Dental-alveolar Consonants and [ATR] Vowel Distinction in Western Nilotic

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Some predecessors reconstructed the Proto Western Nilotic (PWN) or Proto Nilotic (PN) consonant system with stops based on the phonemic contrasts at five points of articulation. They assumed that the contrastive opposition between dental and alveolar stops had existed in PWN, without submitting evidence to support their reconstruction. In fact, the distinction between dental and alveolar plosives did not exist in PWN. The reconstructed dental-alveolar phonemes (such as a voiceless and voiced plosive, and a nasal) had been pronounced phonetically as a dental before a [-ATR] vowel and as an alveolar before a [+ATR] vowel in PWN. The reconstructed dental-alveolar phonemes split into independent dental and alveolar phonemes in the course of the development of modern languages. PN did not have the contrastive opposition between dental and alveolar consonants, either.

Key words: historical linguistics, phonemic split, dental-alveolar consonants, [ATR], Western Nilotic

1. INTRODUCTION

Nilotic languages, which are spoken in East Africa, South Sudan, Ethiopia, Uganda, Kenya, Tanzania, and Congo, are a group of languages that originated from a common ancestor language. They are classified into three groups: Western, Eastern, and Southern Nilotic. Western Nilotic (WN) languages are divided into three subgroups: North Nilotic (NN), Dinka-Atout-Nuer (DAN), and Lwo. Lwo languages are subdivided into Northern Lwo (NL) and Southern Lwo (SL).[1]

Burun and Mabaan belong to NN; Dinka, Atout, and Nuer to DAN; Anywa, Shilluk, Jur, Thuri, Pari, and Bor Belanda to NL; and Luo, Acooli, Alur, Lango, Kumam, and Adhola to SL. We will discuss dental and alveolar consonants in WN by using the data on Nuer (Kiggen 1948, Huffman 1929), Dinka (Nebel 1954), Anywa (Reh 1999), Shilluk (Heasty 1937), Luo (Tucker 1994), and Acooli (Blackings 2009, Crazzolara 1938). We do not have enough data on NN to discuss this consonant system.

Dimmendaal reconstructed the Proto Nilotic (PN) consonant system to consist of stops based on phonemic contrasts at five points of articulation: bilabial, dental, alveolar, palatal, and velar. In particular, he proposed that PN consonant system contained the phonemic contrast between dental and alveolar stops (Dimmendaal 1988: 7).[2] Eastern and Southern Nilotic languages have a consonant system with plosives contrasting at four points of articulation, and do not have the contrastive opposition between dental and alveolar plosives, while modern WN languages—except for some SL languages such as Acooli, Kumam, and Lango—have a consonant system with plosives contrasting at five points of articulation. The modern languages have the contrastive opposition between dental and alveolar plosives. Dimmendaal (1988: 7–11) and other scholars reconstructed the Proto Western

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Nilotic (PWN) consonant system containing dental and alveolar plosive phonemes, without submitting evidence to support this reconstruction (Hall & Hall 1996: 153–4, Reh 1997 (included in Rottland 1997: 139–173)). Therefore, the conclusion that PWN contained dental and alveolar plosive contrasts is premature. In fact, it is not easy to reconstruct dental and alveolar plosives in PWN. For example, the Dinka alveolar /t/ corresponds to the Anywa, Shilluk, and Luo dental /t̪/ in some cases: Dinka *tim* "tree, wood," Anywa *t̪ìm* "savanna," Shilluk *t̪im* "forest, woods," and Luo *t̪im* "wilds, jungle." The Dinka and Anywa dental /t̪/ corresponds to the Luo alveolar /t/ in other cases: Dinka (Malual) *t̪iin* "small," Anywa *t̪ìŋ* "small," and Luo *ti'n* "small." Dimmendaal (1988: 42) reconstructed a dental stop *t̪ in the initial position of PN form *t̪im "forest." If one grants that Dimmendaal's reconstruction of the dental stop in the former correspondence is correct, does she or he reconstruct a dental stop in the latter correspondence? Otherwise, does she or he reconstruct an alveolar stop?

