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# GRAMMATICAL STRUCTURES IN NEWS BULLETINS: INSIGHTS FROM FULFULDE AND ENGLISH

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**Abstract** Syntactic analysis, through which the structures can be observed and used to express different ideas, play a vital communication role. This research paper examined the variations in syntactic structures of Fulfulde and English news bulletins of Adamawa Broadcasting Corporation Yola. Three sentences were selected each from the news bulletins between the months of February and March, 2024, and were analyzed using Transformational Generative Grammar (TGG) theory of Chomsky (1957), and its revised version (1965), as a theoretical Framework. Results of the analysis indicate that, the Fulfulde past tense markers do not indicate only the tense, but also shows plurality in that same sentence. It also revealed that, modal auxiliary verbs are used in English sentence as an independent lexemes, while in Fulfulde sentences their equivalents operate as inflectional elements. Also observed that the word order of sentences of the two languages vary despite the fact that both the two languages are SVO (subject, verb, object languages). It was concluded that the variations in syntactic structures occurred in the areas of subject, verb and object of the sentences. The study recommends that, ESP practitioners should pay more attention to the analysis of variations in syntactic structure of languages, in material writing and production for the students of languages.

Key words: Linguistics, Variation, Bulletin, Phrase, Three Diagram

### INTRODUCTION

#### **Background of the research**

Language is the chief source of communication of ideas. There are some other ways also, such as dance, music, physical gesture, and symbol, through which we can communicate ideas. But language is a very common and an easy source of communication. It is the basis of human civilization which would have been impossible without it. Language documentation is not only important to the academic community but when presented in a nontechnical manner; it can be of great use to the language communities themselves by making them see comparative descriptions of their own languages and language variants (Keyne, 2012). Variation is a process between different forms of languages within speech community or major languages such as Fulfulde and English language. It is

apparent to state that no human language is fixed, uniform or unvarying: all languages show internal variation. Actual usage varies from group to group, and speaker to speaker, in terms of the pronunciation of a language, the choice of words and the meaning of those words, and even the use of syntactic construction (Dillard, 1972). To take a well – known example, the speech of Americans is noticeably different from the speech of the British, and the speech of these two groups in turn is distinct from the speech of Australians. When groups of speakers differ noticeably in their language, they are often said to speak different dialects of the language. However, the variation does not end with dialects; each recognizable dialect of a language is itself subject to considerable internal variation: no two speakers of a language, even if they are speakers of the same dialect, produce and use their language in exactly the same way. We are able to recognize different individuals by their distinct speech and language patterns; indeed, a person's language is one of the most fundamental features of self-identity. The form of a language spoken by a single individual is referred to as an idiolects, an every speaker of a language has a distinct idiolect. Furthermore, language is the vehicle through which media processes their news. News language is the form and style of language used by journalists in mass media such as print and broadcasts. Media content help people to understand the happening around them by simplifying the language through the choice of words, sentences and other grammatical devices to enhance understanding of the media content (Thorne, 2008). News is information; new, relevant and judged to be news worthy by the Journalists and the audience. Indeed, news bulletin is not created in a vacuum but through the gatekeepers whose duty is to get story, process and present it to the mass audience through broadcast; radio or television. However, news language is of paramount important as the news itself. Because news language is the form and style of language used by journalists in mass media such as print and broadcasts. The media content help people to understand the happening around them by simplifying the language through the choice of words, sentences and other grammatical devices to enhance understanding of the media content. However, in many circumstances due to the variations within and between languages pose some difficulties in understanding the content of news, specifically when reporting a story which emanated from different language (Hudson, 1980). Therefore, it is expedient for linguists to analyse the syntactic structure of languages with the view to identifying the kind of variations that exist in the languages and to find out the disparity and similarities that may exist between languages so as to avert misconception of the news content. The major role of syntactic analysis is to produce accurate analysis of sequences of the element of sentences. Furthermore, such studies can have important implications for those involve in language policy because they may see the form of speech in a minority language group in its original terms and not as a "poorly spoken" variety of a non-native speakers or users.

