda-Moll & De Bleser, 2005; Diouny, 2007; Friedmann, 2001; 2002; 2005; Milman, 1997; Stavrakaki & Kouvava, 2003; Wenzlaff & Clahsen, 2005), the data did not show whether the impairment is due to a deficit at language processing or representation. TPH argues that certain nodes at the syntactic tree are pruned in agrammatism and the data did not show any evidence for such assumption.

The current result of the overall production of gender and number could also be explained by DMH (Lee et al., 2005; Thompson et al., 2002). DMH is a neurolinguistic theory which assumes that certain processes of language are impaired in agrammatism rather than language representation. It claims that agrammatism is due to a flawed feature-to-morpheme mapping rather than an inability to project to higher nodes at the syntactic tree.

According to DMH, inflections require feature-to-morpheme mapping and thus are impaired in agrammatism. Since participants produced items that matched the target in gender but not number, it might be argued that the participants were able to map between the *gender* feature and the morpheme but mapping between the *number* feature and the morpheme was flawed. While the claim of the impaired feature-to-morpheme mapping could account for error pattern in the overall production of number and gender, the claim that higher nodes are harder to produce than lower nodes is also valid.

Wang, Yoshida and Thompson (2014) investigated the differences between production of clauses and nominal phrases in light of TPH and DMH. While the current result was accounted for by both hypotheses, Wang et al. concluded that neither the TPH nor the DMH could account for all the production data in their study. There were certain results that could be accounted for by either one of the two theories but not the other.

The above has discussed the overall production of gender and number where gender was better retained than number. This was explained in the context of morpho-syntactic models of gender and number representation and the data supported the Bundling (Carstens, 2003). The result was also analysed according to neurolinguistic theories of agrammatism. It was shown that both the TPH (Friedmann,1994; Friedmann & Grodzinsky, 1997) and DMH (Lee et al., 2005; Thompson et al., 2002) could account for the current pattern of error.

Gender, number and definiteness errors are discussed individually in the next section.

10.1.2 Inflectional errors

This section examines the gender, number and definiteness errors in the context of morpho-syntactic theories.

10.1.2.1 Gender errors

Gender errors are examined in this section. Analysis of gender errors provides a characterisation of gender production within Arabic NP and adds to the cross-linguistic characterisation of production in agrammatism. The analysis of gender errors shows that participants tended to substitute the F SG with the M SG inflection (e.g. /*tˤiwi:l-ah*/ 'tall.F.SG' substituted with /*tˤiwi:l*/ 'tall.M.SG') across subtests, or the F PL with the M PL (e.g. /*ʤalis-a:t*/ 'setting.F.PL' substituted with /*ʤalis-i:n*/ 'setting.M.PL') in the *Gender and Number Agreement Subtest*. Substitution of the F SG with the M SG inflection was the most common gender substitution type within the *Gender and Number Agreement Subtest* and across subtests.

The pattern of errors in gender can be explained in light of the N-raising Hypothesis (Ritter, 1991) and the Phrasal Movement Hypothesis (Shlonsky, 2003) which are syntactic hypotheses of Arabic NP.

The role of syntax in the production of gender errors

The results showed that participants tended to substitute the F SG with the M SG. The preference for the M SG could be explained in light of syntactic hypotheses of Arabic noun phrases: N-raising Hypothesis (Ritter, 1991) and the Phrasal Movement Hypothesis (Shlonsky, 2003). The syntactic hypotheses of Arabic NP claim that a syntactic movement carries the head of the NP to the left of the modifier, resulting in the apparent order of Arabic noun phrases that consists of a noun followed by an adjective. According to one view (N-raising Hypothesis), the noun is raised to determiner (D) position as the specifier of the determiner phrase (DP). The highest adjectival phrase then moves to the specifier of dp1 targeting agreement there (Fassi-Fehri, 1989; 1993). According to another view (Phrasal Movement Hypothesis), the whole NP is raised to the left of the modifiers, moving from specifier to specifier; it then pied-pipes all the elements occurring on the right, resulting in either a reversed or a mirrored order of these elements (Shlonsky, 2003). Both analyses agree on the multiple movements required in producing agreement inflections. Since masculine singular is bare in Arabic, Arabic speakers with agrammatism might prefer masculine singular to reduce the complex syntactic movements when they produce a noun phrase.

The current finding is also similar to previously conducted investigations which showed that gender is specifically impaired at the non-single word level (Vigliocco & Zilli, 1999; Luzzatti & Bleser, 1999; Scarnà & Ellis, 2002; Mondini, Luzzatti, Saletta, Allamano & Semenza, 2005). For example, Luzzatti (1996), who studied production of compound NPs in Italian, reported that participants had severe problems with the implementation of gender, and other morphology, in specific syntactic contexts since they performed well in most of the tasks that tested derivational and inflectional morphology in single nouns but not in compound NPs.

While the claim that the participants of the current study substituted F SG with M SG to reduce syntactic movements, this does not explain substitution of F PL with M PL inflections, which was the second gender substitution error type. When a participant substituted a F PL with a M PL inflection, agreement movements are still required since the participant did not produce bare nouns and adjectives but produced nouns and adjectives with M PL inflections.

Gender substitution can also be explained from a neurolinguistic perspective. The following presents a discussion of gender errors in light of DMH (Lee et al., 2005; Thompson et al., 2002).

The role of morphology in the production of gender errors

DMH (Lee et al., 2005; Thompson et al., 2002), summarised in section 10.1.1.2 above, could also explain the gender substitution errors.

According to DMH, substitutions of F SG with M SG can be explained in two different ways. When a participant produced F SG instead of M SG, the participants have dropped the inflections and produced a NP with bare nouns and adjectives which might be due to flawed feature-to-morpheme mapping since inflections require feature-to-morpheme mapping and thus are impaired in agrammatism. Alternatively, the participants substituted the inflections where they preserved the number but dropped the gender, and this could be explained by hypothesising flawed mapping between the feature and the gender but not the number. Similarly, when a participant substituted F PL with M PL inflections, only mapping between the gender feature and the morpheme was flawed but mapping between the number feature and the morpheme was preserved. However, this contradicts the argument made earlier in this chapter regarding the overall gender and number production. The overall production of gender and number reflected that gender tended to be more preserved than number and this was explained by assuming preserved feature-to-morpheme mapping in gender but not number. It can be seen that DMH can explain substitution of F SG with M SG partially, but does not provide an explanation for the participants' tendency to substitute F PL with M PL inflections.

10.1.2.2 Number errors

This section examines production of number errors. These errors can contribute to the characterisation of number deficits in Arabic agrammatism and to the characterisation of agrammatism cross-linguistically. The analysis of number errors has revealed that participants tended to substitute the F PL plural with the F SG inflection (e.g. /*na:jim-a:t*/ 'asleep.F.PL' was substituted with /*na:jim-ah*/ 'asleep.F.SG'), and the M PL with the M SG (e.g. /*sami:n-i:n*/ 'fat.M.PL' was substituted with /*sami:n*/ 'fat.M.SG') in the *gender and number agreement Subtest*. The most commonly occurring number substitution type was the substitution of the F PL inflections with the F SG inflections.

The pattern of number errors can be examined in light of syntactic hypotheses of Arabic NP. This is discussed in the next section.

The role of syntax in the production of number errors

Similar to gender substitution errors, the preference for M SG and F SG over M PL and F PL could be explained from a syntactic point of view. Both of the N-raising Hypothesis (Ritter, 1991) and the Phrasal Movement Hypothesis (Shlonsky, 2003; introduced in Chapter Three) claim that a syntactic movement carries the head of the NP to the left of the modifier, resulting in the apparent order of Arabic noun phrases, and then other movements are required to produce agreement inflections. When participants produce M SG, they reduce agreement movements since M SG is bare in Arabic. In other words, participants produce a bare noun and a bare adjective when they produce a M SG NP and thus no agreement movement is required. When they produce F SG, they also avoid agreement movements because F SG is assumed to be lexically specified; the inflection in the F SG is part of the noun at the lexicon and does not require the adding of inflections at the syntax (Fassi-Fehri, 1989; 1993). This analysis suggests that singular inflections are easier than plural inflections for the Arabic agrammatic participants in the current study.

Similar to the current result where participants tended to substitute plural with singular inflections, Ahlsen et al (1996), who explored the NP production in agrammatism in Swedish, French, German, Polish and English reported a pattern where participants used the singular for plural NP forms. It was found that production errors increased as syntactic complexity and phrase length increased. The study indicated effect of syntax on number production.

While the syntactic hypotheses of Arabic NP could provide explanation for the error pattern in number, a possible explanation may come from DMH (Lee et al., 2005; Thompson et al., 2002) as shown in the next section.

The role of morphology in the production of gender errors

Number substitution errors could be explained by DMH (Lee et al., 2005; Thompson et al., 2002). There are two possible explanations for substitutions of M PL with M SG. Similar to the explanation provided above when participants substituted the gender in the F SG with M SG, the participants omitted the inflections and produced a NP with bare nouns and adjectives when they produce a M SG instead of M PL inflection. This might be due to flawed mapping between the morpheme and the features in the inflections. M PL inflections require feature-to-morpheme mapping and thus are impaired in agrammatism unlike M SG because it is bare.

Alternatively, the participants substituted the inflections and were able to map between the gender and the morpheme, but were unable to map between the number and the morpheme. When a participant substituted F SG with F PL inflections, only mapping between the number feature and the morpheme was flawed but mapping between the gender feature and the morpheme was preserved. This is similar to the explanation made earlier in this chapter concerning the overall gender and number production. It was assumed that feature-to-morpheme mapping in gender was preserved but not in number since the overall production of gender and number showed that gender was more preserved than number.

10.1.2.3 Definiteness errors

This section discusses errors in the production of definiteness inflections. Cross-linguistic studies have investigated production of definite and indefinite articles in noun phrases (e.g. Herbert & Bests, 2010; Lorenz & Zwitserlood, 2014; Seyboth, Blanken, Ehmann, Schwarz & Bormann, 2012) to explore the gender or number agreement between the article and the noun. However, this study is unlike previous investigations because it examines the production of definiteness in totally different NP types which are unique to Arabic, and the definiteness agreement between the noun and the adjective which has not been considered in previous research. Definiteness agreement will be discussed under agreement production (section 11.5).

The most common substitution errors in definiteness inflections across subtests were the substitution of definite with indefinite (e.g. */el-ħamra/* 'the red' was substituted with */ħamrah/* 'red'). Production of Arabic indefinite nouns instead of definite nouns has been reported by Safi-Stagni (1995) who analysed the production of grammatical markers by a SA speaker with agrammatism.

The error pattern in the production of definiteness inflection can be explained based on syntactic hypotheses of Arabic NP.

The role of syntax in the production of definiteness errors

Syntactically, SA speakers with agrammatism prefer indefinite articles over definite articles because the indefinite in Arabic is a zero feature, like the masculine singular. Since they have to undergo multiple syntactic movement to produce a well-formed definite noun phrase, they prefer the indefinite to reduce the number of movements. This is based on the N-raising Hypothesis (Ritter, 1991) and the Phrasal Movement Hypothesis which have been explained earlier in this chapter.

While definiteness substitution errors can be explained in light of syntactic hypotheses of Arabic NP, morphology could also provide an explanation for such errors as the next section shows.

The role of morphology in the production of definiteness errors

The substitution of definite with indefinite can be explained by DMH (Lee et al., 2005; Thompson et al., 2002). In Arabic, definite is marked by morphemes, whereas the indefinite is unmarked. Production of indefinite inflection can be either an omission of the inflection or a substitution. In case of an omission, the inflection is omitted and only the noun or the adjective are produced since production of inflection requires mapping between the feature and the morpheme inflection, a process that is assumed to be flawed in agrammatism by DMH. In case of a substitution, the inflection is produced but the inflection is assigned a wrong feature.

