1. Introduction

The phenomenon: Wolof, an Atlantic language of Senegal, displays complex morpheme reorderings in the verbal complex:

(1) a. d-oon-u-ma lekk  IMPERF-NEG-1SG IMPERF-PAST-NEG-1SG eat  “I was not eating”

b. d-u-ma woon lekk  IMPERF-NEG-AGRS-TENSE IMPERF-NEG-1SG PAST eat  “I was not eating”

- In (1)a past tense, -oon, precedes negation (-u(l)) and the subject agreement marker (-ma).
- In (1)b, past tense follows both negation and the subject agreement marker.

These examples manifest the basic problem: The morpheme reorderings seem to violate Baker’s Mirror Principle (1985).

Assuming that the imperfect auxiliary di surfaces in the specifier of an Aspect Phrase (AspP), then, (1)b can be derived from (2)b straightforwardly. However, to derive (1)a, as in (2)a, requires violation of the Head Movement Constraint, given the surface order of affixes. That is, T⁰ must headmove over AgrSP⁰:

(2) a. AspP
    AuxP NegP
    di u(l) AgrSP
    ma T
    oon VP

    V

    b. AspP
    AuxP NegP
    di u(l) AgrSP
    ma T
    oon VP

    V
• Thus, (1)a represents a Mirror Principle violation because the surface order of affixes does not reflect the underlying hierarchy of functional heads.

• We argue that such affix order variation does not violate the Mirror Principle, but follows from syntactic VP and TP movement, not head movement of V^0.

2. Goals

Show that generating Wolof affix orders follows from syntactic processes. Specifically, we argue that Wolof surface affix orders result from

• Syntactic phrasal (XP) movement, with a residue of head movement,

• Pied piping and stranding of pieces of clausal structure.

We further show that

• Phrasal movement is responsible for affix orders in both valence-changing morphology (i.e., the lower clausal structure) and the higher functional domain of the clause.

3. Background

Wolof possesses an aspectual system in which perfective and imperfective form the basic opposition. Perfectivity is unmarked, while imperfective clauses are indicated by the presence of the auxiliary di:

(3) a. lekk-na-a ceeb b-i
   eat-FIN-1SG rice class-the
   “I ate/have eaten the rice”

b. di-na-a lekk ceeb b-i
   IMPERF-FIN-1SG eat rice class-the
   “I will eat the rice”

There are two past tense affixes:

(4) a. lekk-oon-na-a
   eat-PAST-FIN-1SG
   “I ate/had eaten”

b. d-aan-na-a lekk
   IMPERF-HAB.PAST-FIN-1SG eat
   “I used to eat”
4. Valence-changing Morphology in Wolof

Like other Atlantic languages, Wolof is extremely rich in derivational verb morphology, with approximately 25 affixes (Ka 1981). Here, we focus on three valence-changing affixes: benefactive, instrumental, and causative (Buell and Sy 2005, 2006):

(5) Faatu togg-na jën w-i
    Faatu cook-FIN fish CL-the
    “Faatu cooked the fish”

**Benefactive**

(6) Faatu togg-al-na Gàllaay jën w-I
    Faatu cook-BEN-FIN Gallaay fish CL-the
    “Faatu cooked the fish for Gallaay”

**Instrumental**

(7) Faatu togg-e-na jën w-i (ag) diwtiir
    Faatu cook-INSTR-FIN fish CL-the with palm.oil
    “Faatu cookd the fish with palmoil”

**Causative**

(8) Faatu toog-loo-na Gàllaay jën w-i
    Faatu cook-CAUS-FIN Gallaay fish CL-the
    “Faatu had/made Gallaay cook the fish”

5. The Hierarchy of Valence-changing Heads

In this section, we show that the ordering of causative, benefactive, and instrumental affixes cannot be derived from a single hierarchy of functional heads and head movement.

