

TOP as a Grammatical Category: The Case in Ngas and Hausa

1.0 Introduction:

Since his work on Metta in 1987, Teke has adduced that African languages are better analyzed using TOP, a position which serves as the landing site for move- α . Languages such as Yoruba, Tiv, and Bafut have been investigated along this line (Atanga, 1996) (Teke G. T., 1995) (1996). (Danjuma, 1996; 2003) and (Teke & Danjuma, 2004) have also dealt with some of the aspects of this analysis in Ngas. However, this paper seeks to focus on the movement of nouns and verbs into TOP in both Ngas and Hausa which are both Chadic languages in order to draw the basic similarities and differences as regards this analysis of move- α into TOP.

1.1 TOP as a Grammatical Category: The Hypothesis

Briefly put, the postulation of the position, TOP is the consequence of the controversy about the landing site for move- α , particularly Chomsky (1977) that wh-movement is into COMP outside S and Koopman (1984) that verb movement is into INFL. Both positions Teke rejects and rather postulates 'a unified analysis which is that these movements are into the TOPIC position and that this position is within S, where S is a minimal sentence' Teke, (1992:1) In the case of Koopman's analysis, Teke (1988,1992) further state that both COMP and INFL can not contain α because both COMP and INFL are not empty and are too small to contain move- α even though V-movement is forced by the Case Filter; and that INFL being the specifier of V is not a V' position and V can not move into Spec-VP given the analysis of X.

This minimal sentence structure he gives as:

1. $S \rightarrow TOP NP INFL VP$
2. $S \rightarrow I''$

Where I'' is the projection of INFL and the internal structure of TOP is:

$$3. \text{ TOP} \rightarrow \left\{ \begin{array}{l} \text{EP} \quad \text{N (P)} \\ \text{FM N (P) FM} \\ \text{FM VP} \\ \text{EP FM (N (NP), WH-, V (P), PP, AP, S) FM} \end{array} \right\}$$

TOP contains a Focus Marker which can be an empty pronoun. This Focus Marker is a movement trigger that can move α into TOP.

The distributional subject-verb agreement is responsible for INFL assigning nominative case to the left or right even in languages with null operator elements such as FM in TOP or overt agreement markers, AGR in INFL.

Furthermore, the TOP analysis replaces c-command (Reinhart, 1976) and Unambiguous paths (Kayne, 1984) and also redefines the principle of government (Chomsky, 1986), thereby establishing a semantic relation between an antecedent and its anaphor, holding that resumptive pronouns are actually pronominal traces in Teke, (2004). In this case, the following points are adduced, Teke, (2004:9):

11. Let a category TOP (in a phrase structure tree T) be marked by α such that:
 - a. α is a movement trigger in TOP
 - b. TOP serves as the landing site for β

Of primary interest to us in this paper are the particles: **mwa**, **do** and **ki**. We shall present in sections 2.1 and 2.2 the fact that **nyi/mwa** are markers of singularity/plurality and are also pronominal traces respectively, and indeed, they are also person-aspectual markers as part of the Agr feature in INFL, while **do** is a focus marker that triggers movement to TOP. Besides, **ki** and other modals and auxiliary verbs are presented in Danjuma, (1996), clarifying the fact that there exists in Ngas the verb BE and **do** is not an equative verb. However, agreeing with Burquest that there is also an empty copula in Ngas, especially in equative sentences.

2.1 N(P) Movement into TOP

Using examples from Burquest (2000), represented here as (8) and (9) below, the topicalised variants are given as (10), (11) and (12) where N(P) moves into TOP.