The above interpreted inflectional errors on the basis of morpho-syntactic theories of Arabic NP and agrammatism. The current study hypothesised that Arabic speakers with agrammatism might prefer the M SG and the indefinite form because they are bare, and producing them might reduce complex syntactic movements needed for agreement in NP as assumed by the N-raising and the Phrasal Movement hypotheses. Similarly, when participants produced F SG, they reduce syntactic movements required for producing inflections that agree together since F SG inflection is assumed to be lexically specified in Arabic. However, syntax failed to explain substitutions of F PL with M PL. The inflectional errors were also interpreted in the context of DMH. According to DMH, when participants produce M SG and indefinite inflections rather than other types of inflection, participants might have omitted the inflection due to impaired morpheme-to-feature mapping in agrammatism. Another explanation was provided for the M SG based on DMH. When participants produce M SG instead of other gender and number inflections, they might substitute and they either map between the gender feature and the morpheme, or between the number feature and the morpheme. DMH provided contradictory explanations for other gender and number production errors.

Agreement errors are examined in the following.

10.1.3 Agreement errors

Agreement production was analysed within and across subtests. The current study examined the noun-adjective agreement, in the *Gender and Number Agreement Subtest* and the *Definiteness Agreement Subtest*, and the agreement between the noun and particle, in the *Non-Construct State Subtest*. This is the first study that examines agreement production within NPs in Arabic agrammatism. The study adds to the understanding of agreement production in NPs in agrammatism cross-linguistically by analysing agreement in a range of different types of NPs that are unique to Arabic.

An important pattern that arose from agreement errors can be seen in the *ungrammatical* errors, or disagreement errors. The analysis of the *ungrammatical* errors shows that errors in agreement tended to be due to inflectional errors in the modifier, either the adjective or the particle *ħag* (e.g. /*lambah ħag*/ ‘light.F.SG for.M.SG’*)* rather than the noun.

The current pattern of the ungrammatical errors can be explained in light of the N-raising Hypothesis and the Phrasal Movement Hypothesis as shown in the next section.

10.1.3.1 Agreement errors and the syntax of Arabic NP

The fact that ungrammatical errors arose from the wrong adjective or particle inflections suggests that the participants were able to inflect the noun correctly, but unable to inflect the other part of the noun phrase. The current ungrammatical errors can be explained in light of syntactic theories of Arabic NP: the N-raising Hypothesis (Ritter, 1991) and the Phrasal Movement Hypothesis (Shlonsky, 2004).

Both the N-raising Hypothesis and the Phrasal Movement Hypothesis claim that a noun in Arabic noun phrases is moved from the left side of the syntactic tree up to a higher node occurring on the right. According to this claim, the noun is assigned gender, number and/or definiteness inflections before any other element. However, the N-raising Hypothesis and the Phrasal Movement Hypothesis disagree on how the noun is raised.

According to the N-raising Hypothesis (Ritter, 1991), a noun is the element that is first raised out of the NP to a position left of and above the adjectival field identified as D^0. Fassi-Fehri (1989; 1993) maintains that the adjectival phrase (AP) moves to the Spec of dp1 targeting agreement there.

On the other hand, the Phrasal Movement Hypothesis (Shlonsky, 2004) argues that the whole NP (not only the noun) raises to the left of the modifiers, moving from specifier to specifier; it then pied-pipes all the elements occurring on the right, resulting in either a reversed or a mirrored order of these elements.

The data from the current study shows that the noun was assigned the correct gender, number and/or definiteness inflections, but participants failed to assign the correct inflections to the adjective or the particle in the noun phrase. Shlonsky (2004) argues in the Phrasal Movement Hypothesis that the whole NP is raised and then all elements occurring on the left (like adjectives or particles) are pied-piped. Since adjectives and all other elements occurring on the left of the noun are pied-piped, the hypothesis predicts similar inflectional impairments in the noun and the modifiers. However, agreement errors occurred in the adjectives or the particles but not the head nouns and this could not be explained by the Phrasal Movement Hypothesis.

On the other hand, the data could be explained in light of the N-raising Hypothesis (Ritter, 1991) and by Fassi-Fehri's assumption of the raising of adjectival phrases after the noun raising. That is to say, since Fassi-Fehri argues that the noun is first raised and then the adjectival phrase is raised in Arabic noun phrases, SA speakers with agrammatism were able to raise and inflect the noun but raising the adjectival phrase was problematic as reflected by the inflectional errors, which led to disagreement errors, in the adjectives or particles. In other words, the pattern where participants were able to inflect the noun correctly and failed to inflect the adjective or the particle reflected the fact that there exists an independent movement after the noun movement which might be affected by agrammatism. This pattern might reflect the psychological reality of the syntactic movement in the Arabic NP as explained by the N-raising Hypothesis.

The above discussion demonstrates that the *ungrammatical* errors were often due to inflectional errors in the modifier, either the adjective or the particle *ħag* (for), and not the head nouns. This pattern has not been reported in previous literature of NP production. In this pattern, participants were able to inflect the noun correctly but unable to inflect the other part of the noun phrase. This supported the N-raising Hypothesis which argues that there exists an independent movement after the noun movement, and based on the data this second movement might be affected by agrammatism.

In the sections above, the inflectional and the agreement production have been discussed. The next section discusses the lexical production.

10.1.4 Lexical errors

The types of lexical errors, irrespective of any other error types, were examined within and across subtests. The examination of ungrammatical errors showed that errors were commonly due to wrong inflections in either the modifying adjective or the particle. Similarly, an analysis of lexical errors across subtests showed that modifying adjectives or nouns tended to be more impaired than head nouns when gender and number agreement is required in the context, in *Gender and Number Agreement Subtest* and *Non-Construct State Subtest*. This has not been reported in previously conducted studies, and the current finding can provide implications to the N-raising Hypothesis.

10.1.4.1 Lexical errors and the syntax of Arabic NP

The examination of lexical errors in modifying adjectives showed that the *no response* (deletion) errors were a common error type in the *Gender and Number Agreement Subtest*. Since the N-raising Hypothesis claims that an NP in Arabic involves the raising of the noun up to D position and then raising of the adjectival phrase (Fassi-Fehri, 1989; 1993), Arabic speakers with agrammatism might not be able to raise the adjectival phrase and consequently delete the whole adjectival phrase.

However, most commonly occurring lexical errors in modifying nouns in the *Non-Construct State Subtest* consisted of *semantic* errors which cannot be explained within the context of N-raising Hypothesis.

It was seen that modifiers tended to be more impaired in modifiers when gender and number agreement is required in the context. N-raising Hypothesis could explain lexical errors in the *Gender and Number Agreement Subtest* but not in the *Non-Construct State Subtest*.

In the above sections, the results have been discussed form the point of view of morpho-syntax. Gender, number and definiteness errors can be interpreted from alternative perspectives: usage-based perspective and psycholinguistic perspective. The usage-based perspective is discussed next, followed by a discussion of the psycholinguistic interpretation of the inflectional errors.

10.2 Usage-based accounts of frequency and grammatical production

Gender, number and definiteness production and errors are reconsidered here from a usage-based account of language production. Usage-based accounts of language (Croft, 2001; Dik, 1997; Goldberg, 1995; Hengeveld & Mackenzie, 2008; Langacker, 1991; Tomasello, 2009; Van Valin & LaPolla, 1997) assume that children acquire a language based on experience and by using domain-general processing capacities rather than universal rules of grammar that children are endowed with. A review of usage-based assumptions has been presented in section (1.2.3.3)

The adoption of usage-based approaches to the study of aphasia is gaining increasing attention in an attempt to provide implications to linguistic theories and to language assessment and intervention in aphasia. The current study contributes to usage-based accounts of aphasia by analysing, for the first time, the effect of frequency and lexical/grammatical distinction on production of NP by Arabic speakers with aphasia and agrammatism.

In the next section, gender and number production is first discussed followed by a discussion of definiteness production.

10.2.1 Gender and number errors

The analysis of gender errors across groups showed that F SG was commonly substituted with M SG across subtests, and F PL tended to be substituted with M PL in the *Gender and Number Agreement Subtest*. In number errors, M PL was often substituted with M SG, and F PL tended to be substituted with F SG in the *Gender and Number Agreement Subtest*. Substitution with the M SG was the most occurring substitution type across subtests, while the F PL was the most impaired inflection in the *Gender and Number Agreement Subtest*.

This pattern can be interpreted in terms of frequency related factors as discussed in the following.

10.2.1.1 The effect of frequency on production of gender and number inflections

According to usage-based approaches to language, frequency is a driving force for the development of grammar, and it affects language structure. It enhances the representation of linguistic patterns in the mind and supports the activation and processing of such patterns (Diessel, 2017). Gahl and Menn (2016) claim that frequency effect is evident in the language of people with aphasia. In addition, reports showed that lexical frequency affected production of single nouns in aphasia; pictures of objects with high frequency names elicited faster naming responses (Newcombe, Oldfield & Wingfield, 1965) and more accurate word retrieval (Kay & Ellis, 1987; Kittredge, Dell, Verkuilen & Schwartz, 2008; Nozari, Kittredge, Dell & Schwartz, 2010) than objects with low frequency names in picture naming tasks.

Substitutions with M SG

The results showed that the M SG was often the most preferred inflection across subtests, where most substitutions tended to be substitutions with M SG. As explained above in section 10.1.2.1, since the inflection in the M SG is absent, production of M SG can be considered either an omission or a substitution of the inflection. The token frequency data (Appendices E, F, G & H) which were obtained from ARALEX (Boudelaa & Marslen-Wilson, 2010) in the current study indicates that production of M SG instead of other inflections is a substitution of the inflection rather than an omission. This is because the token frequency data showed that the M SG was the most frequent type. Since it was the most frequent, this might suggest that when participants produced M SG, they substituted by producing a more frequent form rather than omitting the inflection. This is also in line with usage-based accounts (Gahl & Menn, 2016) which assume that effect of frequency is evident in the production of people with aphasia as explained above. In brief, M SG was the most preferred inflection in the current sample because it was the most frequent as predicted by usage-based accounts.

Evidence of the relative ease in the production of the M SG also comes from language acquisition studies in Arabic. Omar (2007) found that masculine singular in Arabic is the most frequent and is considered the default in Arabic. In addition to being a default, it was shown that the masculine singular is the simplest, preferable for non-proficient speakers, and the first to emerge in early childhood (Omar, 2007). Moreover, in a study that tested subject-verb and adjective-noun agreement production by healthy Arabic speakers, Albirini, Benmamoun and Chakrani (2013) found that participants were more accurate in the production of agreement inflections in M SG form than in other forms, and they tended to substitute with M SG inflections. Similar to Omar’s findings (2007), Albirini, Benmamoun and Chakrani (2013) also found that accuracy in using M SG and substitutions with M SG inflections was explained by frequency related factors. It was explained that M SG in Arabic is the most frequent gender and number type.

Substitutions with F SG

The F SG tended to be substituted with the M SG across groups and subtests. However, substitutions of M SG with F SG were the most common substitution type in the particle within the *Non-Construct State Subtest.* In this subtest, the NP consisted of a head noun, followed by a particle that agrees with the noun in gender and number, and a modifying noun. Substitutions of M SG with F SG cannot be explained in terms of token frequency since the token frequency data showed that M SG forms had higher frequency than F SG forms. Since this pattern was within the *Non-Construct State Subtest* only, it might indicate that F SG is more frequent in the *Non-Construct State* construction, suggesting an effect of construction frequency on the production of speakers with aphasia as argued by usage-based accounts (e.g. Menn & Ghal, 2016). That is to say, the construction 'N + *ħag*-F SG + N' might be more frequent in Arabic than 'N + *ħag*-M SG + N' and this was reflected by the performance of the participants in the current study.