- We assume that the valence-changing affixes are merged above VP and that the argument introduced by the affix is merged as the specifier of that affix (following Pylkkänen 2002):

(9) 

\[
\begin{array}{c}
\text{affixP} \\
\text{DP}_{\text{argument}} \\
\text{affix}' \\
-\text{affix}^0 \\
\text{VP}
\end{array}
\]

Consider first the order of the instrumental and causative affixes:

(10)a. Gàllaay dóór-e-loo-na Faatu xeer b-i (ag) bant √ instr…caus
    Gallaay hit-INSTR-CAUS-FIN Faatu stone CL-the with stick
    “Gallaay made Faatu hit the stone with a stick”
Given the surface morpheme order, CausP must be higher than InstrP, following the Mirror Principle:

(11) CauseP > InstrP > VP

The verb head moves to Instr⁰, then the complex head raises to Cause⁰:

(12)

\[
\begin{array}{c}
\text{CauseP} \\
\downarrow \\
-\text{loo} \\
\downarrow \\
\text{InstrP} \\
\downarrow \\
-\text{e} \\
\downarrow \\
\text{VP} \\
\downarrow \\
\text{V}
\end{array}
\]

V-e-loo

Benefactive and instrumental display a strict linear ordering:

(13) a. Gàllaay togg-\text{al-e-na} Faatu yàpp diwtiir \textbf{✓ben...instr}
    Gallaay cook-BEN-INSTR-FIN Faatu meat palm.oil
    “Gallaay cooked Faatu some meat with palm oil”

b. *Gàllaay togg-\text{e-al-na} Faatu yàpp diwtiir \textbf{*instr...ben}
    Gallaay cook-INSTR-BEN-FIN Faatu meat palm.oil

The surface ordering of morphemes indicates that Instr⁰ must be higher than Ben⁰.

(14) InstrP > BenP > VP

That is, the verb first head raises to Ben⁰, yielding \textit{V-al}. This followed by movement of the complex head to Instr⁰.

(15)

\[
\begin{array}{c}
\text{InstrP} \\
\downarrow \\
-\text{e} \\
\downarrow \\
\text{BenP} \\
\downarrow \\
-\text{al} \\
\downarrow \\
\text{VP} \\
\downarrow \\
\text{V}
\end{array}
\]

V-al-e

Based on the surface affix orderings we have seen so far, we can deduce the following hierarchy of low functional heads:
(16) 

```
Cause P
   -loo
   InstrP
     -e
     BenP
       -al
       VP
         V
```

Next, consider the ordering of CAUS and BEN, which adhere to a strict ordering:

(17) a. Gàllaay bind-**loo-al-na** gan g-i xale y-i taalif
    Gallaay write-CAUS-BEN-FIN guest CL-the child CL.PL-the poem
    “Gallaay made the children write the visitor a poem”

    b. *Gàllaay bind-**al-loo-na** gan g-i xale y-i taalif
       Gallaay write-BEN-CAUS-FIN guest CL-the child CL.PL-the poem

Given the grammatical surface order, we deduce that BEN is higher than CAUS:

(18) BenP > CausP > VP

However, there is a problem. It has been established in (16) that CausP is higher than BenP, which contradicts (18).

A similar problem arises if the partial rankings in (11) and (18) are assumed. In that case, the ordering in (13)a and the resulting partial ranking in (14) constitute a contradiction.

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**Conclusion One:** The surface orderings of Benefactive, Causative, and Instrumental morphemes in Wolof display multiple Mirror Principle violations. A head movement analysis is untenable because it requires violations of the Head Movement Constraint.


(19) a. lekk-**oon-na-a**
    eat-past-FIN-1SG
    “I ate”

    b. lekk-u-**ma woon**\(^1\)
    eat-NEG-1SG PAST
    “I did not eat”

---

\(^1\) The full form of the affixal negative marker is –ul. The –l drops in certain phonologically and morphologically determined contexts. We write the full form in syntactic trees.
Properties of (19)a-b:

- *na-* is the head of FinP (Zribi-Hertz and Diagne 2002, Koopman 2006)
- *na-* does not co-occur with negation.
- The subject marker -a follows Tense -oon in (19)a, but precedes Tense in (19)b.

As before, the basic problem is to account for the surface ordering of the morphemes given a single underlying hierarchy of functional heads.

By undoing the morphology in (19)a, the underlying hierarchy of heads is:

(20)

```
AgrSP
   a
   FinP
     na
     TP
      oon
      VP
       V
```

Note first that the tree in (20) is odd because the subject marker, which we take to be an instantiation of AgrS$^0$ is higher than FinP, the lowest head in the C-domain (Rizzi 1997).

However, head movement of V in (20) does yield the correct surface order in (19)a:

(21)

```
AgrSP
   a
   FinP
     na
     TP
      oon
      VP
       V
```

The hierarchy in (20) immediately runs into problems in the negative:

(22)

```
AgrSP
   ma
   FinP
     Fin$^0$
     TP
      oon
      NegP
       -ul
       VP
        V
```
The hierarchical relation between Tense and the subject marker (Agr$^0$) is the problem with (22).