8. a. Musa ngolong
Chief
'Musa is chief'
- b. Musa **do**' ngolong
'Musa is chief'
9. a. gurm mwa mwa pin am m-birng mwa
person pl they give water to-horse pl
'the people gave water to the horses'
- b. gum mwa **do**' mwa pin am m-birng mwa
be
'it's the people who give water to the horses'
10. a. [_S_{TOP} [_{EP} gha [_{NP} Musa nyi]_i [_{FM} do]] [_{NP} t_i] [_{INFL} +Tense, AGR ϕ] [_{NP} ngolong]]
- b. [_S_{TOP} [_{EP} gha [_{NP} ngolong]_i [_{FM} do]] [_{NP} Musa] [_{INFL} +Tense, AGR ϕ] [_{NP} t_i]]
11. a. [_S_{TOP} [_{EP} gha [_{NP} gurm mwa]_i [_{FM} do]] [_{NP} t_i] [_{INFL} mwa] [_{VP} pin am m-birng mwa]]
- b. [_S_{TOP} [_{EP} gha [_{NP} am]_i [_{FM} do]] [_{NP} gurm mwa] [_{INFL} mwa] [_{VP} pin t_i m-birng mwa]]
- c. [_S_{TOP} [_{EP} gha [_{NP} birng mwa]_i [_{FM} do]] [_{NP} gurm mwa] [_{INFL} mwa] [_{VP} pin am mwa]_i]]
12. [_S_{TOP} [_{EP} gha [_{NP} Musa]_i [_{FM} do]] [_{NP} Nenrot] [_{INFL} po] [_{VP} ni nyi]]
'It is Musa, Nenrot is seeing'

The subject NP in (10a) is topicalised, where it moves into TOP along with its case features, leaving a trace *t* in the subject NP position. In (10b) also, the topicalised NP moves into TOP with its case features, leaving a trace *t*. In both cases, we see AGR assigning case to both left and right (cf. Danjuma, 2004) while **gha** and **do** are EP and FM respectively in TOP. In (11) just as in (10), **gha** and **do** are Focus Movement Triggers (FMT) for the topicalised nouns. However in (11), apart from (11a) and (11b) where the topicalised N leaves a trace *t*, the topicalised N in (11c) leaves a Pro-trace **mwa**. The Pro-trace distinction singular/plural **nyi/mwa** is evidence by (11c) and (12)

We can hereby infer that:

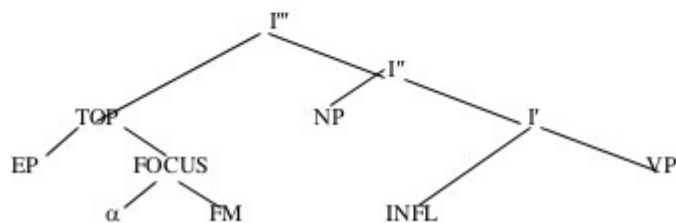
13. TOP is the landing site for move-NP in Ngas
14. **gha** (EP) and **do** (FM) are Focus Movement Trigger (FMT) in TOP in Ngas.

where β is any node within the phrase structure T

12. TOP > β
and the first node dominating TOP does not necessarily dominate β
13. TOP is free for case
14. α governs β iff α c-commands β and every barrier β dominates, α be interpreted in the light of the TOP-antecedent relation.

Given (1), (2), and (3), (4) is a phrase structure tree:

4.



2.0 TOP in Ngas

The grammatical analysis of Ngas presented in Burquest, (1973) makes the following claims that the particle **mwa** is a person-aspectual marker which is glossed as **they**. **mwa** is also a plural marker. The particle **ki** is a person-aspectual marker but with the proviso that it occurs in perfective aspectual sentences, i.e. sentences that are 'completed,' aspectually. Similarly, that: 'The person-aspectual markers... are part of the verb phrase, specifically the manifestation of tense' Burquest (1973:18). The particle **do** is described as a marker of emphasis which is not base generated but is inserted by an emphasis transformation.