This is similar to Jap, Martinez-Ferreiro and Bastiaanse's (2016) finding which showed that production of passive constructions in Standard Indonesian by speakers with aphasia was spared compared to active constructions, unlike the case in previously investigated languages. This was attributed to the frequency of construction where passives in Standard Indonesian were more frequent than active constructions. While the frequency of passive and active constructions was available for Jap, Martinez-Ferreiro and Bastiaanse, studies about Arabic NP constructions using a usage-based framework or Arabic NP construction frequency are not available.

Substitutions of F PL

The results of the *Gender and Number Agreement Subtest* demonstrated that the F PL was the most impaired category across groups. This is in line with the frequency data (Appendix E) which showed that F PL forms were the least frequent among other forms. A usage-based account would predict that forms with lower frequency were most vulnerable after brain damage. This has been found for single nouns (e.g. Nozari, Kittredge, Dell & Schwartz, 2010), NPs (e.g. Hatchard & Levien, 2015) and verb phrases (e.g. Gahl & Menn, 2016). However, Ravid and Farah, (1999; 2001) studied the acquisition of number by non-brain damaged Palestinian Arabic children based on grammatical and processing grounds and found that F PL was acquired earlier by children, and errors produced showed that F PL was a dominant default procedure where children substituted M PL with F PL. The authors suggested that F PL suffix in Arabic was the default noun number inflection and it was likely to be the default because of constraints on the use of M PL, which only maps onto +human +agentive nouns, unlike the regular feminine plural which is more productive and applies to a wider range of nouns. It can be seen that the findings from the current study are not in agreement with the findings reported in Ravid and Farah's study, and their findings cannot be accounted for by usage-based accounts.

In summary, the above sections have illustrated that frequency impacted the production of NP by the participants with aphasia and agrammatism in the current study. The analysis of gender and number errors showed that the token frequency of lexical items, having a specific gender and number, had an effect on production accuracy. Words which were more likely to elicit errors were words with lower frequency, and errors produced were likely to have higher frequency than the frequency of the intended targets.

The following section reanalyses errors from a usage-based view point.

10.2.2 Definiteness errors

The data in the study demonstrated that participants across groups tended to substitute the definite article with the indefinite in the *Definiteness Agreement Subtest* and the *Construct State Subtest*. Production of indefinite instead of definite inflection can be considered either an omission or a substitution of the inflection since indefinite inflection in Arabic is absent. This has been explained in section 10.1.2.3.

Production of grammatical units by speakers with aphasia and agrammatism has been discussed by the ProGram theory (Boye & Harder, 2012). The definiteness errors by the participants of the current study can be explained in the context of this theory as shown next.

10.2.2.1 Usage-based accounts of production of grammatical elements

The ProGram theory (Boye & Harder, 2012) is a usage-based theory of linguistic structure that accounts for agrammatism. It differentiates between lexical and grammatical items based on three criteria. According to the theory, only lexical items can be focalized, addressed in the subsequent discourse and elaborated on through modification. The theory claims that the neurocognitive capacities for combining simple information units into complex wholes is damaged in agrammatism. Hence, the speaker with agrammatism prioritises lexical items because they are crucial for communicative function, and ignores others.

Based on the ProGram theory (Boye & Harder, 2012), definite and indefinite inflections in Arabic are grammatical units. Since they are grammatical units, they are secondary for communication for the participants with agrammatism in the current study and thus will be omitted or substituted due to an impaired cognitive process which is responsible for combining simple information units into complex wholes. When participants produced indefinite instead of definite forms, the ProGram could not explain whether participants omitted the definite or substituted with an indefinite inflection. In brief, the absence of definiteness inflections in nouns and adjectives is predicted based on the ProGram, but whether this absence was due to omission or substitution of the inflection could not be explained based on such theory.

The current finding where grammatical units as classified by the ProGram theory are impaired in the production of participants with agrammatism is in line with previous investigations in Danish (Boye & Bastiaanse, 2018), Dutch (Messerschmidt et al., 2018), French (Ishkhanyan, Sahraoui, Harder, Mogensen & Boye, 2017) and Spanish (Martínez-Ferreiro et al., 2018) which showed that grammatical members were more severely affected in non-fluent aphasia than members classified as lexical.

The above sections have interpreted number, gender and definiteness production and errors from a usage-based point of view. Frequency effect was evident in the production of number and gender errors by participants and less frequent forms elicited more errors. The production of indefinite instead of definite supported the assumption made in the ProGram theory (Boye & Harder, 2012) which predicts omission of inflections which are secondary and retention of lexical items which are primary for communication.

In the following, the number and gender inflectional errors are further examined in the context of psycholinguistic accounts of processing of grammatical gender and number.

10.3 Psycholinguistic accounts of processing of grammatical gender and number

The productions of number and gender in the current study lend themselves to explanations within morpho-syntactic theories and usage-based theories as discussed in the above sections. Alternatively, psycholinguistic accounts of language production could be applied to the data although the current thesis did not employ psycholinguistic tasks.

In this section, the results of the gender and number errors are discussed in light of psycholinguistic models of word production (e.g. Dell et al., 1997; Levelt et al., 1999) and number processing (e.g. Pinker, 1999; Pinker & Ullman, 2002; Ullman, 2001).

10.3.1 Gender errors

As stated several times above, gender errors were more common to feminine than to masculine forms across subtests. The gender errors consisted primarily of substitution of the F SG with the M SG.

Gender production can be explained in the context of two prominent models of word production: the serial access Weaver ++ model (Levelt et al., 1999) and the Interactive 2-step model proposed and developed by Dell and colleagues (Dell et al., 1997).

10.3.1.1 Psycholinguistic representation and processing of gender inflections in Arabic

The Weaver ++ model (Levelt et al., 1999) is a psycholinguistic model of spoken word production which argues that lexical access involves three levels of representation: conceptual, lemma and lexeme level. Lexical access is achieved by the sequential selection of lemma and lexeme nodes through spreading activation emanating from the lexical concept node. The Interactive 2-step model (Dell et al., 1997) also hypothesises that lexical access involves three levels which include semantic, word and phonological level. Unlike the Weaver ++, lexical access is interactive and semantic and phonological processes influence each other and overlap in time. A full review of these models has been presented in section (1.2.3.1).

In both models, the syntactic features that define a word including grammatical gender are involved in the second level of representation, the *lemma level* in the Weaver ++ (Levelt et al., 1999) or *word level* in the Interactive 2-step model (Dell et al., 1997). In addition, it is assumed in these models that different types of grammatical gender are represented in different nodes. All nouns belonging to the same grammatical gender share one gender node (Jescheniak & Levelt, 1994). While these models agree on the assumption of central gender nodes for each gender type in a given language, they disagree on whether gender processing is sensitive to frequency. Levelt et al. claim that frequency does not influence the lemma level but it affects the phonological level only, the lexeme level. In contrast, Dell and colleagues (Dell, 1990; Kitterdge, Dell, Verkuilen & Schwartz, 2008) suggested that lexical access is sensitive to frequency at all stages, and accessing syntactic and grammatical features at the word level is the most important domain of the influence of word frequency on language production.

According to the Weaver ++ (Levelt et al., 1999) and the Interactive 2-step model (Dell et al., 1997), two types of gender node are represented at the lemma/word level in Arabic: a masculine and a feminine gender node. As explained above, production of masculine forms for feminine targets can be considered either an omission of the inflection or a substitution since Arabic M SG is zero inflection. Hence, participants might have been unable to access gender nodes stored at the lemma/word level and accordingly produced bare nouns or adjectives.

Alternatively, participants might have been unable to access the F SG and substituted with the M SG node. This is evidenced by the high frequency of Arabic M SG as shown in the lexical frequency (Appendices E, F, G & H) and by psycholinguistic reports of non-brain damaged Arabic speakers (Albirini, Benmamoun & Chakranim 2013; Omar, 2007). Assuming that production of M SG in gender errors is a substitution due to the high frequency of M SG is in accord with the Interactive 2-step model which assumes effect of frequency at the lemma level.

The finding that Arabic has two separate gender nodes at the lemma/word level and that they are impaired differentially due to the frequency factor matches results obtained from a case study which tested production of gender in determiner-plus-noun NP in German agrammatism

(Seyboth, Blanken, Ehmann, Schwarz & Bormann, 2012). Masculine determiner (*der*) was significantly impaired compared to feminine (*die*) or neutral (*das*) across tasks. The participant could repeat and read aloud determiners including (*der*) which suggested that the deficit was not phonological and gender information is represented at the lemma. Because masculine gender was selectively impaired, it was assumed that there existed central gender nodes for the three genders within the lemma level, and that these might be selectively impaired in agrammatism. The masculine determiner was less frequent than other determiners and thus suggested an effect of frequency at lemma.

Another explanation for the gender errors comes from word length. This is discussed next.

10.3.1.2 Effect of length and frequency on production of gender inflections in Arabic

Word length refers to phoneme number and reports indicated its influence on production in Aphasia. In picture naming, it was found that words which were long were retrieved less accurately than shorter words (Caplan, 1987; Nickels & Howard, 1995; Romani & Calabrese, 1998). The length effect in spoken word production is assumed to be sited at the phonological encoding level of processing (Caplan, 1987) where combining phonemes and syllables to produce words is affected. Another view suggests that the locus of the length effect is at the phonological buffer where holding the representation of a given word in the buffer store is difficult (Miller and Ellis, 1987). While length affects the phonological retrieval, it is assumed that the frequency effect is also present at the phonological retrieval level. Low-frequency words are more likely to elicit errors that are phonologically related to the targets than high-frequency words in non-brain damaged speakers (Dell, 1990) and aphasia (Gordon, 2002).

According to the above, production of M SG for F SG targets might be due to length of phoneme and frequency. The M SG in Arabic is shorter and more frequent than the F SG. Participants with aphasia might have difficulty processing the F SG singular gender at the phonological encoding or at the phonological buffer level and thus might have omitted the gender, or substituted with a more frequent form which is the M SG. In this case, participants might have accessed gender information at previous levels but were unable to retrieve the phonological representation. This is consistent with both the Weaver ++ and the Interactive 2-step model which assume obligatory access to syntax in word production and effect of frequency at the phonological level.

However, the data in the *Non-construct State Subtest* showed that participants sometimes substituted M SG with F SG inflections. Therefore, participants did not have difficulty with the length of the phoneme at the phonological level, but they might have difficulty with the processing of gender at the lemme/word form level. Since F SG is less frequent than M SG, this supported the Weaver ++ model which argues that frequency does not affect selection of gender nodes at the lemma level.

It can be seen form the above sections that analysis of gender errors across subtests had implications to models of word production. Production of M SG for F SG targets was interpreted in two different ways. First, access to F SG node at the lemma/word level was difficult and hence participants substituted with a more frequent gender inflection which was the M SG. This was in line with the Interactive 2-step model since it accounts for the frequency effect at word level. Second, access to F SG at the phonological level was problematic due to length and frequency, where F SG is less frequent and longer than M SG. However, gender errors within subtests showed productions of F SG for M SG targets. Since F SG is longer, this suggested difficulty at the lemma/word level rather than the phonological level. Since F SG was less frequent than M SG, the gender data argues for the Weaver ++ model which claims that frequency effect is not present at the lemma level.

The number errors are discussed in the following section.

10.3.2 Number errors

The number errors in the *Gender and Number Agreement Subtest* included primarily substitutions of the F PL plural with the F SG inflection, and the M PL with the M SG. Most substitution errors occurred in the F PL category.