#### **Statement of the Problem**

It is apparent to state that no human language is fixed, uniform or unvarying: all languages show internal variation. Actual usage varies from group to group, and speaker to speaker, in terms of the pronunciation of a language, the choice of words and the meaning of those words, and even the use of syntactic construction (Dillard, 1972). Variations in sounds and structures of languages are some of the reasons why reporters from other languages encounter difficulties in interpreting other languages in their reportage (Hyellandendu, 2009). Keyne (2012) observes that no two speakers of English language have exactly the same syntax. Where, studies available on Fulfulde idiophones, by Mcintosh (1984), Fulfulde Morpho-Phology by Taylor (1921), Fulfulde verbal system, by Abba- Manga (1991), and double object construction in Fulfulde, by Ahmed (1994) have clearly shown that, there are very few descriptive works carried out on the syntactic structure of Fulfulde. Where a very long

linguistics gap created by absence of material on Fulfulde sentence in general and variation with English language in particular. Moreover, fulfulde like many other languages need to, fit into the current linguistics analysis of the universal grammar. Therefore, this calls for an indepth linguistics analysis on the variation in syntactic structures of Fulfulde and English language to fill in the gap.

# Aim and Objectives of the Study

The aim of this study is to analyse the variations in syntactic structure of Fulfulde and the English language in news bulletins of Adamawa Broadcasting Corporation (ABC), Yola. The objectives are to:

- i. Identify the syntactic structures of Fulfulde and English language in news bulletins of Adamawa Broadcasting Corporation (ABC) Yola.
- ii. Examine the syntactic variations between Fulfulde and the English language in news bulletins of Adamawa Broadcasting Corporation (ABC) Yola.
- iii. Analyse of the similarities and differences in the syntactic structures of Fulfulde and the English language in news bulletins of Adamawa Broadcasting Corporation (ABC) Yola.

## **Research Questions**

The study provided answers to the following research questions

- i. What are the syntactic structures of Fulfulde and English Language?
- ii. What are the syntactic variations between Fulfulde and English Language?
- iii. What are the similarities and differences in the syntactic structure of Fulfulde and the English language?

#### Significance of the Study

It is hoped that this study will advance the knowledge in linguistics and language studies by providing valid and useful information about the relationship of English and Fulfulde sentence. Again, it would provide a teaching input to English for Specific Purpose (ESP) practitioner and guide especially in material writing and production for the student of languages. The study will also provide readers and others interested in the study of languages with the information about the syntactic variation of Fulfulde and English language. In addition, it will also stimulate further studies on other aspect of linguistics study of Fulfulde. Generally, it will unravel the problems associated with the mother tongue interference of Fulfulde speakers learning English as a second language. Whereas, the study will fill the linguistics gap created by absence of material on Fulfulde sentence in general and variation with English language in particular. In addition, the study will show that Fulfulde like many other languages can fit in to the current linguistics analysis of the universal grammar.

# Scope of the Study

The scope of the study is limited to the analysis of the variation in syntactic structures of Fulfulde and English language, three (3) sentences each from Fulfulde and the English language were drawn from the news bulletins of Adamawa Broadcasting Corporation (ABC) Yola from February – March, 2024 for analyses.

#### LITERATURE REVIEW

This paper deals with the review of literature related to the subject matter of variations in syntactic structures of Fulfulde and English language. Concept of Linguistics, Components of Linguistics, Language, Functions of Language, and History of English. History of Fulfulde, language variation, the concept of structure, Sentence Structure, Phrase Structure, Clauses and Sentences, Constituents of structure, Grammatical relations, empirical works, summary of the review and Conceptual Framework.

#### **METHODOLOGY**

This paper deals with the method that was employed in conducting this research. It specifically discusses the research design, the corpus, sources of data and method of data analysis.

## **Research Design**

The descriptive research design is employed in this study. As a corpus based study, descriptive research design is considered appropriate and suitable because it is capable of eliciting information about the structures of languages. The descriptive type of study provides vivid result about a phenomenon without manipulation of any variables. According to Yule (2008), the descriptive approach allows description of the features of language as used in a given context as against how they are supposed to be used.