- In (22), if V head moves to Neg$^0$, then this complex head must skip over T$^0$ in order to drive the correct surface order.

Head movement of V in (22) yields the ungrammatical:

\[(23) *\text{lekk-ul-woon-ma} \quad *\text{V-Neg-T-AgrS} \]
\[\text{eat-NEG-PAST-1SG} \]

- Given (21), the negative clause in (19)b represents a Mirror Principle violation.

An alternative is to take the Negative in (19)b as displaying the underlying hierarchy. Undoing the morphology in (19)b yields:

\[(24) \quad \text{FinP} \]
\[\text{FIN} \quad \text{TP} \]
\[\text{oon} \quad \text{AgrSP} \]
\[\text{ma} \quad \text{NegP} \]
\[\text{ul} \quad \text{VP} \]
\[\text{lekk} \quad \text{“eat”} \]

Head movement in (24) does yield the correct surface ordering of morphemes for the negative:

\[(25) \quad \text{V-Neg-AgrS} \quad \text{T} \]
\[\text{lekk-u-ma} \quad \text{woon} \]

A problem arises if the hierarchy in (24) is assumed for the affirmative perfective:

\[(26) \quad \text{lekk-oon-na-a} \quad \text{affirmative perfective} \]
\[\text{eat-PAST-FIN-1SG} \]
\[\text{“I ate”} \]

Inserting the morphemes for (26) in the hierarchy from (24) yields:

\[(27) \quad \text{FinP} \]
\[\text{na} \quad \text{TP} \]
\[\text{oon} \quad \text{AgrSP} \]
\[\text{a} \quad \text{VP} \]
\[\text{lekk} \quad \text{“eat”} \]
However, given the structure in (27), the result of simple head movement of the verb is ungrammatical:

(28) *V-AgrS-T-FIN
    *lekk-a-woon-na
    “I ate”

If (27) is the underlying tree, then the affirmative can only be derived by head movement of V to T, skipping over AgrSP. This would be followed by the complex head [V+oon] moving to Fin'.

In this way, the affirmative form in (19)a represents a Mirror Principle violation.

**Conclusion Two:** The surface ordering of tense, negation, and subject markers display Mirror Principle violations. A constrained head movement account of these ordering variations is not possible with a single underlying hierarchy of functional heads.

**Conclusion Three:** In Wolof both the “low” valence-changing morphology exhibits Mirror Principle violations and the “higher” tense and agreement morphology exhibits Mirror Principle violations.

Wolof is therefore an interesting case because mirror violations are pervasive in the derivational and inflectional morphology.

7. **The Solution: Syntactic Processes Determine Affix Ordering**

The proposal has two ingredients:

- There is a single underlying hierarchy of heads
- The surface affix orders result from syntactic XP movement interacting with the functional hierarchy.

Thus,

- The Mirror Principle violations are illusory.

7.1 **XP Movement in the Valence-Changing Domain**

We propose the following as the underlying hierarchy of functional heads in the valence-changing domain (i.e. low in the clause):
When Caus and Instr co-occur, Instr must precede Cause.

Under an XP movement analysis, the derivation of (10)a is:

- The VP remnant raises to SpecInstrP. This yields \( V-Instr \) order.
- VP raises to SpecCausP and pied pipes InstrP. This yields a surface affix order of \( V-Instr-Caus \).
- The fact that \( ^*V-Caus-Instr \) is ungrammatical follows if (30) is an obligatory pied piping configuration.

\[ (29) \quad \text{CausP} \]
\[ \quad \text{-loo} \quad \text{BenP} \]
\[ \quad \text{-al} \quad \text{InstrP} \]
\[ \quad \text{-e} \quad \text{VP} \]
\[ \quad \text{V} \]

\[ (30) \quad \text{CausP} \]
\[ \quad \text{-loo} \quad \text{InstrP} \]
\[ \quad \text{-e} \quad \text{VP} \]
\[ \quad \text{V} \]

\[ (31) \quad \text{BenP} \]
\[ \quad \text{-al} \quad \text{InstrP} \]
\[ \quad \text{-e} \quad \text{VP} \]
\[ \quad \text{V} \]
• The VP remnant raises to SpecInstrP. This yields \( V-{\text{Instr}} \).