The current result could shed light on psycholinguistic processing of number inflection in Arabic, as explained in the following.

10.3.2.1 Psycholinguistic processing of number inflections in Arabic

In Arabic, Safi-Stagni (1995); Mimouni, Kehayia and Jarema (1998); and Khwaileh, Body and Herbert (2015) studied regular and irregular plural processing in speakers with agrammatism and aphasia. These studies showed that production of Arabic regular plurals tended to be more impaired than production of irregular plurals. This was explained by the fact that regular plurals in Arabic involve inflection and are composed online based on pre-defined rules, whereas irregular plurals do not include inflections and are stored as whole units. This explanation was based on the Dual Mechanism accounts (Kiparsky, 1982; Pinker & Ullman, 2002) which are psycholinguistic accounts of morphological production in which it is assumed that morphologically complex forms are processed through stored full-form representations, or by rules that compose inflected or derived word forms from smaller morphological units.

While the current study did not compare between production of regular and irregular plurals and only production of regular plural was involved, the analysis of number errors provides further evidence for number processing in Arabic aphasia. The data illustrated that the production of number was severely impaired as predicted by previous studies of number in Arabic aphasia (Khwaileh, Body & Herbert, 2015; Mimouni, Kehayia & Jarema, 1998; Safi-Stagni, 1995). According to previous accounts of Arabic number production, M PL and F PL in the current data were severely impaired because they are regular plurals which are processed through a route in which morphologically complex forms are composed online from smaller units. Since plural forms in the current data required combining a plural inflection with a stem based on existing rules, this is difficult for participants in the current study because language processes that depend on rules application is assumed to be impaired in agrammatism (Pinker and Ullman, 2002).

While the assumption that the impaired production of number in the current study is due to an impaired rules application process might be valid, evidence for a length and frequency effect is also present in number errors. This is discussed in the next section.

10.3.2.2 Effect of length and frequency on production of number inflections in Arabic

As mentioned above in gender errors, studies showed that words with a greater number of phonemes were retrieved less accurately than shorter words in aphasia in picture naming (Caplan, 1987; Nickels & Howard, 1995; omani & Calabrese, 1998) and that the locus of length effect is at the phonological level. Reports also showed that lexical access was sensitive to frequency at all stages (Dell, 1990; Kitterdge, Dell, Verkuilen & Schwartz, 2008).

In the current data, M SG tended to be produced for M PL. This could be an omission, as explained several times above, where processing plural inflection at the phonological level is difficult due to length only. It can also be a substitution with a shorter and more frequent form since M SG is the most productive form in Arabic (Albirini, Benmamoun & Chakranim 2013; Omar, 2007). In the case of a substitution, both length and frequency might have an effect in the production of M PL at the phonological level.

In addition, F SG was commonly produced for F PL targets. F SG is shorter and more frequent (Appendices E, F, G & H) and thus substitutions of F PL with F SG could be an effect of frequency and length at the phonological level. However, M PL was sometimes produced for F PL targets; both of these inflections have the same number of phonemes but the M PL is more frequent as indicated in the frequency data (Appendix E) and thus suggesting an effect of frequency only at the phonological level. The number errors suggested that frequency is an important factor that affects the production of number at the phonological level in Arabic regular plurals, with errors produced having higher frequency than the frequency of the intended targets.

The gender and number errors in the above were examined within the context of psycholinguistic models of word production and number processing. It was shown that gender errors were more likely to be due to impairment at the lemma/word level and that frequency affected production at that level. This was consistent with the Interactive 2-step model but not the Weaver ++ model. Number errors were more likely to be due to impaired processing at the phonological level, and frequency also influenced number production. This was in line with both the Interactive 2-step model and the Weaver ++ model.

Assignment of participants to groups is discussed in the following.

10.4 Assignment of participants to groups

A major aim for the classification of the groups was to obtain a wide image of the impairment patterns in NP production by SA speakers with agrammatism. Another aim was to avoid any possible statistical outliers that might affect the overall results of the four linguistic subtests. That is, since some participants were different by having very mild aphasia, considering their results might affect the overall pattern of errors across participants.

The participants were classified into two groups based on their results in the language assessment. The first group (Group I) included the participants SA, WA and WI with scores above average in most language assessment subtests. The second group (Group II) included all other participants with scores below average in either all or most of the subtests. Although the differences were not statistically significant within all aphasia assessment subtests, the difference between the scores of the two groups across subtests was statistically significant. In addition, the results of the four linguistic subtests supported the assignment of the participants to two groups. Across the four linguistic subtests, Group I produced very few lexical, inflectional and agreement errors compared to Group II.

However, although the groups had different levels of aphasia severity, and Group I performed better than Group II across the subtests, there was sometimes an overlap in the performance of some of the members from the two groups within some subtests. In addition, the two groups produced similar patterns of errors across subtests.

It can be seen that while the independent examination of the two groups was helpful for providing an in-depth description of NP production in agrammatism in SA, combining all participants in one group would not affect the overall results.

The development of the coding system is discussed in the following.

10.5 Development of the coding system

The data was coded for lexical, inflectional and agreement errors. Lexical errors were coded based on the coding system developed by Dell et al. (1997) and adapted by Herbert et al. (2014) as Appendix J presents. As for inflectional and agreement errors, a coding system was developed for each.

Inflectional errors were first coded as number errors, gender errors, or definiteness errors, as illustrated in Appendix K. However, data from the pilot phase showed that some errors were not accounted for and more codes had to be developed for them. Based on the pilot data, the inflectional errors were then analysed in two stages. The first stage included the same codes that have been developed before the pilot phase and which are shown in Appendix K. The second stage of inflectional errors coding investigated the types of gender and number substitution errors in specific. The second stage of inflectional errors coding is presented in Appendix T.

As for agreement errors, data were coded as *correct agreement*, *grammatical not target,* or *ungrammatical*. These codes are shown in Appendix L. However, data from the pilot phase showed that some agreement errors could not be computed due to the omission of one of the lexical items and its inflection or all the lexical items with their inflections. Hence, a code that accounted for this error type was added as presented in Appendix T.

The development of coding systems for inflectional and agreement errors in Arabic noun phrases was necessary due to the lack of coding systems appropriate for the data and that could be adopted. The only available coding system for Arabic noun phrases was introduced by Khwaileh (2011). This coding system addressed the morpho-syntax of the head noun and its modifier to account for the gender and number agreement between the head noun and the adjective. However, this system could not be adopted because it tested only gender and number agreement between a noun and an adjective. The current data required a system that accounts for inflectional errors as well as agreement errors in three different types of Arabic noun phrases, namely, the adjectival noun phrase, the construct state NP and the non-construct sate noun phrase. The current coding system is the first one that accounts for all of these different NP structures.

10.6 Conclusions

The study has explored production of NP by Arabic speakers with aphasia and agrammatism which has contributed to knowledge of morpho-syntax in aphasia. The results have been mainly investigated in light of morpho-syntactic theories of NP and agrammatism. The analysis of the overall production of gender and number showed that gender was better retained than number. This was in line with the bundling model (Carstens, 2003) which assumes that gender is lexical, and thus is likely to be spared in agrammatism, and number is positioned higher than gender in the syntactic tree, and accordingly number is likely to be impaired in agrammatism. This result was also consistent with predictions of both TPH (Friedmann,1994; Friedmann & Grodzinsky,1997) and DMH (Lee et al., 2008; Thompson et al., 2002).

Gender errors often consisted of production of M SG for F SG targets, definiteness errors were commonly production of indefinite for definite targets, and number errors tended to production of F SG for F PL targets. These inflectional errors were explained based on the N-raising hypothesis (Ritter, 1991) and the Phrasal Movement hypothesis (Shlonsky, 2004). According to these hypotheses, participants produced M SG and indefinite forms because both are zero inflection, and producing them might reduce complex syntactic movements needed for agreement in Arabic NP. Similarly, when participants produced F SG, they reduce syntactic movements required for producing inflections that agree together since F SG inflection is assumed to be lexically specified in Arabic. While these hypotheses could account for production of M SG, F SG and indefinite forms; they failed to explain production of M PL for F PL targets.

The inflectional errors were also interpreted from the view point of DMH (Lee et al., 2008; Thompson et al., 2002). According to DMH, production of M SG and indefinite inflections for other inflectional targets could indicate omission of the inflection due to impaired morpheme-to-feature mapping in agrammatism. DMH provided another explanation for production of M SG for F SG targets by hypothesising spared mapping between number feature and the morpheme, and impaired mapping between the gender feature and the morpheme. DMH provided inconsistent explanations for other gender and number production errors.

In the analysis of agreement errors, it was found that participants tended to inflect the noun correctly but inflecting the other part of the NP tended to be incorrect. This was in line with predictions of the N-raising Hypothesis (Ritter, 1991) which assumes that an independent movement for the modifier occurs after the noun movement, and the current study assumes that this movement might be affected by agrammatism. Similarly, lexical errors tended to occur in modifiers in the *Gender and Number Agreement Subtest* and the *Non-Construct State Subtest* suggesting that modifiers are likely to be more impaired than heads when gender and number agreement is required in the context. However, N-raising Hypothesis could not provide explanation for all lexical error types. It can be seen that morpho-syntactic theories have been useful for interpreting a number of different error patterns but some errors have remained challenging to these accounts.

The study has also considered the results in the context of usage-based accounts of frequency and grammatical production. The analysis of gender and number errors showed that frequency affected production of number and gender errors as predicted by usage-based accounts (e.g. Gahl and Menn, 2016). Words which were more likely to elicit errors were words with lower frequency, and errors produced were likely to have higher frequency than the frequency of the intended targets. The production of indefinite for definite targets was in line with predictions of the ProGram theory (Boye & Harder, 2012) which expects omission of inflections which are secondary, and retention of lexical items which are primary in communication.

Lastly, the study has examined the results from the view point of psycholinguistic accounts of gender and number processing. It was found that gender errors in the current data were more likely to be due to impairment at the lemma/word level and that frequency affected production at that level. This was consistent with the Interactive 2-step model (Dell et al., 1997) but not the Weaver ++ model (Levelt et al., 1999). Number errors were more likely to be due to impaired processing at the phonological level and frequency also influenced number production. This was in line with both the Interactive 2-step model and the Weaver ++ model.

No one single account could account for all production errors independently; however, the various theoretical stances have been able to account for most production errors in the data. Consideration of multiple perspectives has been useful for a wider interpretation of error patterns in the current study.

10.7 Limitations and recommendations

The current study adds to our understanding of agrammatism within Arabic and cross-linguistically, and provides different theoretical implications. However, there is a number of methodological limitations which future investigations should account for.

There was no information available on the lesion site, and CT scans were not accessible. The speech language pathologists did not access such information and diagnosis was based on language assessment and the patients' medical history. This could have an impact on the diagnoses' accuracy and consequently the results, and a more accurate diagnosis is recommended.

The aphasia assessment used in the current study was taken from the aphasia assessment available in clinics in Saudi Arabia, but this language assessment has several weaknesses. In particular, it is an adaptation of some Western assessments, and although it provides a translated version that has been changed to be more culturally appropriate, it has not been standardised. Although it provides a scoring system, norms and pictorial stimuli are not available. In addition, there were no other standardised assessments in other Arabic speaking communities that could be used for the current investigation at the time of data collection.

There were no readymade pictorial stimuli in Arabic that could be used for testing noun phrases in Arabic, therefore the pictorial stimuli used in the current study have been developed for the purposes of the study. Although the stimuli are culturally appropriate and have been tested for name agreement, visual complexity, age of acquisition was not measured, therefore it is recommended to consider visual complexity and age of acquisition in future investigations to check whether maturity or youth have an impact.