# The Corpus

The corpus of this study was purposively selected, consisting three (3) sentences each from news bulletins of Fulfulde and its English equivalent in the broadcast of Adamawa Broadcasting Corporation (ABC) Yola.

#### **Sources of Data**

This research is corpus based and the data was derived from news bulletins of ABC, Yola. The source of the data was the archive of the Adamawa Broadcasting Corporation, Yola, that was drawn from the news broad last in February to march, 2024.

#### **Method of Data Analysis**

The data of this research was analysed using Chomsky's (1957) Transformational Generative Grammar (TGG) model of analysis. This model is considered useful in this type of research because it provides framework that can be used in analyzing and describing the structures of languages. Therefore, TGG was used to analyze explicitly the syntactic structure of Fulfulde and English Language.

#### **DATA ANALYSIS**

This analyses the data collected from the news bulletins of the Adamawa Broadcasting Corporation (ABC) Yola. The analysis is based on the theory of Chomsky (1957) Transformational Generative Grammar (TGG) Model of analysis and it is revised version (1962) as discussed in the framework.

#### **Data Presentation**

In this section, the research presents an analysis of the data collected. The data is made up of three (3) sentences of Fulfulde and its equivalent in English Language of news bulletins using TGG Model of analysis. The analysed data is in accordance with the stipulated objectives of the study. The presentation provide data that identify the syntactic structures of Fulfulde and English language, find out the syntactic variation between the two, and analyses the similarities and differences in the syntactic structure of Fulfulde and English language. The sentences in the corpus were labelled sentences one to three (1-3).

## **Sentence number 1 (English Version):**

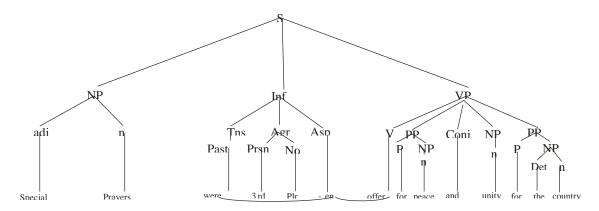
Special prayers were offered for peace and unity of the country.

#### **Phrase Structure of the Sentence:**

$$S$$
  $\longrightarrow$   $np + inf + vp$ 
 $Np = adj + n$ 
 $Adj = special$ 
 $N = prayers$ 
 $Inf = tns + agr + asp$ 
 $Tns = past$ 

```
Past
       =
               were
Agr
               prsn + no
       =
Prsn
       =
               3rd
No
               plr
        =
Asp
               -en
       =
Vp
               v + pp + conj + np + pp
V
               offer
Pp
               p + np
               for
        =
Np
               n
N
               peace
Conj
       =
               and
Np
               n
N
               unity
Pp
               p + np
P
               of
        =
Np
               det + n
        =
Det
               the
        =
N
               country
```

Therefore the phrase structure of sentence number one (1) can be represented in a tree diagram.



Tree Diagram of Sentence Number 1 - English

Tree diagram showing phrase structure of sentence number one (1) (English) Source; Field Study, 2024

Sentence Number 1 (Fulfulde Equivalent): Do'aji kimminidii dau njodie njam e kautal hore lesdi waɗama.

### **Phrase Structure of the Sentence:**

$$S \longrightarrow np + inf + vp$$

$$Np = n + adj + pp + conj + np$$

$$N = do'aji$$

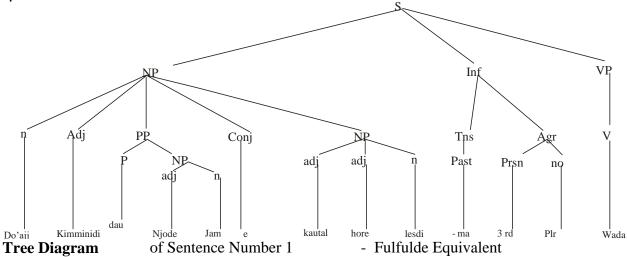
$$Adj = kimminidii$$

$$Pp = pp + np$$

$$P = dau$$

Np adj + nnjodie Adj =N njam = Conj = e Np adj + adj + n= kautal Adj Adj = hore N lesdi Inf tns + agr=Tns past Past = - ma Agr prsn + noPrsn 3rd=No plr Vp = v = vV wada

The phrase structure of sentence number 1 (Fulfulde) can be represented in a tree diagram .