In the following section, I will show that dental and alveolar plosives and nasal consonants in cognate sets exist partially in supplementary distributions. We will get glimpse of the PWN consonant system from the biased distributions of the dental and alveolar consonants in the cognate sets. I argue that the contrastive opposition between dental and alveolar consonants did not exist in PWN. I also argue that reconstruction of the PWN consonant system with plosive and nasal consonants contrasting at four points of articulation solves some of the problems in diachronic and synchronic studies of Nilotic languages.

In the case of diachronic studies, when we admit a hypothesis that phonemic contrast between dental and alveolar consonants did not exist in PWN, we have not to consider that Eastern and Southern languages may have lost this contrastive opposition reconstructed in the PN consonant system. The PN consonant system with plosives contrasting at five points of articulation is reconstructed standing on WN consonant systems contrasting at five points of articulation. In fact, the contrastive opposition between dental and alveolar consonants did not exist in the PN consonant system because it did not exist in the PWN consonant system.

Study of the verbal morphology of WN confronts us with a dilemma. In NL such as Shilluk and Anywa, the qualitative form of a verb is derived from its applicative form by changing the stem vowel.[3] There is no morphological change of consonants in the stem initial position. However, the Anywa applicative form *t̪àl* [–ATR] "to cook" has the qualitative counterpart *téedó* [+ATR] "to do cooking." In Anywa, the applicative form "to cook" has a dental voiceless plosive /t̪/, while the qualitative counterpart has an alveolar voiceless plosive /t/ in the initial position. How do we explain this irregularity? The qualitative form is suppletive synchronically, though I will demonstrate later that the qualitative form was derived regularly from the applicative form in the proto-language.

There is a similar example in Dinka morphology. The Dinka noun *tiet* [+ATR] "witchdoctor" may be derived by nominalization from the verb *t̪ɛɛt̪* [–ATR] "to bewitch." The noun begins with an alveolar voiceless plosive /t/, while the verb begins with a dental voiceless plosive /t̪/. The alternation of consonants in the initial position is irregular synchronically, because there is no morphological change of consonants in the stem initial position when nominal forms are derived from verbs in Dinka. We will see that this irregularity is a relic of the regular phonetic representations of the reconstructed dental-alveolar voiceless plosive in the proto-language.

Finally, some modern WN languages show "consonant harmony," in which alveolar consonants do not co-occur with dental ones within a stem (Reh 1996: 58). A fundamental explanation for "consonant harmony" results from reconstruction of the consonant system with consonants contrasting at four points of articulation.

In section 2, I will discuss the distribution of dental and alveolar plosive and nasal consonants in cognate sets within WN modern languages. I will this distribution in morphology in section 3. I will discuss "consonant harmony" in section 4.

2. DISTRIBUTION OF DENTAL AND ALVEOLAR CONSONANTS

There is synchronically contrastive opposition between dental and alveolar plosives in modern WN languages, except in the cases of SL languages such as Acooli, Kumam, and Lango. We can find out minimum pairs that demonstrate this contrastive opposition, as follows: *ʈaac* [-ATR] "to sit with crossed legs" vs. *taac* [-ATR] "to smooth," *ɖak* [-ATR] "boys" vs. *dak* [-ATR] "not to suffice" in Dinka, *ʈɛk* [-ATR] "to cook for a feast as a wedding feast" vs. *tɛk* [-ATR] "strong," *ɖoŋ* [+ATR] "basket made of coarse grass" vs. *doŋ* [+ATR] "to stay" in Shilluk, *ʈóò* [+ATR] "tree species" vs. *tòò* [+ATR] "to do squeezing," *ɖooŋ* [+ATR] "to box sb's ear" vs. *dòoŋ* [+ATR] "to remain" in Anywa, and *ʈim* [+ATR] "wilds, jungle" vs. *tíˆm* [+ATR] "team," *ɖɔk* [-ATR] "mouth" vs. *dɔk* [-ATR] "to go back" in Luo.[4]

I will discuss the distribution of dental and alveolar plosives in stem initial positions, because consonants are not changed by morphological derivations in these positions. Stem final is not an appropriate position for discussing the distribution of consonants without analyzing morphology, because stem final consonants are frequently altered in the process of morphological derivations. For example, when a qualitative form is derived from an applicative form of a verb ending with a lateral /l/ in the stem, the lateral /l/ is altered to an alveolar voiced plosive /d/ in Anywa: *ʈàl* [-ATR] "to cook sth." (applicative) > *téedó* [+ATR] "to do cooking" (qualitative).