Another limitation of the study is the frequency database which the frequency of items was taken from. This database was developed based on written form in Arabic and not spoken form. Written Arabic is a type of standard Arabic with grammatical rules and morphology that is not used in daily life by Arabic speakers, therefore there is a gap between what speakers speak in the Arabic dialect and what they read and write. Since the current study has tested the production of one Arabic dialect, the frequency database may not be accurate enough, and a database for the spoken production of Arabic is needed.

It is worth noting that number of items in the conditions within the *Definiteness Agreement Subtest* and the *Non-construct State Subtest* differ. This is because it was hard to control all linguistic and psycholinguistic variables at the same time, so more balanced conditions ought to be considered in the future.

In addition, the study did not aim to collect control data. Control data is recommended because it enables the drawing of comparisons between non-brain-damaged and brain-damaged individuals.

The tasks in the current study have been designed based on generative morpho-syntactic descriptions and theories which were available for Arabic NP. These tasks may not be the most appropriate for usage-based and psycholinguistic investigations of Arabic NP, and may limit the ability of these accounts to interpret the data comprehensively. Tasks that are developed in accordance with each of these two different accounts are recommended.

Finally, this study has considered only the basic structure of Arabic noun phrases due to the exploratory nature of the study. There are other more complex noun phrase structures which might be of interest for future investigations.

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Appendix A

Items for Gender and Number Agreement Subtest

Item #	Words & translation		Transcription (IPA)		Number	Gender	Frequency		Length	
	N	Adj	N	Adj	N & Adj	N & Adj	N	Adj	N	Adj
1	رسام painter	وصخ Dirty	*rassam*	*wasˤiχ*	*SG*	*M*	3.04	0.08	6	5
2	معلم teacher	طويل Tall	*muʕllim*	*tˤiwi:l*	*SG*	*M*	4.99	51.24	7	6
3	طباخ cook	سمين Fat	*tˀabbaχ*	*sami:n*	*SG*	*M*	0.23	0.18	6	6
4	مذيع news presenter	جالس sitting	*muðˀiʕ*	*ʤa:lis*	*SG*	*M*	1.33	2.37	5	6
5	ممرض nurse	زعلان angry	*mumarriðʕ*	*zaʕla:n*	*SG*	*M*	10.2	0.21	8	7
6	خياط tailor	نايم asleep	*χajatˀ*	*na:jim*	*SG*	*M*	3.12	1.01	5	6
7	رسامة Painter	وصخة dirty	*rassam-ah*	*wasˤiχ-ah*	*SG*	*F*	0.18	0.1	8	7
8	معلمة teacher	طويلة tall	*muʕllim-ah*	*tˤiwi:l-ah*	*SG*	*F*	0.7	103.75	9	8
9	طباخة cook	سمينه fat	*tˀabbaχ-ah*	*sami:n-ah*	*SG*	*F*	0.03	0.16	8	8
10	مذيعة News presenter	جالسة sitting	*muðˀiʕ-ah*	*ʤalis-ah*	*SG*	*F*	1.51	1.59	7	8
11	ممرضه nurse	زعلانة angry	*mumarriðʕ -ah*	*zaʕla:n-ah*	*SG*	*F*	0.49	0.05	9	9
12	خياطة tailor	نايمة asleep	*χajatˀ-ah*	*na:jim-ah*	*SG*	*F*	0.83	1.95	7	8
13	رسامين painters	وصخين dirty	*rassam-i:n*	*wasˤiχ-i:n*	*PL*	*M*	0.55	No value	9	8
14	معلمين teachers	طويلين tall	*muʕllim-i:n*	*tˤiwi:l-i:n*	*PL*	*M*	0.91	0.42	10	9
15	طباخين cooks	سمينين fat	*tˀabaχ-i:n*	*sami:n-i:n*	*PL*	*M*	0.03	0.03	7	9
16	مذيعين News presenters	جالسين sitting	*muðˀiʕ-i:n*	*ʤalis-i:n*	*PL*	*M*	0.23	0.68	8	9
17	ممرضين nurses	زعلانين angry	*mumarriðʕ-i:n*	*zaʕla:n-i:n*	*PL*	*M*	0.23	0.03	11	10

18	خياطين tailors	نايمين asleep	*χajatˀ-i:n*	*na:jim-i:n*	*PL*	*M*	0	0.36	8	9
19	رسامات painters	وصخات dirty	*rassam-a:t*	*wasˤiχ-a:t*	*PL*	*F*	0	No value	9	8
20	معلمات teachers	طويلات tall	*muʕllim-a:t*	*tˤiwi:l-a:t*	*PL*	*F*	0.1	0.03	10	9
21	طباخات cooks	سمينات fat	*tˀabaχ-a:t*	*sami:n-a:t*	*PL*	*F*	0	0.03	8	9
22	مذيعات News presenters	جالسات sittings	*muðˀiʕ-a:t*	*ʤalis-a:t*	*PL*	*F*	0.29	0.05	8	9
23	ممرضات nurses	زعلانات angry	*mumarriðʕ -a:t*	*zaʕla:n-a:t*	*PL*	*F*	0.03	N value	11	10
24	خياطات tailors	نايمات asleep	*χajatˀ-a:t*	*na:jim-a:t*	*PL*	*F*	0	0.03	8	9

Appendix B

Items for Definiteness Agreement Subtest

Item #	Word and Translation		Transcription (IBA)		Number	Gender	Frequency		Length	
	N	Adj	N	Adj	N & Adj	N & Adj	N	Adj	N	Adj
1	الوردة flower	الحمراء red	*el-war:dah*	*el-ħamrah*	*SG*	*F*	5.2	5.8	7	6
2	تفاحة apple	الخضراء green	*el-tuf:aħah*	*el-χaðˤrah*	*SG*	*F*	0.78	10.07	8	5
3	الكورة ball	الزرقاء blue	*el-ku:rah*	*ez-zarga*	*SG*	*F*	0.21	2.86	6	5
4	الكاسة glass	الخضراء green	*el-kasah*	*el-χaðˤrah*	*SG*	*F*	1.85	0.42	7	8
5	الطاولة table	البيضاء white	*el-tˤa:wilah*	*el-bajðˤa*	*SG*	*F*	12.74	11	8	4
6	البلوزة T-shirt	الصفراء yellow	*el-blu:zah*	*esˤ-sˤafra*	*SG*	*F*	0.16	2	7	5
7	السيارة car	السوداء black	*es-saj:arah*	*es-suda:*	*SG*	*F*	84.03	11.24	8	5
8	الساعة clock	الصغيرة small	*es-saʕah*	*esˤ-sˤiʁi:rah*	*SG*	*F*	117.66	26.68	5	6
9	السكينة knife	الحمراء red	*es-sikinah*	*el-ħamrah*	*SG*	*F*	0.1	5.8	6	6
10	المخدة pillow	البيضاء white	*el-maχadah*	*el-bajðˤa*	*SG*	*F*	0.34	11	7	6
11	اللوحة picture	الكبيرة big	*el-luħah*	*el-kabi:rah*	*SG*	*F*	25.25	311.58	5	8
12	الملعقة spoon	الزرقاء blue	*el-milʕagah*	*el-zarga*	*SG*	*F*	0.52	2.86	8	5
13	شنطة bag	حمراء red	*ʃan:tˤah*	*ħamrah*	*SG*	*F*	0.44	5.8	7	6
14	غترة headscarf	بيضاء white	*ʁitrah*	*bajðˤa*	*SG*	*F*	0.03	11	6	6
15	جزمة shoes	سوداء black	*ʤazmah*	*suda:*	*SG*	*F*	0.21	11.24	6	5
16	نظارة glasses	زرقاء blue	*naðˤa:rah*	*zarga*	*SG*	*F*	1.82	2.86	8	5

17	مسطرة ruler	بنية brown	*mistˤarah*	*buni:j:ah*	*SG*	*F*	0.39	23.59	8	9
18	لمبة light	زرقاء blue	*lambah*	*zarga*	*SG*	*F*	0.6	2.86	6	5

Appendix C

Items for Construct State Subtest

Item	Word & Translation		Transcription (IPA)		Number	Gender	Frequency		Length	
	N1	N2	N1	N2	N1 & N2	N1 & N2	N1	N2	N1	N2
1	بيت house	رجال man	*bajt*	*ridʒal*	*SG*	*M*	100.24	112.18	3	5
2	عش nest	عصفور bird	*ʕiʃ*	*ʕasˤu:r*	*SG*	*M*	1.69	no value	3	6
3	سحاب zipper	بنطلون pants	*saħab*	*bantˤalu:n*	*SG*	*M*	2.65	0.52	5	9
4	مفتاح key	بيت house	*miftaħ*	*bajt*	*SG*	*M*	13.76	100.24	6	3
5	عش nest	دجاجة chicken	*ʕiʃ*		*SG*	*M*	1.69	0.75	3	6
6	سحاب zipper	فستان dress	*saħab*	*fustan*	*SG*	*M*	2.65	1.2	5	6
7	كفر wheel	سيكل bicycle	*kafar*	*sajkal*	*SG*	*M*	13.47	0.03	5	5
8	شباك window	بيت house	*ʃubak*	*bajt*	*SG*	*M*	6.11	100.24	5	3
9	مفتاح key	مسجد mosque	*miftaħ*	*masdʒid*	*SG*	*M*	13.76	23.77	6	6
10	سيارة car	الشرطي policeman	*saj:arah*	*ʃirtˤah*	*SG*	*F*	84.03	28.27	8	6
11	شنطة bag	ولد boy	*ʃantˤah*	*walad*	*SG*	*F*	0.44	44.19	6	5
12	شنطة bag	بنت girl	*ʃantˤah*	*binit*	*SG*	*F*	0.44	no value	6	5
13	بيت house	حرمة woman	*bajt*	*ħirmah*	*SG*	*M (1st) F (2nd)*	100.24	3.77	3	6
14	برج tour	المملكة kingdom	*burdʒ*	*almamlakah*	*SG*	*M (1st) F (2nd)*	15.55	127.36	4	9
15	كفر wheel	سيارة car	*kafar*	*saj:arah*	*SG*	*M (1st) F (2nd)*	13.47	84.03	5	8
16	شباك window	سيارة car	*ʃubak*	*saj:arah*	*SG*	*M (1st) F (2nd)*	6.11	84.03	5	8

17	برج tour	فيصلية Faisalyia h	*burʤ*	*fajsaljah*	*SG*	*M (1st) F (2nd)*	15.55	0.05	4	9
18	فرشاية brush	أسنان tooth	*furʃa:ja h*	*asna:n*	*SG*	*F (1st) M (2nd)*	0.81	0.6	9	6
19	سماعة headset	تليفون telphone	*samaʕa h*	*tilifune*	*SG*	*F (1st) M (2nd)*	1.33	6.14	7	8
20	شجرة tree	تفاح apple	*ʃaʤara t*	*tufaħ*	*SG*	*F (1st) M (2nd)*	16.59	0.7	7	5
21	سماعة headset	جوال Mobile	*samaʕa h*	*ʤawal*	*SG*	*F (1st) M (2nd)*	1.33	0.88	7	5
22	فرشة brush	شعر hair	*furʃat*	*ʃaʕar*	*SG*	*F (1st) M (2nd)*	6.11	40.73	6	5
23	شجرة tree	برتقال orange	*ʃaʤara t*	*burtugal*	*SG*	*F (1st) M (2nd)*	16.59	0.42	7	8
24	سيارة car	اسعاف ambulanc e	*saj:ara h*	*isʕa:f*	*SG*	*F (1st) M (2nd)*	84.03	no value	8	7