Tree diagram showing phrase structure of sentence number 1 (Fulfulde)

## Source; Field Study, 2024

In the above sentences analysed from Fulfulde and English language. Phrase structures and the tree diagrams were used to analyze and reveals the variation that occurred between English and Fulfulde sentences, at the word order level. The case of word order in the two languages varies where in English sentence the word adjective 'special' occurred before the head word 'prayer' as usual, which is not like the case of Fulfulde sentence, where the word adjective 'kimminidi' occurred after the word Do'aji, that is ''Do'aji kimminidi''. **Sentence number 2** 

# (English Version):

Highlight of the marriage ceremony was the Qur'anic graduation of the two brides.

# **Phrase Structure of the Sentence:**

$$S \longrightarrow np+inf+vp$$

Np = n + ppN highlight =Pp =p + npP = of Np det + adj + n= Det the Adj marriage N ceremony Inf tns + agr=Tns past Past -ed = Agr = prsn + noPrsn 3rd= No sng Vp v + np + ppV =is Np det + adj + n=Det the =

Adj = quar'anic N = graduation

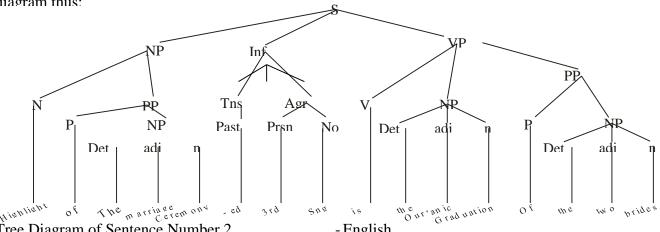
 $Pp \qquad = \qquad p + np$ 

P = of

Np = det + adj + n

 $\begin{array}{lll} \text{Det} & = & \text{the} \\ \text{Adj} & = & \text{two} \\ \text{N} & = & \text{brides} \end{array}$ 

The phrase structure of sentence number 2 (English) can be represented in a tree diagram thus:



Tree Diagram of Sentence Number 2 - English
Tree diagram showing phrase structure of sentence number 2 (English)

Source; Field Study, 2024

Sentence Number 2 (Fulfulde Equivalent):Do'a Al'qur'ana do der ko doggina ha lamar habbol tegal man. Phrase Structure of the Sentence:

$$S \longrightarrow np + inf + vp$$

$$Np = adj + n$$

$$Adj = do'a$$

$$N = alqur'ana$$

$$Inf = tns + agr$$

$$Tns = past$$

$$Past = -a$$

$$Agr = prsn + no$$

$$Prsn = 3rd$$

$$No = sng$$

$$Vp = adv + adv + v + pp$$

$$Adv = do der$$

$$Adv = ko$$

$$V = doggin$$

$$Pp = p + np$$

$$P = ha$$

$$Np = adj + adj + n + adj$$

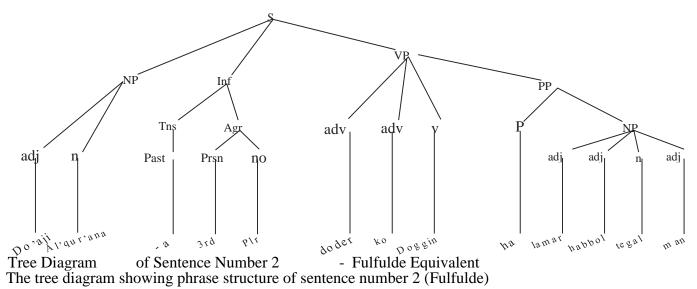
$$Adj = lamar$$

$$Adj = habbol$$

$$N = tegal$$

$$Adj = man$$

The phrase structure of Fulfulde sentence 2 can equally be represented in a tree diagram as:



Source; Field Study, 2024

The above English and Fulfulde sentences were analysed using phrase structure rules and the tree diagrams in order to find out the variations that may exist between the two languages

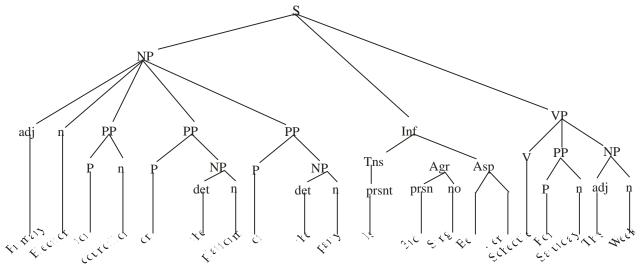
# **Sentence number 3 (English Version):**

Primary election for councillorship on the platform of the party is scheduled for Saturday this week.

### **Phrase Structure of the Sentence:**

```
np + inf + vp
Np
      =
              adj + n + pp + pp + pp
Adj
             primary
       =
             election
N
       =
             p + np^2
Pp
       =
P
             for
      =
Np
      =
             n
N
             councillorship
      =
             p + np^3
Pp
      =
       =
             on
Np^3
             det +n
N
       =
             plat form
             p + np^4
Pp
       =
       =
             of
Np^4
      =
             det + n
Det
      =
             the
N
      =
             party
Inf
      =
             tns + agr + asp
Tns
      =
             prsnt
Prsnt =
             is
Agr
             prsn + no
      =
Prsn
      =
              3rd
No
      =
             sng
Asp
             be + in
      =
Vp
             v + pp + np
      =
V
             schedule
      =
Pp
      =
             p + np
P
             for
      =
Np
      =
             n
N
             Saturday
      =
Np
      =
             adj + n
Adj
             this
      =
N
              week
       =
```

The phrase structure of sentence number 3 can be represented in a tree diagram thus:



**Tree Diagram** of Sentence Number 3

- English tence number 3 (English)

The tree diagram showing phrase structure of sentence number 3 (English)

Source; Field Study, 2024

Sentence Number 3 (Fulfulde Equivalent): Chubi Kansilla en wadata assawe assawere warande.

#### **Phrase Structure of the Sentence:**

$$S$$
  $\longrightarrow$   $np + inf + vp$   
 $Np = adj + n + det$   
 $Adj = chu6i$ 

N = kansilla

Det = 'en

Inf = tns + agr

Tns = prsnt

Prsnt = -ta

Agr = prsn + no

Prsn = 3rd

No = plr

Vp = v + np + adv

V = wada

Np = adj + n

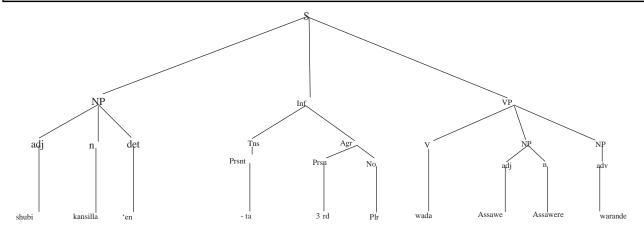
Adi = assawe

N = assawere

Adv = adv

Adv = warande

The phrase structure of Fulfulde sentence 3 can be represented in a tree diagram



Tree Diagram of Sentence Number 3 - Fulfulde Equivalent

The tree diagram showing phrase structure of sentence number 3 (Fulfulde) Source; Field Study, 2024

These sentences were also analysed using phrase structure rules and the tree diagrams, processing to find out a variation between English and Fulfulde sentences.

## **Findings of the Study**

From the data analysed in the study, the major findings are:

- i. There is dual grammatical function of words in Fulfulde sentences
- ii. The modal auxiliary verbs 'will' was used in English sentence as an independent lexeme (word), while in Fulfulde sentences equivalent its operate as an inflectional (dependent) element, -'ete' as in hokkete iii. There is a difference in the sentences of the two languages in the case of word order
- iv. There is also a difference in the inflectional past tense markers of Fulfulde and English language.
- v. The phrasal verb operating in English sentence observed not existing in Fulfulde sentence equivalent.