Tables 1, 2, 3, 4, and 5 contain sets of cognates beginning with a dental or alveolar voiceless plosive, followed by high front vowels, mid-front vowels, low vowels, mid-back vowels, and high back vowels, respectively. Tables 7, 8, 9, 10, and 11 contain sets of cognates beginning with a dental or alveolar voiced plosive, followed by high front vowels, mid-front vowels, low vowels, mid-back vowels, and high back vowels, respectively. Table 13 contains a set of cognates beginning with a dental or alveolar nasal in the stem.

Most WN languages have ten vowels, divided into two categories, [-Advanced Tongue Root] and [+Advanced Tongue Root]: [-ATR] ɪ, ɛ, a, ɔ, ʊ and [+ATR] i, e, ɑ, o, u. The [ATR] categories are described tentatively for all vowels in the tables, though the description of [ATR] categories is not clear in Dinka, Nuer, and Shilluk.

Table 1. Dental and alveolar voiceless plosives before a high front vowel

	Dinka	Anywa	Luo
	Nuer	Shilluk	Acooli
forest, bush[5]	tim [+]	ʈìm [+]	ʈim [+]
		ʈɪm [-]	tiim [+]
shadow, shade[6]	atiep [+]	tìpò [+]	tipó [+]
	tieb [+]	tipo [+]	tipfu [+]
spoon, shell	tɪal [-]	apaal [-]	
		pal [-]	
small	ʈiin [+]	ʈiiɳ [-]	tíˆn [-]
			tɪdɪ [-]
to take wife	ʈɪɛɛk [-]	ʈyɛk [-] "wedding"	
hide	ʈɪan [-]	pìen [+]	pien [+]
		pyɛn [-]	pièn [+]

Table 2. Dental and alveolar voiceless plosives before a mid-front vowel

	Dinka	Anywa	Luo
	Nuer	Shilluk	Acooli
to shake[7]	teŋ ~ tieŋ [+]	jàŋ [+]	tɛŋɔ [-]
	tiŋtiŋ [+] "shiver"		yèŋò [+]
witchdoctor	tiet [+]		jaʈieʈ [+]
	tiet [+]		táál [-] "witchcraft"
to bewitch	ʈɛɛʈ [-]	ʈieʈ [+]	
		ʈyeeʈ [+]	tàal [-]
dew[8]	ʈec ~ ʈɑc [+]	ʈóoí [+]	ʈô [+]
	ʈac [-]	ʈoc [+]	tóyó [+]
evening	ʈɛɪ [-]	wìʈieɳ(ò) [+]	otienó [+] "night"
	ʈiaŋ [-]	ʈyeɳo [+]	òtyeènu [+]
to test	ʈɛm [-]		
		tɑm [+]	teèmò [+]

Table 3. Dental and alveolar voiceless plosives before a low vowel

	Dinka	Anywa	Luo
	Nuer	Shilluk	Acooli
spleen	tɑk [+]	tàa [-]	
	tak [-]	otɑk [+]	
tobacco	tap [-]	aʈàbá [-]	
	tap [-]	aʈabo [-]	tóbâ [+]
to cook[9]	ʈal [-]	ʈàal [-]	ʈɔlɔ [-] "to roast"
	ʈal [-]	ʈal [-]	tèed [+]
bottom	ʈar [-]	ʈaw [-]	pɪer [-]
	ʈar [-]	ʈar [-]	tɛrrɛɛ [-]
to press	ʈaŋ [-]	ʈeŋ [-] "to force sth. on sb."	
	twaŋ [-]		

Table 4. Dental and alveolar voiceless plosives before a mid-back vowel

	Dinka	Anywa	Luo
	Nuer	Shilluk	Acooli
spear[10]	tɔŋ [-]	tɔŋ [-]	tóŋ [-]
		tɔŋ [-]	tóóŋ [-]
to forge	ʈɔɔʈ ~ ʈaʈ[-]	ʈàɑʈ [+]	ʈeɖo [+]
	tadhɛ [-]	ʈaʈ [-]	tètò [+]
male[11]	ʈɔn [-]	ʈùɔŋ [-]	ʈʊɔn [-]
		ʈwɔŋ [-]	twɔòn [-]
temple[12]	ʈòòŋ [+]	ʈàɑŋɔ [+]	teŋg [+] "side"
	ʈaaŋ [-] "cheek"[13]	ʈaŋo [-]	tèngé [+] "side"
to finish	ʈòk [+]		tɪɛkɔ [+]
	ʈuk [+]	tyek [+]	