However, Burquest, (2000) proposes that Ngas has no verb 'to be' instead an empty copular; that **do** is often glossed as 'be' but it is primarily a topicalisation marker. This proposed 'empty copular' assigns the θ -role THEME to any NP with which the PP occurs, assuming further that prepositions assign θ -roles to their external arguments. In topicalised sentences, all arguments are present, **do** functions like an equative verb, though not obligatory. Similarly, every NP is case marked in its original position, with **do** positioned under C of CP in D-structure and its S-structure

5. [CP Spec **do** [IP gurm mwa mwa pin am m-birng mwa]] D-Structure
6. [CP am, **do** [IP gurm mwa mwa pin t_i m-birng mwa]] S-Structure

(6) is a case where a trace is left behind. Burquest calls this trace a resumptive pronoun, suggesting that there is no pied-piping in Ngas (cf. Haegeman, 1994:375-376), more so that the topicalised NP is base generated in its initial position (Haegeman, 1996:409), without movement, to preserve the parallelism among related structures as in (7)

7. [CP bing mwa **do** [IP gurm mwa mwa pin am m-mwa]] D/S-Structure

15. The Trace *t* and the Pro-trace, **mwa** are the antecedents of the topicalised NPs
 16. The Pro-traces in Ngas are *mwa* and *nyi* basically for topicalised direct and indirect object NPs

2.1 V(P) Movement into TOP

Given the following sentences, we can describe V(P) movement into TOP in Ngas:

17. [_S[_{TOP} [_{EP} *gha* [_{VP} *pin am m-birng mwa*]_i [_{FM} *do*]]] [_{NP} *gurm mwa*] [_{INFL} *mwa*] [_{VP} *chin*]]
 18. [_S[_{TOP} [_{EP} *gha* [_{VP} *ni Musa*]_i [_{FM} *do*]]] [_{NP} *Nenrot*] [_{INFL} *po*] [_{VP} *chin*]]

As can be seen in (17) and (18), only the VP moves into TOP, leaving a dummy verb, **chin** 'do' as its antecedent in VP. The topicalisation of the V alone is not permitted. Therefore, we can draw the conclusion that:

19. Only VP is moved into TOP in Ngas not V
 20. The antecedent of the moved VP into TOP is a dummy verb, **chin**
 21. FMT are EP **gha** and FM **do**

3.0 TOP in Hausa

The most seminal work done on topicalisation in Hausa are Junaidu, (1987) and Newman, (2000). Quite a number of issues are raised in these analyses. The following examples from Junaidu, (1987: 172-180) and Newman, (2000:187-190,615-618) will serve to bring these issues out explicitly, one after the other as regards the TOP hypothesis:

22. *yan sun kai wa Musa kaya*
 boys-the 3plP take to Musa loads
 'The boys took the loads to Musa'
23. a. *yan (dai) [+T], sun kai wa Musa kaya*
 '(As for) the boys, they took the loads to Musa.'
- b. *kai wa Musa kaya (dai), [+T], yan sun kai (su)*
 '(As for) taking the loads to Musa, the boys took them.'
- c. *kai wa Musa kaya (dai) yan sun yi (shi)*
 (as for) taking the loads to Musa, the boys did (it).'
- d. *Musa (dai) [+T], yan sun kai masa kaya*
 '(As for) Musa, the boys took the loads to him.'
- e. *Kayan (dai) [+T], yan sun kai wa Musa (su)*
 '(As for) the loads, the boys took them to Musa.'
24. *Audu da magensa, [+T], ba ya son abinda zai taba ta,*
 Audu and cat-his, Neg. 3msPr like thing-that Ft-3ms touch it
 'As for Audu and his cat, he wants no harm to come to it'
25. *yan itatuwa [+T], Audu ya fi son mangwaro*
 goods of trees, Audu 3msP exceed like mango
 'As for fruits, Audu prefers mangoes'

26. game da Audu kam [+T], na gan shi jiya
 About Audu, well 1sP see him yesterday
 'Concerning Audu, I saw him yesterday.'

In (22) and (23), the Transformational analyses of topic constructions in Hausa is given in line with Jaggar, (1978:72) while (34-26) are the observations noted by Junaidu why Transformational analysis of topicalisation is not tenable in Hausa.