#### **Conclusions**

This research was carried out with the aim of analyzing the variation in syntactic structures of Fulfulde and English language in new bulletins of Adamawa Broadcasting corporation (ABC) Yola, in order to identity the syntactic structures of the two language. The study also sought to find out the syntactic variation between Fulfulde and English language. Based on the analysis and interpretation of the data collected, it was concluded that the variation in syntactic structures occurred in the areas of subject, verb and object (that is noun phrase (NP) inflectional (INF) and verb phrase (VP). This shows that, the finding revealed the syntactic variation that occurred under the noun phrase as; there is a difference in the case of word order, where adjective comes after the noun at the subjective part of the sentence which is not as in the case of English sentence. In the inflectional level, it was discovered on the analysed data that, there is a variation in the past tense markers of the two languages. Its further reveals that, the modal auxiliary verb found operating differently. Also, under the verb phrase, finding reveals that phrasal verb found operating in English sentence but it doesn't exist in Fulfulde sentence equivalent.

Conclusively, syntactic analysis, through which the structure can be observed and used to express different ideals, plays a vital communication role.

#### Recommendations

Based on the data collected and analysed in this study, the following recommendations are made:

i. ESP practitioners should pay more attention to analysis of variations in syntactic structures of different language, especially in material writing and production for the students of languages.

- ii. Further studies should be carried out on other branches of linguistics, such as phonology, morphology and semantic. This would serve as means of providing information on the variation between two different languages.
- iii. Fulfulde speakers of English language should pay more attention on the variation in syntactic structures of Fulfulde and English languages, for the avoidance of problem associated with the mother tongue interference at the syntactic level.
- iv. Language experts should know that, not all English sentences can be exactly translated in to Fulfulde sentences. Despite the fact that, both the two languages are operating on SVO (Subject Verb, Object).

#### REFERENCES

Abba, M. (1991). Initial Consonant Permutation in Fulfulde verbs and Nouns. In: studies in Fulfulde language, literature and culture. Proceedings to the 1<sup>st</sup> – 4<sup>th</sup>international conference on Fulfulde language, literature and culture: Abba, I. A. El al. (eds)

Adeji, E and kangiwa, M. (2008). Fundamental Issues in Contemporary English Studies. Kaduna; Oriel Printers.

Ahmed, A. (1994). Indirect Object Construction in Adamawa Fulfulde: An unpublished M. A Dissertation, Maiduguri, Faculty of Arts, University of Maiduguri.

April, M. (2006). An Introduction to English Phonology. Edinburgh; Edinburgh University-Press.

Arnott, D.W. (1990) "Fula Dialects in the Polyglots Africa" Sierra Leona Language reviews.

Baker, M. (2001). The Atoms of Language York; Basic Brook.

Bernd, K (2005). English Linguistics: Essentials. Berlin Cornel Sen Village

Brooks: B.S, Kennedy, Moch, R.D, & Ranly, D. (ed) (2009). Telling the story:

The Convergence of print, broad cast and online media (Rve. Ed) Bedford /st.martins: The Missouri Group.

Bloomfield, L. (1933). Language. Allen and Unwin.

Chapman R. (1973). Linguistics and Literature. London: Edward Arnold PublishersLtd.

Chomsky, N. (1965). Aspects of the Theory of Syntax. MIT Press.

Chomsky, N. (1957). Syntactic Structure. Mouton, The Hague.

Chomsky, N. (1975). Reflections on Language. New York: Pantheon Books.

Culicover, P. Jackendoff, R. (2005). Simpler syntax New York: Oxford University Press

Crystal D. and Devey D. (1985). Investigating English Styles. New York: Longman.