Table 5. Dental and alveolar voiceless plosives before a high back vowel

	Dinka	Anywa	Luo
	Nuer	Shilluk	Acooli
horn[14]	tuŋ [+]	tùuŋ [+]	túˆŋ [+]
	tuŋ [+]	tuŋo [+]	tùuŋ [+]
pus[15]	tut [+]	tuut [+]	tútú [+]
		tut [+]	túút [+]
to play	ʈɛɛc [-]	túuk [+]	tugo [+]
		tuk [+]	tùuk [+]
breast[16]	ʈuin [+] (Malual)	ʈùɳò [+]	ʈuno [+]
	ʈɪn [-]	ʈɪɳɪ [-]	tùnò [+]
mucus	aʈuor [+]	ʈùuɲé [+]	ɔʈíɲɔ̂ [-]
	ʈuiɲ [+]		

Table 6. Correspondences of dental and alveolar voiceless plosives

DAN	Northern Lwo	Luo	examples	Tables	Notes
ʈ	ʈ	ʈ	"to take wife" "dew" "to cook" "to forge" "mucus"	Table 1 Table 2 Table 3 Table 4 Table 5	Not found in Luo
ʈ	ʈ	t	"small" "evening" "bottom" "temple"	Table 1 Table 2 Table 3 Table 4	Not determined in Luo
ʈ	t	ʈ	not exist		
ʈ	t	t	"to test" "to play"	Table 2 Table 5	Not found in Luo
t	ʈ	ʈ	"forest"	Table 1	
t	ʈ	t	"tobacco"	Table 3	
t	t	ʈ	not exist		
t	t	t	"shadow" "to shake" "spleen" "spear" "horn"	Table 1 Table 2 Table 3 Table 4 Table 5	Not found in Anyw Not found in Luo

Table 7. Dental and alveolar voiced plosives before a high front vowel

	Dinka	Anywa	Luo
	Nuer	Shilluk	Acooli
three[17]	diɑk [+]	ɑdɑ́k [+]	ɑdé̀k [+]
	diok [+]	ɑdɑk [+]	ɑ̀déék [+]
to want	dɪɛt [-] (auxiliary)		dwa(rɔ) [-]
		dwato [-]	dwaàrɔ̀ [-]
big	dit [+]		dî̀t [+]
	diid [+]		dîît [+]
five	ɖɪɛc [-]	ɑbíic [+]	abî̀c [+]
	ɖiec [+]	ɑbic [+]	ɑ̀bîic [+]
termite	ɖɪɛɪ [-]	bìey [+]	biye [+]
		bi [+]	
to filter, strain	ɖiim [+]		
	ɖiimɛ [+]	dim [+] "strainer"	
to benumb[18]	ɖiir [+]		
	dil [+]	ɖɪl [-]	dìiŋ [+] "numb"

Table 8. Dental and alveolar voiced plosives before a mid-front vowel

	Dinka	Anywa	Luo
	Nuer	Shilluk	Acooli
skin	del [+]	dèel [+]	del [+] "body"
		del [+]	dyèel [+]
to drink	dɛk [+]	dɛ̀ɛk [-] "soup"	dɛk [-] "stew"
	dekdek [+] "thick (as soup)"		dɛ̀ɛk [-] "stew"
glory	ɖɛŋ [-]		
		ɖwɑŋ [+]	
cow[19]	wɛŋ [-]	ɖìaŋ [-]	ɖɪaŋ [-]
		ɖyaŋ [-]	dyààŋ [-]

Table 9. Dental and alveolar voiced plosives before a low vowel

	Dinka	Anywa	Luo
	Nuer	Shilluk	Acooli
to scold	daac [-]		
		dɑr [+]	
to move away	yak [-]	dàk [-]	
		dag [-]	dìir [+] "to move"
person[20]	rààn [-]	ɖàanɔ́ [-]	ɖánɔ̂ [-]
	raan [-]	ɖaŋɔ [-]	dánɔ́ɔ̀ [-]
woman		ɖáagɔ́ [-]	ɖákɔ̂ [-]
		ɖacɔ [-]	dàkɔ́ɔ̀ [-]