The particle **dai**, is given as a kind of focus marker for transformation to apply in (2) and the element topicalised leaves a copy or a trace in its extraction site given the Topic-Comment paradigm.

However, Junaidu, (1987:174-180) notes the following anomalies with this analysis.

- A. Topicalised sentences bearing split anaphoric pronouns with conjoined nominal phrases in the topic position are not accounted for.
- B. Instances of topicalised sentences in which the topic element does not appear to have an original position in the comment clause from which it could have been front shifted is also not accounted for by the Transformational analysis.
- C. The cases of topic-introducing expressions or topic-signalling modal particles are also not accounted for by the analysis.

The points given above are characterized by (24), (25), and (26), respectively. In regards to the points above, we would like to make the following observations as concerns the TOP hypothesis:

27. ϕ is a focus marker in TOP (23a-e)
28. (su) (23b); yi (shi) (23c); masa (2dd); and (su) (23e) are Pronominal traces of the topicalised elements which are co-indexed.
29. (24) is a case of the Binding theory principles (B) and (C) within the minimal S
30. (25), the extraction site of **yayan itatuwa** is after **mangwaro** where it leaves a trace t
31. (26) is the case of a PP with a subcategorized adverb as a complement in TOP.

In the analysis presented in Newman, (2000), a distinction is drawn between focus constructions and topic constructions in Hausa. Of interest to us in this paper is the fact that both occur in front of the minimal sentence and/or at the sentence initial position, the position which we refer to as TOP. Equally of importance to note is the fact that **ne**; **ce**; **nan**; **o**; and **ta** are particles associated with focus constructions while the particles **dai**; **fa**; **kam**; **kuwa**; **ma**; **to**; **wallahi**; and **ina** are associated with topic constructions. The particles **ne** and **ce** are described as STAB i.e. 'the gender/number sensitive stabilizer' Newman, (2000:160). Whereas, **dai**; **fa**; **kam**; **kuwa**; and **ma** are modal particles; and **to**; **wallahi**; and **ina** are 'exclamatory or expressive materials.' Newman, (2000:617). STAB, modal particles, and exclamatory or expressive materials will be examined in the light of the TOP hypothesis. The following sentences from Newman, (2000) suffice:

32. (Musa ne) ta aura
 'It was *Musa* she married.'
33. (Kande ce) ta ci jarrabawa
 '*Kande* passed the exam.'

34. (Mutanen nan) muka gaya wa
'It was these *men* we it to.'
35. (kwai) yara suke saye
'It's *eggs* the children are buying.'
36. (bera ne) ya shiga kwabad
'It was a *rat* that got in the cupboard.'
37. ba Talatu ta zage shi ba
'It wasn't *Talatu* who insulted him.'
38. aku dai, ban yarda da shi ba
'As for the parrot, I don't agree with him.'
39. Audu dai, yana cin nama kullum
'As for Audu, he eats meat everyday.'
40. Kande fa, mun fi sonta
'As for Kande, we like her the most.'
41. goro kuwa, ya yi mini dace
'Kolonuts moreover, they are too bitter for me.'
42. gwado ma, zan saya maka
'The blanket also, I will buy (it) for you.'
43. tsuntsu kam, maharbi yana kama wa waziri
'The bird, well, the hunter is catching it for the vizier.'
44. Audu dai, wallahi, yana cin nama kullum
'As for Audu, truly he eats meat everyday.'
45. Kande, to, mun fi sonta
Kande, OK, we like her the most.'
46. waccan kurar, ina! Ba zan taba ta ba.
'That hyena, no way! I won't touch it.'

Thus far, we can now turn our attention to 3.1 in which we account for (22-26) and (32-46) in the light of the observations (32-46).