Appendix D

Items for Non-Construct State Subtest

Item	Word and Translation		*Transcription (IPA)*		*Number*	*Gender*	Frequency		Length	
	N1	N2	*N1*	*N2*	*N1 & N2*	*N1 & N2*	N1	N2	N 1	N 2
1	جوال Mobile	ولد boy	*dʒawal*	*walad*	*SG*	*M*	0.88	44.19	5	5
2	كاس glass	مويا water	*ka:s*	*mu:jah*	*SG*	*M*	68.12	0.68	4	6
3	صحن plate	رز rice	sˤaħan	*riz*	*SG*	*M*	1.87	0.29	5	3
4	كوب cup	شاهي tea	*ku:b*	*ʃahi:*	*SG*	*M*	2.05	2.21	4	5
5	جوال mobile	بنت girl	*dʒawal*	*binit*	*SG*	*M*	0.88	no value	5	5
6	كاس glass	عصير juice	*kas*	*ʕasˤ*i:r	*SG*	*M*	68.12	1.85	3	6
7	قلم pen	معلمة teacher	*galim*	*muʕalim-ah*	*SG*	*M (1st) F (2nd)*	5.33	0.7	5	8
8	قلم pen	مدرس teacher	*galim*	*mudaris*	*SG*	*M (1st) F (2nd)*	5.33	6.66	5	6
9	صحن plate	شوربة soup	*sˤaħan*	*ʃurbah*	*SG*	*M (1st) F (2nd)*	1.87	0.1	5	6
10	لوحة plate	سيارة car	*luħah*	*saj:arah*	*SG*	*F*	25.25	84.03	5	8
11	ساعة watch	رجال man	*saʕah*	*ridʒal*	*SG*	*F*	117.66	112.18	5	5
12	ساعة watch	حرمة woman	*saʕah*	*ħurmah*	*SG*	*F*	117.66	3.77	5	6
13	سماعة stethoscope	دكتورة doctor	*samaʕah*	*diktu:r-ah*	*SG*	*F*	1.33	0.49	7	9
14	سماعة stethoscope	دكتور doctor	*samaʕah*	*diktu:r*	*SG*	*F*	1.33	10.2	7	7
15	شنطة bag	مضيفة flight attendant	*ʃantˤah*	*muðˤifah*	*SG*	*F*	0.44	2.21	6	7

16	قبعة cap	ممرضة nurse	*gubaʕa h*	*mumarið ˀ-ah*	*SG*	*F*	0.44	1.01	7	9
17	لمبة light	صالة Livingroo m	*lambah*	sˤalah	*SG*	*F*	0.6	16.31	6	5
18	قبعة cap	ممرض nurse	*gubaʕa h*	*mumariðˤ*	*SG*	*F*	0.44	0.13	7	7
19	شنطة bag	مضيف flight attendant	*ʃantˤah*	*muðˤif*	*SG*	*F*	0.44	0.47	6	5
20	لمبة light	حمام Toilet	*lambah*	*ħamam*	*SG*	*F (1st) M (2nd)*	0.6	4.84	6	5
21	قبعة cap	مهندس engineer	*gubaʕa h*	*muhandis*	*SG*	*F (1st) M (2nd)*	1.82	12.3	7	8
22	كوب cup	قهوة coffee	*ku:b*	*gahwah*	*SG*	*F (1st) M (2nd)*	2.05	3.28	4	6
23	قبعة cap	شرطي policeman	*gubaʕa h*	*ʃirtˤi*	*SG*	*F (1st) M (2nd)*	1.82	8.82	7	5
24	لوحة Sign	محل shop	*luħah*	*maħal*	*SG*	*F (1st) M (2nd)*	25.25	62.24	5	5

Appendix E

Matching of stimuli in the Number and Gender Agreement Subtest

Frequency

Statistics	**Masculine nouns**	**Feminine nouns**
Total number	12	12
Mean frequency	1.22	0.41
ST dev	1.63	0.49
Range	0.00 – 4.99	0.00 – 1.5`
***U* statistic**	53.000	
***P*-value**	.271	

Statistics	**Singular nouns**	**Plural nouns**
Total number	12	12
Mean frequency	1.42	0.20
ST dev	1.53	0.28
Range	0.03 – 4.99	0.00 0.91
***U* statistic**	24.000	
***P*-value**	.005	

Statistics	**Masculine adjectives**	**Feminine adjectives**
Total number	12	12
Mean frequency	4.72	8.98
ST dev	14.66	29.85
Range	0.00 – 51.24	0.00 - 103.75
***U* statistic**	53.000	
***P*-value**	.270	

Statistics	**Singular adjectives**	**Plural adjectives**
Total number	12	12
Mean frequency	13.55	0.14
ST dev	31.90	0.22
Range	0.05 - 103.75	0.00 - 0.68
***U* statistic**	18.500	
***P*-value**	.002	

Length

Statistics	**Masculine nouns**	**Feminine nouns**
Total number	12	12
Mean length	7.58	8.67
ST dev	1.78	1.07
Range	5.00 – 11.00	7.00 – 11.00
***U* statistic**	46.000	
***P*-value**	.120	

Statistics	**Singular nouns**	**Plural nouns**
Total number	12	12
Mean length	7.16	9.08
ST dev	1.40	0.99
Range	5.00 – 10.00	8.00 – 11.00
***U* statistic**	49.500	
***P*-value**	.165	

Statistics	**Masculine adjectives**	**Feminine adjectives**
Total number	12	12
Mean length	7.50	8.50
ST dev	1.68	0.79
Range	5.00 – 10.00	7.00 – 10.00
***U* statistic**	49.500	
***P*-value**	.177	

Statistics	**Singular adjectives**	**Plural adjectives**
Total number	12	12
Mean length	7.00	9.00
ST dev	1.20	0.60
Range	5.00 – 9.00	8.00 – 10.00
***U* statistic**	10.000	
***P*-value**	.000	

Appendix F

Matching of stimuli in the Definiteness Agreement Subtest

Frequency

Statistics	**Definite Nouns**	**Indefinite Nouns**
Total number	12	6
Mean frequency	20.74	0.58
ST dev	38.82	0.64
Range	0.10 -117.66	0.03 - 1.82
***U* statistic**	21.50	
***P*-value**	.174	

Statistics	**Definite Adjectives**	**Indefinite Adjectives**
Total number	12	6
Mean frequency	33.44	9.5583
ST dev	87.87	7.81862
Range	0.42 - 311.58	2.86 - 23.59
***U* statistic**	33.500	
***P*-value**	.813	

Length

Statistics	**Definite Nouns**	**Indefinite Nouns**
Total number	12	6
Mean length	6.83	6.8333
ST dev	1.11	.98319
Range	3.00 - 5.00	6.00 - 8.00
***U* statistic**	35.00	
***P*-value**	.922	

Statistics	**Definite Adjectives**	**Indefinite Adjectives**
Total number	12	6
Mean length	5.75	6.0000
ST dev	1.21	1.54919
Range	4.00 - 8.00	5.00 - 9.00
***U* statistic**	33.50	
***P*-value**	.802	

Appendix G

Matching of stimuli in the Construct State Subtest

Frequency

Statistics	**Masculine head noun**	**Feminine head noun**
Total number	14	10
Mean frequency	21.92	21.17
ST dev	33.61	33.72
Range	1.69 – 100.24	0.44 – 84.03
***U* statistic**	53.000	
***P*-value**	.318	

Statistics	**Masculine modifying noun**	**Feminine modifying noun**
Total number	16	8
Mean frequency	24.27	46.46
ST dev	41.24	47.57
Range	0.00 – 112.18	0.00 – 127.36
***U* statistic**	47.000	
***P*-value**	.297	

Length

Statistics	**Masculine head noun**	**Feminine head noun**
Total number	14	10
Mean frequency	4.43	7.10
ST dev	1.09	0.99
Range	3.00 – 6.00	6.00 – 9.00
***U* statistic**	3.000	
***P*-value**	.000	

Statistics	**Masculine modifying noun**	**Feminine modifying noun**
Total number	16	8
Mean frequency	5.81	7.00
ST dev	1.64	1.69
Range	3.00 – 9.00	5.00 – 9.00
***U* statistic**	41.000	
***P*-value**	.147	

Appendix H

Matching of stimuli in the Non-Construct State Subtest

Frequency

Statistics	**Masculine head noun**	**Feminine head noun**
Total number	9	15
Mean frequency	17.16	19.81
ST dev	28.94	40.61
Range	0.88 – 68.12	0.44 - 117.66
***U* statistic**	44.500	
***P*-value**	.168	

Statistics	**Masculine modifying noun**	**Feminine modifying noun**
Total number	11	13
Mean frequency	12.79	18.33
ST dev	20.73	36.19
Range	0.00 – 62.24	0.10 – 112.18
***U* statistic**	68.500	
***P*-value**	.862	