- Daudu, G.K. (2005). A Study of movement operation in Fulfulde. An unpublished Ph.D Thesis, Maiduguri, Faculty of Arts, University of Maiduguri.
- Edward, F (2004). Language: Its Structure and Use. Fort Worth: Harcourt Brace College Publisher
- Fromkin, V. and Rodman, R. (1988). An Introduction to Language 4<sup>th</sup> Edition. Chicago: Hoct, Rinehart and hinzton Inc.
- Fromkin, V. Rodman R. and Hyams N (2003). An Introduction to Language. Australia, Thomson Wodsworth: Boston, USA.
- Fries, C.C. (1952). The Structure of English. Longman, 1963.
- Gleasen, H.A (1965). Linguistics and English Grammar. Holt, Rinehart & Winton.
- Greene Y. (1986). Language Understanding. A Cognitive Approach, England: Open University Education Enterprises
- Halliday, M.A.K (1985). Language and Social Semiotic London: Edward Arnold
- Hallidy, M.A.K (1978). Language as Social Semiotic London: Parigiun Books.
- Hallidey M.A.K (1986). Language, context and Text: Aspects Language in Social in Semantics Perspective, Victoria: Deakin University Press.
- Harris, Zelling S. (1951). Method Structural Linguistics. University of Chicago Press, Chicago, Illinois.
- Hudson, R.A (1980). Socio Linguistics: London: Cambridge Unreality Press.
- Ingo, P. (2003). Word Formation in English. Cambridge: Cambridge University Press.
- Jen, S.U (2004). Fundamentals of Research Methodology: Yola. Paraclete Publishers.
- Jim, M. (2002). An Introduction to English Syntax. Edinburgh: Edinburgh University Press.
- Keyne R.S (1994). The Anti-symmetry of Syntax. Cambridge, M.A: MIT Press.
- Langacker, R. (1967). Language and its Structure. Brace and World.
- Lyons, J. (1968). Introduction to Theoretical Linguistics. Cambridge University Press.
- Lyons, J. (1972). New Henzons in Linguistics, Penguin.

Marantz, A. (1997). No Escape from Syntax: Don't try Morphological Analysis in the Privacyof your Own Lexicon.In Dimitriadis, A. etal. (eds) University of Pennsylvania Working Paper in Linguistics, vol 4.2 Proceedings of the 21<sup>st</sup> Annual Penn Linguistics Colloquium 201 – 225.

Master, peter (1998). New Ways in English for Specific Purposes.

McGregor, W. (2009). Linguistics, an Introduction London, Continuum International Publishing Group.

McIntosh, M. (1984). Fulfulde syntax and verbal Morphology. KPI' Boston, Melborne and Henley.

Mukoshy, I.A. "Aspects of Fulfulde Syntax and Morphology" PhD. Thesis, Soas, University of London, 1981.

Nwogu, K.N. (2009).Inaugural Lectures, A linguist in the Laboratory: Shaping the Construction of Scientific and Technological Knowledge.American University of Nigeria (AUN) Printing Press, Yola.

O' Neill, D. and Harcup T. (2009). News Value and Selectivity in Wahl-jorgennsen, k. & Hanitzech, T. (ed). The Handbook of journalism Studies. New York: Routledge Taylor and Francis Group.

Radford, A. (1998). Syntax: A minimalist Introduction, London, University of Cambridge.

Palmer, F.R. (1986). Semantics London. Cambridge University Press.

Plag, Ingo et al. (2007). Introduction to English Linguistics, Berlin: Mouton, Kap. 4

Shardama E.C (2008). A Linguistics Analysis of Variation in Professional and Popularized legal text. Modibbo Adama University of Technology, Yola. Unpublished Ph'd Thesis.

Taylot, F. W. (1921). A Grammar of Adamawa Dialect of the Fulani language. DUP.

Tuggle, C.A (2004). Characteristics of Broadcast News Writing. In Tuggle, C.A; Carr, F; Huffman, S. McGraw Hill.

Thorne, S. (1997). Mastering Advanced English Language. New York: Palgrave Master Series.

Thorne, S. (2008). Advanced English Language 2nd Edition. London: Pallagrare Macmillan

Yule, G. (2002). The Study of Language. Cambridge, Cambridge University press.

Yule, G. (2006). The Study of Language Cambridge, Cambridge University press.

Yule, G (2008). Interpersonal Meaning of Discourse Markers by Foreign Language Teacher in Class – room. Journal of Graduates of Sun Yet-sen University Sciences 29 (3), 129–135