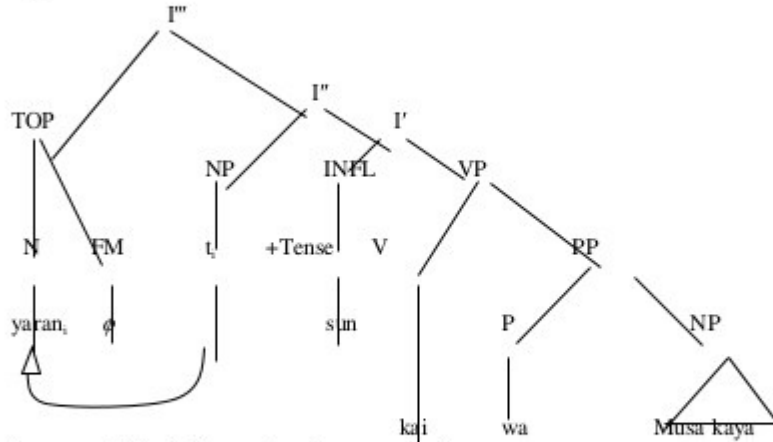
3.1 N(P) Movement into TOP

In this section, N(P) movement in Hausa is investigated. (22) is represented here as (47) with the appropriate indexation applied.

47. [_S [_{TOP} [_{NP} yaran_i]] [_{FM} ϕ]] [_{NP} t] [_{INFL} sun] [_{VP} kai wa Musa kaya]]
 boys-the null trace AGR take to Musa loads

yaran is topicalised, given the topic-comment paradigm in this case, and it moves into TOP along with its case properties leaving a trace *t* in the subject NP position. In this construction, however, FM is ϕ (null). The tree structure below represents the same points for (47):

48.



In the case of (23a-e), they are herein represented as: .

49. a. [S [TOP [NP yaran_i [ADV dai]] [FM ϕ]] [NP t_i] [INFL sun] [VP kai wa Musa kaya]]
- b. [S [TOP [VP kai wa Musa kaya_j [ADV dai]] [FM ϕ]] [NP yaran] [INFL sun] [VP kai (su)_j]]
- c. [S [TOP [VP kai wa Musa kaya_j [ADV (dai)]] [FM ϕ] [NP yaran] [INFL sun] [VP yi (shi)_j]]
- d. [S [TOP [NP Musa_i [ADV (dai)]] [FM ϕ]] [NP yaran] [INFL sun] [VP kai masa_i kaya]]
- e. [S [TOP [NP kayan_i [ADV (dai)]] [FM ϕ]] [NP yaran] [INFL sun] [VP kai wa Musa (su)_i]]

In (49 a, d, & e) and (49 b & c), the particle **dai** is an adverb of manner which is subcategorized for the NPs as a post nominal constituent and VPs, respectively; and in all of these cases, **dai** is optional as can be seen in (23) above. In addition, FM is ϕ in TOP, permitting for topicalisation to apply, whereas, t_i is the trace of **yaran_i** in (49a); **kai_i** is a copy of the topicalised **kai_i** and **(su)_j** is the Pro-trace of **kaya_j** in (49b); in (49c), **yi_i** is the dummy verb trace of **kai_i** while **(shi)_j** is the Pro-trace of **kaya_j**; and in (49d) and (49e), **masa_i** and **(su)_i** are Pro-traces of **Musa_i** and **kayan_i**, respectively. In all the cases, however, **sun** is an agreement marker in INFL.

Given the Binding theory principles (B) and (C) (Chomsky, (1981)) for (3), **megensa_j** and **ta_j** are both free in S and can freely be co-indexed as pronominals while **Audu** is also free as an R-expression in TOP within S. Besides, **megensa_j** moves from the object position of the VP into TOP leaving **ta_j** as its pronominal-trace *in situ* whereas **Audu_i** moves from the subject position into TOP. Even though **Audu** and **megensa** are conjoined by **da**, this does not rule out the fact that two movements into TOP have applied. The question is which movement applies first. In our opinion, **Audu_i** moves first into TOP before **megensa_j** is conjoined to it in TOP. (24) is here represented as (50):