Table 10. Dental and alveolar voiced plosives before a mid-back vowel

	Dinka	Anywa	Luo
	Nuer	Shilluk	Acooli
to remain	doŋ [+]	dòoŋ [+]	doŋ [+]
	doɻɛ [+]	doŋ [+]	doòŋ [+]
voice	rol [+]	dʊɔl [-]	dwɔl [-]
	rool [+] "throat"		dwóón [+]
goat[21]	boor [+] (Pan Ruu)	dɪɛl [-]	dɪɛl [-]
	dɛɛl [-]	dyɛl [-]	dyɛɛ̀l [-]
to be tired	ɖor [+]		ol [+]
		ɖar [-] "very tired"	òol [+] "to exhaust"

Table 11. Dental and alveolar voiced plosives before a high back vowel

	Dinka	Anywa	Luo
	Nuer	Shilluk	Acooli
to be poor	bur ~ ɑyur [+]		ɖier [+]
		ɑbu [+]	
gourd with carving unit	ɑduok [+] "large bowl"		ɑbú [+] "gourd"
		ɑɖuki [+]	
blister	buot [+]		
	dʊɔɻ [-]	ɖɛɻ [-] (verb)	
to return[22]	ɖuk [+]	dɔ̀ɔk [-]	dɔk [-] "to go back"
		dɔk [-]	dɔ̀ɔk [-]

Table 12. Correspondences of dental and alveolar voiced plosives

DAN	Northern Lwo	Luo	examples	Tables	Notes
ɖ	ɖ	ɖ	"cow" "person" "to be tired"	Table 8 Table 9 Table 10	Not determined in DAN Not determined in DAN Not found in Luo
ɖ	ɖ	d	"to benumb" "blister"	Table 7 Table 11	Not found in Luo Irregular in Nuer
ɖ	d	ɖ	not exist		
ɖ	d	d	"to return"	Table 11	
d	ɖ	ɖ	Not found		
d	ɖ	d	"gourd"	Table 11	Not determined in Luo
d	d	ɖ	not exist		
d	d	d	"three" "skin" "to scold" "to remain"	Table 7 Table 8 Table 9 Table 10	Not found in Luo

Table 13. Dental and alveolar nasals

	Dinka	Anywa	Luo
	Nuer	Shilluk	Acooli
to sleep[23]	niin [+]		nɪndɔ [-]
	niinɛ [+]	nino [+]	nìnnò [+]
testicle	n̪ɪaan [-]	màalɔ̀ [-]	
	n̪ɪan [-]	manɔ [-]	maàn [-]
sky, up	n̪ìàl [-]	máal [-]	mɑlɔ́ [+] "up"
	n̪ial [+]	mal [-]	màlɔ́ [-] "up"
to pinch			
	n̪ɪɛdɛ [-]	ŋwɛt [-]	
to kill	nɑk [+]	nɑk [+]	nego [+]
	naɣɛ [-]	nɑk [+]	nèèk [+]
face, front	n̪om [+] "front"	ɲim [+] "front"	ɲíˆm [+]
	n̪ɪam [-]		ɲíím [+]