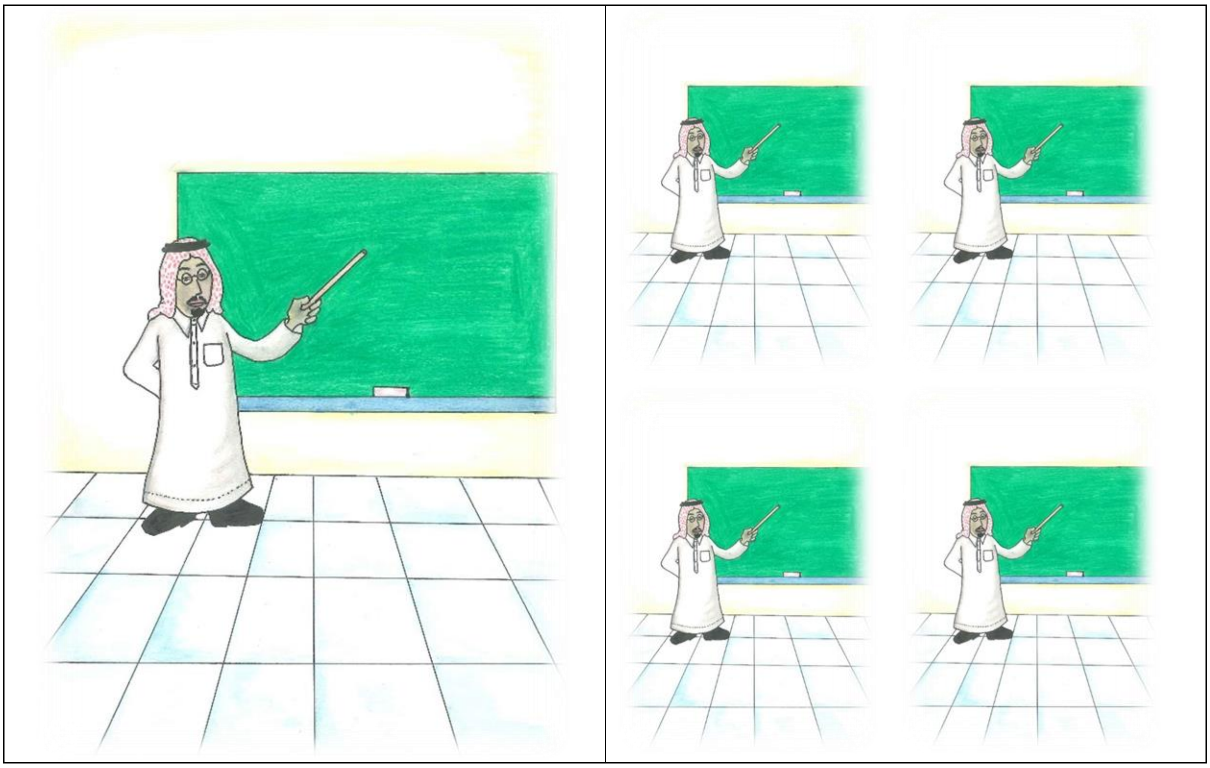
Length

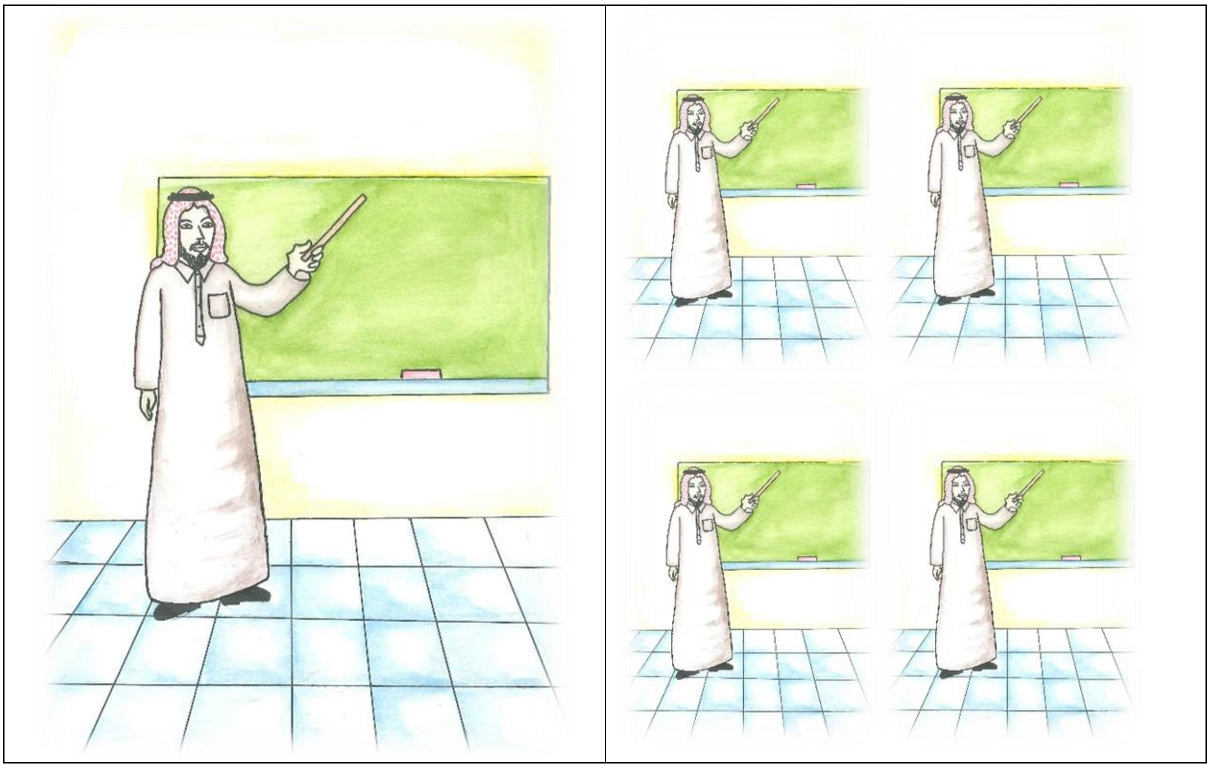
Statistics	**Masculine head noun**	**Feminine head noun**
Total number	9	15
Mean frequency	4.55	6.00
ST dev	0.73	1.00
Range	3.00 – 5.00	4.00 – 7.00
***U* statistic**	19.000	
***P*-value**	.002	

Statistics	**Masculine modifying noun**	**Feminine modifying noun**
Total number	11	13
Mean frequency	5.36	6.77
ST dev	1.21	1.42
Range	3.00 – 8.00	5.00 – 9.00
***U* statistic**	32.500	
***P*-value**	.019	

Appendix I

Sample for images used for eliciting plural nouns





Appendix J

Coding of lexical items

Lexical error	Description
Semantic	The response is a synonym, category coordinate, category superordinate, category subordinate or associate of the target.
Formal	The response is phonologically similar to the target, i.e., the target and response starts and ends with the same phoneme, has a common phoneme in another syllable or word position or has more than one common phoneme in any position. Proper nouns and plural morphemes do not contribute to phonological similarity.
Mixed	The response meets the criteria for both semantic and formal errors.
Unrelated	The response meets neither semantic nor formal errors and is not visually related to the target
Phonologically related non-word	Criteria as for Formal but resulting in a non-word.
Semantically related or semantically and phonologically related non-word	e.g., response 'babbit' for target 'squirrel'.
Unrelated non-word	No relationship to the target and not a real word.
Description	The response is a multiword utterance or single adjective or adverb that characterizes the target object or explains its function or purpose.
No response	No spoken production of the noun, the adjective or the noun and the adjective apart from comments such as 'Oh what's the word'
Miscellaneous	e.g., named a part of the target object such as response 'sleeve' for target 'jumper'.

Note. Description is taken from Herbert et all. (2014, p. 217).

Appendix K

Coding of inflectional items

Inflectional error	Description
Substitution of gender	The response is a feminine inflection for a masculine stimulus or a masculine inflection for a feminine stimulus. (e.g. *rassam* ‘painter-M.SG’ instead of *rassam-ah* ‘painter-F.SG’).
Substitution of number	The response is a singular inflection for a plural stimulus or a plural inflection for a singular stimulus. (e.g. *rasam* ‘painter-M.SG’ instead of *rasam-i:n* ‘painter-M.PL’).
Substitution of gender and number	The response is an inflectional error that involves both a substitution of gender error and a substitution of number error (e.g. *rasam* ‘painter-M.SG’ instead of *rasam-a:t* ‘painter-F.PL’).
Substitution of definiteness	The response is definite article for indefinite, or indefinite article for definite (e.g. *el-rasam* ‘Def-painter’) instead of *rasam ‘Indef*-painter’).
No response	No spoken production of both the inflections and the lexical item (noun, adjective or the particle *ħag*) to which the inflection is attached.

Appendix L

Coding of agreement

Agreement type	Description
Correct agreement	The response matches the target in inflections and agreement. The response may or may not match the target in lexical items.
Grammatical not target	The response is grammatical, grammatical internal agreement, but does not match the target response. for example, production of M SG inflections (*rasam wasʕiχ* 'painter-M.SG + dirty-M.SG') instead of F SG inflections (*rasam-ah wasʕiχ-ah* painter-F.SG + dirty-F.SG)
Ungrammatical	The response has incorrect inflections, incorrect internal agreement (disagreement) and correct or incorrect lexical items. Violation of internal agreement in the *Number and Gender Agreement* test can be due to different gender inflections (e.g. *rasam wasʕiχ-ah* 'painter-M.SG + dirty-F.SG'), different number inflections (e.g. *rasam wasʕiχ-i:n* 'painter-M.SG + dirty-M.PL') or different number and gender inflections (e.g. *rasam wasʕiχ-at* 'painter-M.SG + dirty-F.PL'). In the *Definiteness Agreement Test*, violation of internal agreement can be due to different definiteness inflections (e.g. *rasam el-wasʕiχ* 'Indef.-painter-M.SG + Def- dirty-M.SG'), different gender inflections (e.g. *rasam wasʕiχ-ah* 'painter-M.SG + dirty-F.SG'), or different definiteness and gender inflections (e.g. *rasam el-wasʕiχ-ah* Indef.-painter-M.SG + Def- dirty-F.SG). In the *Non-Construct Sate* test, agreement occurred between the inflection of the first noun and the inflection of the particle *ħag* (for) that follows the first noun. Violation of internal agreement occurs due to different gender inflections (e.g. *rasam ħag-at* 'painter-M.SG + of-F.SG'), different number inflections (e.g. *rasam ħag-i:n* 'painter-M.SG + of-M.PL') or different number and gender inflections (e.g. *rasam ħag-a:t* 'painter-M.SG + of-F.PL').

Appendix M

Information sheet for name agreement test

Information Sheet
Name Agreement Test

Project title: Noun Phrases in Arabic

The project described below is a study to be carried out at the University of Sheffield as part of a doctoral degree. For further information, you can contact the student researcher, Mrs. Shams Almuzaini

The Research Team

Mrs. Shams Almuzaini is a PhD student at the University of Sheffield. This project is carried out under the supervision of Dr.Ruth Herbert, Dr. Richard Body and Dr. Lamya Alabdulkarim.

Ethical approval

This study has been approved by the Department of Human Communication Sciences Research Ethics Review Panel according to university procedures.

1. What is the purpose of the study?

This study is part of a larger study that is designed to investigate how noun phrases (e.g. *the red apple*) are produced by Saudi Arabic speakers with agrammatism (a language disorder due to brain damage). This study is very important. It involves investigating the degree to which certain nouns refer to particular pictures (e.g. *the red apple* refers to a picture of a red apple not a green apple). The study will help find appropriate pictures in order to use for testing people with agrammatism.

2. Who are the participants involved in the study?

The participants **must** be:

1. Adult Arabic speakers
2. Aged from 18 and above
3. Healthy speakers

And **must not**:

4. Be bilingual
5. Have hearing or vision impairment
6. Have previous history of speech and language impairment
7. Have other neurological or psychiatric conditions.

3. Is it necessary to take part?

You are free to decide whether you want to take part in the study or not.
If you decide to take part, you will be asked to sign a consent form.
If you wish to withdraw, you can do so at any point of time without giving a reason.

4. What does the study involve?

The study involves collecting speech material data. The speech material will be obtained in one session that lasts for an hour. The participant will be asked name pictures. The speech will be audio-recorded.

5. When and where will the study be conducted?

If you are happy to take part in the study, an appointment will be given to you by the researcher. The test will take place in a quiet clinic room at the Department of Rehabilitation at King Saud University in Riyadh.

6. What will happen to the data and audio-recordings?

The data that will be taken from you will be stored in the researcher's office and on a password protected pc that belongs to the researcher. All your responses to the tasks and all your audio-recordings will be anonymously coded for reports and presentations. You will not be identified in any reports or publications based on the data and recordings. Your responses from the recordings will be used to present data at conferences. The original audio samples might be played in scientific conferences or meetings when appropriate and the names will be anonymous if you give consent. If for any reasons you do not want your audio-recording to be played to anybody, the researcher will only use your audio-recording for analysing. After all relevant reports are published the data and audio recording will be destroyed.

7. What will happen to the result of the study?

The results of the study will be used mainly as part of the researcher's PhD project. They will also be reported in scientific publications and at conferences. Your identity will not be revealed in any of these reports.

8. What are the potential advantages of taking part?

There is no direct advantage for you when taking part in the study. However, your participation is extremely valuable since it will contribute to the study in order to understand the speech of Saudi people with agrammatism and help find appropriate intervention. It will also help contribute to the studies and theories of agrammatism.

9. What are the potential disadvantages and risks of taking part?

There is little potential for disadvantages or risk when you participate in this study. All the tasks used in this study are picture-naming tasks and will not cause you any physical or psychological harm. In case you feel fatigued, you will be given a short break then the test will be resumed.

10. What if there is a problem or I want to make a complaint?

If you have any complaint or concern, you may contact one of the following people.

Shams O. Almuzaini

CAMC
King Saud University
Imam Muhammed the first road
Riyadh
Mobile: + 966 565552238
Email: salmuzaini@ksu.edu.sa

Dr. Lamya Alabdulkarim

CAMC
King Saud University
Imam Muhammed the first road
Riyadh
Mobile: + 966 503181173

Email: laalabdulkarim@ksu.edu.sa

Dr. Ruth Herbert

Department of Human Communication Sciences
University of Sheffield
362 Mushroom Lane
Sheffield
S10 2TS
United Kingdom
Tel: +44 (0) 114 222 2418
Email: r.herbert@sheffield.ac.uk

Prof. Patricia E Cowell

Head of Department
Department of Human Communication Sciences
University of Sheffield
362 Mushroom Lane
Sheffield
S10 2TS
United Kingdom
Tel: +44 (0) 114 222 2426
Email: p.e.cowell@sheffield.ac.uk

Thank you for your time.