50. [S [TOP [NP Audu_i da megensa_j] [FM ϕ]] [NP t_i] [NEG ba] [INFL ya] [VP son] [COMP ϕ] [S' [NP abinda] [INFL zai] [VP taba ta_j]]]

The problem with (46) as noted in (51) above is with the determination of the extraction site of **yayan ituwa** which we adduced to be after **mangwaro** given the fact that the VP with **mangwaro**

subcategorizes for PP with the preposition **acikin** ‘with’ as the head, leaving a trace *t* where the PP is topicalised. If that is the case, we can then represent (46) as (51):

51. [_S[_{TOP}[_{PP} acikin yayan itatuwa] [_{FM} ϕ]] [_{NP} Audu] [_{INFL} ya] [_{AP} fi] [_{VP} son mangwaro] [_{PP} *t*]]

A similar case holds for (47) in which a PP is introduced to the topicalised N within TOP. The noun topicalised is **Audu**, which leaves a Pro-trace **shi** in its extraction site. Besides, the PP subcategorizes for an adverb **kam** as in the case of (23) for **dai**. The head of the PP is **game** ‘about’. As for (50) and (51), FM is ϕ . It is also the case for (52):

52. [_S[_{TOP}[_{PP} game da Audu, [ADV kam]] [_{FM} ϕ]] [_{NP} na] [_{VP} gan shi jya]]

For (32-37), we shall represent them herein as follows:

53. [_S[_{TOP}[_{NP} Musa,] [_{FM} ne]] [_{NP} *t*] [_{INFL} ta] [_{VP} aural]]
 54. [_S[_{TOP}[_{NP} Kande,] [_{FM} ce]] [_{NP} *t*] [_{INFL} ta] [_{VP} ci jarnabawa]]
 55. [_S[_{TOP}[_{NP} Mutanen] [_{FM} nan]] [_{NP} ϕ] [_{INFL} muka] [_{VP} gaya wa *t*]]
 56. [_S[_{TOP}[_{NP} kwai,] [_{FM} ϕ]] [_{NP} yara] [_{INFL} suke] [_{VP} saye *t*]]
 57. [_S[_{TOP}[_{NP} bera] [_{FM} ne] [_{NP} *t*] [_{INFL} ya] [_{VP} shiga kwabad]]
 58. [_S [_{TOP}[_{NEG} ba,] [_{NP} Talatu] [_{FM} ϕ]] [_{NP} *t*] [_{INFL} ta] [_{VP} zage shi] [_{NEG} ba]]

As can be seen from the above, **ne**, **ce**, and **nan** are Focus Markers (53, 54, 55, & 57) and also ϕ in (56) and (58). The subject NP topicalised in (53), (54), and (58) all leave a Pro-trace *t* in the subject NP position. On the other hand, where the subject NP is not topicalised, the subject NP remains *in situ* as in (56) and (58). The case of (55) is where the subject NP is ‘dropped’, leaving the position empty.

59. [_S[_{TOP}[_{NP} aku, [ADV dai] [_{FM} ϕ]] [_{NP} ϕ] [_{INFL} ban] [_{VP} yarda da shi ba]]
 60. [_S[_{TOP}[_{NP} Audu, [ADV dai] [_{FM} ϕ]] [_{NP} *t*] [_{INFL} yana] [_{VP} cin nama kullum]]
 61. [_S[_{TOP}[_{NP} Kande,] [ADV fa] [_{FM} ϕ]] [_{NP} ϕ] [_{INFL} mun] [_{AP} fi son ta,]]
 62. [_S[_{TOP}[_{NP} goro,] [ADV kuwa] [_{FM} ϕ]] [_{NP} *t*] [_{INFL} ya] [_{VP} yi mini dace]]
 63. [_S[_{TOP}[_{NP} gwado,] [ADV ma] [_{FM} ϕ]] [_{NP} ϕ] [_{INFL} zan] [_{VP} saya maka *t*]]
 64. [_S[_{TOP}[_{NP} tsuntsu,] [ADV kam] [_{FM} ϕ]] [_{NP} maharbi] [_{INFL} yana] [_{VP} kama wa waziri *t*]]