There are cognates in the tables that have a bilabial voiceless plosive /p/, a voiced plosive /b/, or a nasal /m/ in the stem initial position. The bilabial plosives /p/ and /b/ (and sometimes bilabial approximant /w/), and the nasal /m/ correspond to the dental or alveolar plosives /t̪/ or /t/, /d̪/ or /d/, and nasal /n̪/ or /n/ respectively, within WN languages. For example, the dental voiceless plosive /t̪/ of Dinka *t̪ian* [-ATR] "hide" corresponds to the bilabial voiceless plosive /p/ of Shilluk *pyɛn* [-ATR] "hide" or Luo *pien* [+ATR] "hide." The alveolar voiceless plosive /t/ of Dinka *tial* [-ATR] "spoon, shell" corresponds to the bilabial voiceless plosive /p/ of Anywa *apaal* [-ATR] "spoon, shell" or Shilluk *pal* [-ATR] "spoon, shell." The dental voiced plosive /d̪/ of Shilluk *d̪yaŋ* [-ATR] "cow" or Luo *d̪iaŋ* [-ATR] "cow" corresponds to the bilabial approximant /w/ of Dinka *wɛŋ* [-ATR] "cow."[24] Furthermore, the dental nasal /n̪/ of Dinka *n̪ɪaan* [-ATR] "testicle" corresponds to the bilabial nasal /m/ of Shilluk *manɔ* [-ATR] "testicle." The PWN dental-alveolar *t, *d, and *n might have been altered to a bilabial /p/, /b/, and /m/ followed by a diphthong ɪa/iɑ or ɪɛ/ie (sometimes written as ya/yɑ or yɛ/ye) respectively. The alternation of a dental-alveolar consonant into a bilabial one might have accompanied monophthongization of a diphthong. Elucidation of how this process occurred is an aim of future research.[25] Here, I focus on the reconstruction of PWN dental-alveolar consonants.

Various combinations of corresponding dental and alveolar plosives are observed, with some exceptions, as summarized in Table 6 and 12. The exceptions are as follows. There is no cognate set in which NL (Anywa and Shilluk) /t/ and /d/ correspond to SL (Luo) /t̪/ and /d̪/ respectively in the stem initial position: DAN t̪: NL t: SL t̪, DAN t: NL t: SL t̪ in Table 6, and DAN d̪: NL d: SL d̪, DAN d: NL d: SL d̪ in Table 12.

The cognate sets in Tables 1, 2, 3, 4, 5, 7, 8, 9, 10, and 11 do not provide clear evidence that dental and alveolar plosives originated from single phonemes. Nevertheless, I would like to propose that the single phonemes split into independent dental and alveolar plosive phonemes. In the cognate sets, there is not a sufficient evidence to prove that the split is conditioned by height or front/back features of the following vowels, as the correspondences listed in Table 6 and 12 happen before vowels of various heights and front/back features.

When we compare DAN, NL, and SL cognates in the tables more precisely, we notice possible environments under which the aforementioned split may have occurred. These environments are not specified clearly, but there is an obscure tendency for dental and alveolar plosives to appear in particular environments in WN modern languages.

As has been mentioned, most WN languages have ten vowels, divided into two categories: [-Advanced Tongue Root] and [+Advanced Tongue Root]. The tendency is for dental plosives to appear before

vowels of [-ATR], while alveolar ones appear before vowels of [+ATR]. The fundamental phonetic explanation for the relationship between the consonants and [ATR] vowel distinctions is beyond of the scope of this paper. Nevertheless, this observation may provide a new perspective from which to resolve the characteristics of [ATR] categories in WN. For example, Dinka *ȶɪɛɛk* "to take wife" has a dental voiceless /ȶ/ followed by a high front vowel of [-ATR] /ɪ/ and Dinka *tim* "forest" has an alveolar voiceless /t/ followed by a high front vowel of [+ATR] /i/ (see Table 1). Anywa *ȶyɛk* "wedding ceremony" has a dental voiceless /ȶ/ followed by a diphthong of [-ATR] /yɛ/ and Anywa *tìpò* "shade" has an alveolar voiceless /t/ followed by a high front vowel of [+ATR] /i/ (see Table 1). Luo *ȶɔlɔ* "to roast" has a dental voiceless /ȶ/ followed by a mid-back vowel of [-ATR] /ɔ/ (see Table 3) and Luo *tipó* "shade" has an alveolar voiceless /t/ followed by a high front vowel of [+ATR] /i/ (see Table 1).

The same tendency is observed in dental and alveolar voiced plosives. For example, Dinka *ɖɪɛc* "five" has a dental voiced /ɖ/ followed by a diphthong of [-ATR] /ɪɛ/ and Dinka *diak* "three" has an alveolar voiced /d/ followed by a diphthong of [+ATR] /iɑ/ (see Table 7). Anywa *ɖiaŋ* "cow" has a dental voiced /ɖ/ followed by a diphthong of [-ATR] /ɪa/ (see Table 8) and Anywa *adák* "three" has an alveolar voiced /d/ followed by a low vowel of [+ATR] /ɑ/ (see Table 7). Luo *ɖɪaŋ* "cow" has a dental voiced /ɖ/ followed by a diphthong of [-ATR] /ɪa/ and Luo *del* "body" has an alveolar voiced /d/ followed by a mid-front vowel of [+ATR] /e/ (see Table 8).