Appendix N

Consent form for name agreement test

Informed Consent Form

Participant number:

Title of Project: Name agreement test

Name of Researcher: Shams Almuzaini

Please initial box

1. I confirm I have read and understand the information sheet.
2. I confirm I have had the opportunity to ask questions.
3. I understand that my participation is voluntary.
4. I understand that I can take rest, stop at any time or withdraw and I don not have to give reasons.
5. My responses will be anonymised before analysis.
6. Members of the research team might access my responses.
7. I agree to record my speech.
8. I agree that my audio-recordings might be played in conferences and meeting s without revealing my identity.
9. I agree to use my data in futre resrach project.

10. I agree to take part in this research project.

Name of Participant	Date	Signature
Name of person taking consent	Date	Signature

To be signed and dated in presence of the participant.

Appendix O

Information sheet for pilot study and main experiment

Information Sheet

Pilot Study & Main Experiment

Project title: Noun Phrases in Arabic

The project described below is a study to be carried out at the University of Sheffield as part of a doctoral degree. For further information, you can contact the student researcher, Mrs. Shams Almuzaini

The Research Team

Mrs. Shams Almuzaini is a PhD student at the University of Sheffield. This project is carried out under the supervision of Dr.Ruth Herbert, Dr. Richard Body and Dr. Lamya Alabdulkarim.

Ethical approval

This study has been approved by the Department of Human Communication Sciences Research Ethics Review Panel according to university procedures.

11. What is the purpose of the study?

The study is designed to investigate how noun phrases (e.g. *the red apple*) are produced by Saudi Arabic speakers with agrammatism (a language disorder due to brain damage). The study will help describe how people with agrammatism speak. It will in turn support the intervention of agrammatism. It will also contribute to the different studies and theories of agrammatism.

12. Who are the participants involved in the study?

The participants **must** be:

8. Adult Arabic speakers
9. Aged from 18 and above
10. Diagnosed with aphasia post stroke.

And **must not**:

11. Be bilingual
12. Have significant hearing impairment
13. Have significant unintelligibility of speech
14. Have previous history of speech and language impairment prior to stroke
15. Have other neurological or psychiatric conditions.

13. Is it necessary to take part?

You are free to decide whether you want to take part in the study or not.
If you decide to take part, you will be asked to sign a consent form.
If you wish to withdraw, you can do so at any point of time without giving a reason.

14. What does the study involve?

The study involves collecting speech material data. The speech material will be obtained in three to four sessions that each one lasts for an hour. The participant will be asked to do some linguistic tests via picture naming. The speech will be audio-recorded.

15. When and where will the study be conducted?

If you are happy to take part in the study, an appointment will be given to you by the researcher. The test will take place in a quiet clinic room at either King Fahad Medical City or Sultan Bin Abdulaziz Humanitarian City.

16. What will happen to the data and audio-recordings?

The data that will be taken from you will be stored in the researcher's office and on a password protected pc that belongs to the researcher. All your responses to the tasks and all your audio-recordings will be anonymously coded for reports and presentations. You will not be identified in any reports or publications based on the data and recordings. Your responses from the recordings will be used to present data at conferences. The original audio samples might be played in scientific conferences or meetings when appropriate and the names will be anonymous if you give consent. If for any reasons you do not want your audio-recording to be played to anybody, the researcher will only use your audio-recording for analysing. After all relevant reports are published the data and audio recording will be destroyed.

17. What will happen to the result of the study?

The results of the study will be used mainly as part of the researcher's PhD project. They will also be reported in scientific publications and at conferences. Your identity will not be revealed in any of these reports.

18. What are the potential advantages of taking part?

There is no direct advantage for you when taking part in the study. However, your participation is extremely valuable since it will contribute to our understanding of the speech of Saudi people with agrammatism and help find appropriate intervention. It will also significantly contribute to different studies and theories of agrammatism.

19. What are the potential disadvantages and risks of taking part?

There is little potential for disadvantages or risk when you participate in this study. All the tasks used in this study are picture-naming tasks and will not cause you any physical or psychological harm. In case you feel fatigued, you will be given a short break then the test will be resumed.

20. What if there is a problem or I want to make a complaint?

If you have any complaint or concern, you may contact one of the following people.

Shams O. Almuzaini

CAMC
King Saud University
Imam Muhammed the first road
Riyadh
Mobile: + 966 565552238
Email: salmuzaini@ksu.edu.sa

Dr. Lamya Alabdulkarim

CAMC
King Saud University
Imam Muhammed the first road
Riyadh
Mobile: + 966 503181173

Email: laalabdulkarim@ksu.edu.sa

Dr. Ruth Herbert

Department of Human Communication Sciences
University of Sheffield
362 Mushroom Lane
Sheffield
S10 2TS
United Kingdom
Tel: +44 (0) 114 222 2418
Email: r.herbert@sheffield.ac.uk

Prof. Patricia E Cowell

Head of Department
Department of Human Communication Sciences
University of Sheffield
362 Mushroom Lane
Sheffield
S10 2TS
United Kingdom
Tel: +44 (0) 114 222 2426
Email: p.e.cowell@sheffield.ac.uk

Thank you for your time.

Appendix P

Consent form used for pilot study and main experiment

Informed Consent Form

Participant number:

Title of Project: Nouns and Adjectives in Arabic

Name of Researcher: Shams Almuzaini

Please initial box

I confirm:

11. I have read the information sheet.
12. I have understood the information sheet.
13. I have had the opportunity to ask questions.

I understand:

1. My participation is voluntary.
2. I can stop at any time.
3. I can rest at any time.
4. I am free to withdraw at any time.
5. I don't have to give reason when I want to withdraw.
6. My responses will be anonymised before analysis.
7. Members of the research team might access my responses.

I agree to:

1. Record my speech.
2. Play my audio-recording at meetings without revealing my identity.

3. Play my audio-recording at conferences without revealing my identity.
4. Use the data in future research reports.
5. Take part in this research project.

Name of Participant	Date	Signature
Name of person taking consent	Date	Signature

To be signed and dated in presence of the participant.

Appendix Q

Ethical approval obtained from The University of Sheffield

The University Of Sheffield.

Downloaded: 08/04/2015
Approved: 31/03/2015

Shams Almuzaini
Registration number: 130105589
Human Communication Sciences
Postgraduate Research Student

Dear Shams

PROJECT TITLE: Production of Nominal Inflections by Saudi Arabic Speakers with Agrammatism
APPLICATION: Reference Number 001128

On behalf of the University ethics reviewers who reviewed your project, I am pleased to inform you that on 31/03/2015 the above-named project was **approved** on ethics grounds, on the basis that you will adhere to the following documentation that you submitted for ethics review:

- University research ethics application form 001128 (dated 26/03/2015).
- Participant information sheet 006801 (26/03/2015)
- Participant information sheet 006800 (26/03/2015)
- Participant information sheet 006799 (26/03/2015)
- Participant information sheet 003802 (02/12/2014)
- Participant information sheet 003801 (02/12/2014)
- Participant information sheet 003803 (02/12/2014)
- Participant consent form 006803 (26/03/2015)
- Participant consent form 006802 (26/03/2015)
- Participant consent form 005010 (02/02/2015)
- Participant consent form 005011 (02/02/2015)

If during the course of the project you need to deviate significantly from the above-approved documentation please inform me since written approval will be required.

Yours sincerely

Thomas Muskett
Ethics Administrator
Human Communication Sciences

Appendix R

Ethical approval obtained from Sultan Bib Abdelaziz Humanitarian City

مدينة سلطان بن عبد العزيز للخدمات الإنسانية
SULTAN BIN ABDULAZIZ HUMANITARIAN CITY

RESEARCH & ETHICS COMMITTEE

24 June 2015

Shams Al Muzaini
Principal Investigator
Human Communication Sciences
Imam Muhammad University

Subject : Production of Non-clausal Functional Elements by Saudi Arabic Speakers with Agrammatism

Dear Ms. Shams Al Muzaini:

Thank you for submitting your research proposal.

The above mentioned proposal has been reviewed by the assigned members of the Research and Ethics Committee of the Sultan bin Abdulaziz Humanitarian City, Riyadh. I am pleased to inform you that this project has been approved by Research and Ethics Committee (Chairman Action).

Your research protocol has now been documented under:

Project Number : 002/2015/24 June
Series of : 2014 June 24

Kindly quote the project number indicated herein in all transactions and communications. You are advised to submit a progress report, this time after three (3) months from approval of your research proposal, in relation to this research schemed we need you also to send us a Final report after your research will be completed in relation to this research schemed to update the committee of its progress.

I trust your research scheme proves fruitful and beneficial to you, the patients and this institution.

Thank you,

Dr. Sadi Al Zahrani, SLP Cons.
Chairman of Research & Ethics Committee
Sultan Bin Abdulaziz Humanitarian City
P.O. Box 64399, Riyadh 11536
Kingdom of Saudi Arabia

Appendix S

Ethical approval obtained from King Fahad Medical City

Kingdom of Saudi Arabia
Ministry of Health
King Fahad Medical City
(162)

مدينة الملك فهد الطبية
King Fahad Medical City

المملكة العربية السعودية
وزارة الصحة
مدينة الملك فهد الطبية
(١٦٢)

IRB Registration Number with KACST, KSA: H-01-R-012
IRB Registration Number with OHRP/NIH, USA: IRB00008644
Approval Number Federal Wide Assurance NIH, USA: FWA00018774

October 5, 2015
IRB Log Number: 15-350E
Department: External
Category of Approval: EXEMPT

Dear Shams Obaid Almuzaini,

I am pleased to inform you that your submission dated September 18, 2015 for the study titled '**Production of Nominal Inflections by Saudi Arabic Speakers with Agrammatism**' was reviewed and was approved. Please note that this approval is from the research ethics perspective only. You will still need to get permission from the head of department or unit in KFMC or an external institution to commence data collection.

We wish you well as you proceed with the study and request you to keep the IRB informed of the progress on a regular basis, using the IRB log number shown above.

Please be advised that regulations require that you submit a progress report on your research every 6 months. You are also required to submit any manuscript resulting from this research for approval by IRB before submission to journals for publication.

If you have any further questions feel free to contact me.

Sincerely yours,

Prof. Omar H. Kasule
Chairman Institutional Review Board--IRB.
King Fahad Medical City, Riyadh, KSA.
Tel: + 966 1 288 9999 Ext. 26913
E-mail: okasule@kfmc.med.sa

KFMC Approved 05 OCT 2015 IRB

Appendix T

Added codes for inflectional and agreement errors based on pilot results.

Inflectional errors - Second stage

Inflectional error	Description
Substitution with M SG	The response is a masculine singular inflection for either a singular feminine or a plural. (e.g. *rasam* 'painter-M.SG' instead of *rasam-ah* 'painter-F.SG')
Substitution with F SG	The response is a feminine singular inflection for either a singular masculine or a plural. (e.g. of *rasam-ah* 'painter-F.SG' instead of *rasam* 'painter-M.SG')
Substitution with M PL	The response is a masculine plural inflection for either a feminine plural or a singular. (e.g. *rasam-i:n* 'painter-M.PL' instead of *rasam-a:t* 'painter-F.PL')
Substitution with F PL	The response is a feminine plural inflection for either a masculine plural or singular. (e.g. *rasam-a:t* 'painter-F.PL' instead of *rasam-i:n* 'painter-M.PL')

Agreement errors

Not able to compute (NTC)	The response involves omission of one of the lexical items and its inflection or all the lexical items with their inflections.