• The mirror order is destroyed when VP *strands* InstrP and raises to SpecBenP.

• Syntactic stranding is therefore the source of the Mirror Principle violation.

• The fact that \( *V-{\text{Instr}}-\text{Ben} \) is ungrammatical follows if (31) is an obligatory stranding configuration.

**Deriving \( V-{\text{Caus}}-\text{Ben} \)**

\[
(32) \quad \begin{array}{c}
\text{CausP} \\
-\text{loo} \\
\text{BenP} \\
-\text{al} \\
\text{VP} \\
V
\end{array}
\]

• The VP remnant raises to SpecBenP. This yields the order \( V-{\text{Ben}} \).

• As before, the mirror order is destroyed when VP strands BenP and raises to SpecCausP.

• Here too, syntactic stranding is the source of the Mirror Principle violation.

• The fact that \( *V-\text{al-loo} \) is ungrammatical follows from (32) being an obligatory stranding configuration.

**Conclusion:** The Mirror Principle violations in valence-changing morphemes follow from syntactic XP movement and a single underlying hierarchy of functional heads.

7.2 XP Movement in the Higher Functional Domain

We propose that the surface affix orders in (19) are derived from a single hierarchy of functional heads:

\[
(33) \quad \begin{array}{c}
\text{FinP} \\
\text{na} \\
\text{AgrSP} \\
\text{ma} \\
\text{NegP} \\
-\text{ul} \\
\text{TP} \\
-\text{oon} \\
\text{VP} \\
V
\end{array}
\]
The affirmative perfective in (34)a is derived as in (34)b:

(34)  a. lekk-oon-na-a  
      eat-PAST-FIN-1SG  
      “I had eaten”  

b.  

- In (34)b, VP has raises to SpecTP.
- VP pied pipes TP to SpecFinP, headed by na-.
- The result of TP movement to SpecFinP yields the correct surface order.

Under an XP movement analysis, the negative in (35)a is derived as in (35)b:

(35)  a. lekk-u-ma  woon  
      eat-NEG-1SG  PAST  
      “I had not eaten”  

b.  

- The derivation of the negative involves both XP movement and head movement.
- The fact that *V-T-AgrS-Neg is ungrammatical follows if (35)b is an obligatory stranding configuration.
• Under the XP analysis, either a TP (in the affirmative) or VP (in the negative) raises into the left periphery.

Dialectal variation supports this conclusion.

Two dialects of Wolof, the St. Louis and Dakar dialects, differ in the possible morpheme orderings in the affirmative.

The affirmative perfective in (36)a, with T (-oon) preceding AgrS (-a) is grammatical in both dialects (and is the form that has been used up to this point).

The Dakar dialect however, also allows (36)b (although it is not common).

(36)  

a. lekk-oon-na-a  
    eat-PAST-FIN-1SG  
    “I ate”  

    ✓ St. Louis, ✓ Dakar

b. %lekk-na-a  
    eat-FIN-1SG PAST  
    “I ate”  

    *St. Louis, ✓ Dakar

In (36)b Tense follows both na- and the subject marker.

Under the analysis of na- clauses proposed here, (36)b represents an instance of VP movement into the left periphery which has failed to pied pipe TP, thereby stranding it in its base position, lower than AgrSP:

(37)

• The affix ordering differences reduce to variation in how much material can or must be pied piped into the left periphery.

• In both dialects, VP ends up in the left periphery in affirmative perfective na-CPs.

In the St. Louis dialect, TP is obligatorily pied piped in the affirmative, while in the Dakar dialect, TP is optionally stranded.
It is not clear why in the St. Louis dialect TP must be pied piped in the affirmative, while pied piping is optional in the affirmative in the Dakar dialect.

- The two dialects pattern identically in the negative, where TP must be stranded. That is, neither dialect allows:

(38) *V-T-Neg-AgrS
   *lekk-oon-u-ma
   “I did not eat”

Further evidence for the XP remnant movement analysis can be found in the distribution of the adverbial affixes -andi “meanwhile”, not discussed here.

**Overall Conclusions:**

- The surface Mirror Principle Violations are illusory.
- Wolof affix orders are derived by XP movement in the syntax, not head movement.
- The apparent Mirror Principle violations result from phrasal pied-piping and stranding.

**References**