However, **dai**, **fa**, **kuwa**, **ma**, and **kam** (59-64) are best construed as adverbs of manner. Therefore, they can not be focus markers. The same holds for **wallahi**, **to**, and **ina** marked **δ** atheoretically in (65)–(67) which we agree with Newman that they are ‘exclamatory or expressive materials.’

65. [_S[_{TOP}[_{NP} Audu] [ADV dai] [_δ wallahi] [_{FM} ϕ]] [_{NP} *t*] [_{INFL} yana] [_{VP} cin nama kullum]]
 66. [_S[_{TOP}[_{NP} Kande] [_δ to] [_{FM} ϕ]] [_{NP} *t*] [_{INFL} mun] [_{AP} fi son ta,]]

67. [_S [_{TOP} [_{NP} waccan kurar,] [_S ina!] [_{FM} ϕ]] [_{NP} t,] [_{NEG} ba] [_{INFL} zan] [_{VP} taba ta,] [_{NEG} ba]]

From the foregoing, we can draw the following conclusions for the status of TOP in the analysis of Hausa NPs:

68. TOP is the landing site for move-NP in both topicalised and focus constructions.
 69. The Focus Movement Trigger (FMT) are ϕ ; **ne**; **ce**; and **nan** as Focus Markers, FM in TOP.
 70. Topicalised/focused subject NPs leave a trace *t* in the subject NP position
 71. Non-subject NPs leave *t*/Pro-traces in their extraction sites

3.2 V(P) Movement into TOP

The sentences, (72-74), describe V(P) movement into TOP in Hausa:

72. [_S [_{TOP} [_{VP} saye kwai]] [_{FM} ϕ]] [_{NP} yara] [_{INFL} suke] [_{VP} yi]]
 73. [_S [_{TOP} [_{VP} kama wa waziri tsuntsu]] [_{FM} ϕ]] [_{NP} maharbi] [_{INFL} yana] [_{VP} yi]]
 74. [_S [_{TOP} [_{VP} shiga kwabad]] [_{FM} ϕ]] [_{NP} bera] [_{INFL} ya] [_{VP} yi]]

In (72-74), only VP moves into TOP not V; and the antecedent of the topicalised VP is a dummy verb *yi*. FM is null. Therefore, we can infer that:

75. Only VP moves into TOP in Hausa
 76. The antecedent of the moved VP into TOP is the dummy verb *yi* 'do.'
 77. FMT is ϕ

4.0 Conclusion

This paper focuses on the movement of nouns and verbs into TOP in both Ngas and Hausa which are both Chadic languages in order to draw the basic similarities and differences as regards the analysis of move- α into TOP.

Given our analysis of move-N(P) and move-V(P) into TOP in Ngas and Hausa, we are able to draw the following similarities as in (78) and differences as in (79):

78. a. TOP is the landing site for move-NP and move-VP
 b. The move-NP has *t* and Pro-trace as antecedents
 c. The antecedent of move-VP is a dummy verb
 d. Both languages have FM as Focus Movement Trigger (FMT)
 79. a. Ngas has **gha** (EP) and **do** (FM) as Focus Movement Trigger (FMT) in TOP while the Focus Movement Trigger (FMT) in Hausa are ϕ ; **ne**; **ce**; and **nan** as FM in TOP with no EP
 b. The Pro-traces in Ngas are **mwa** and **nyi** basically for topicalised direct and indirect object NPs whereas Non-subject NPs leave *t*/Pro-traces **su**; **shi**; **masa**; and **ta**
 c. TOP in Ngas is TOP \rightarrow EP α FM but in Hausa it is TOP \rightarrow α FM

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