As I proposed, the PWN dental-alveolar plosives *t and *d may have become the bilabial plosives /p/ and /b/ (respectively) before diphthongs. PWN dental-alveolar plosives may split into independent dental and alveolar phonemes, as I discuss later. It is not easy to determine whether the bilabial plosives /p/ and /b/ originated from the reconstructed dental-alveolar *t and *d before the split, or from the dental or alveolar plosive phonemes after the split, however. In fact, the bilabial plosives originating from the PWN dental-alveolar plosives *t or *d appear either before a [-ATR] or a [+ATR] vowel. They are distributed freely from the tendency discussed above.

Furthermore, a trill /r/ corresponds to a dental or alveolar voiced plosive in some cognate sets. For example, Dinak *rààn* [-ATR] "person" is cognate with Shilluk *ɖaɲɔ* [-ATR] "person" and Luo *ɖánɔ̀* [-ATR] "person." PWN dental-alveolar voiced plosives presumably altered into trills under unknown conditions.(26)

Regrettably, there are many exceptions to aforementioned tendency. For example, Anywa *ȶìm* "forest" and Luo *ȶìm* "forest" have a dental voiceless /ȶ/ in the initial position, though it is followed by a high front vowel of [+ATR], /i/, (see Table 1). On the other hand, Dinka *tɪal* "spoon, shell" or Luo *tiˆn* "small" has an alveolar voiceless /t/ in the initial position, though it is followed by a diphthong or a high front vowel of [-ATR] /ɪa/, /ɪ/ (see Table 1). Dinka *ɖiim* "to filter" or Luo *ɖier* "to be poor" has a dental voiced /ɖ/ in its initial position, though it is followed by a front high vowel or a diphthong of [+ATR] /i/, /ie/ (see Tables 7, 11). On the other hand, Dinka *dɪɛt* "to want" (auxiliary verb) or Luo *dɛk* "stew" have an alveolar voiced /d/ in the initial position, though it is followed by a diphthong or a mid-front vowel of [-ATR] vowel /ɪɛ/, /ɛ/ (see Tables 7, 8). The distribution of dental and alveolar plosives does not give reliable evidence to support the assertion that these plosives originate from single phonemes.

Table 13 contains a cognate set of lexical items that have dental or alveolar nasals in stem initial positions. There are a few lexical items in WN that begin with a dental nasal /ɳ/. Around ten lexical items are recorded in Dinka, four in Shilluk, and only one in Anywa. There is no contrastive opposition between dental and alveolar nasals in SL.

It is difficult to find cognates beginning with dental or alveolar nasals in stem initial positions. However, from simple comparison in Table 13 we can note the tendency of dental nasals to be followed by [-ATR] vowels, and of alveolar nasals to be followed by [+ATR] vowels. Furthermore, a dental nasal /ɳ/ in Dinka or Nuer sometimes corresponds to a palatal nasal /ɲ/, or a velar nasal /ŋ/ in Anywa, Shilluk, Luo, and Acooli: Dinka *ɳom* (plural *ɳiim*) "front," Shilluk *ɲim* "front," and Nuer *ɳɪɛdɛ* "to pinch," Shilluk *ŋwet* "to pinch." PWN dental-alveolar nasals might have been unstable and shifted drastically according to their following vowels.

In summary, there is a tendency for dental consonants to be followed by [-ATR] vowels and alveolar consonants to be followed by [+ATR] vowels.

3. DISTRIBUTIONS OF DENTAL AND ALVEOLAR PLOSIVES IN MORPHOLOGY

The distributions of dental and alveolar consonants do not provide conclusive evidence that contrastive opposition between dental and alveolar consonants did not exist in PWN. However, irregularities in the verbal morphology of NL languages give us foundations to discuss the distribution of dental and alveolar voiceless plosives.

For example, a patient-deleting derivation turns bivalent transitive verbs into monovalent ones in Anywa (Reh 1996: 220). Bivalent transitive forms are called applicative, and derived monovalent forms qualitative.[27] Qualitative forms are derived from applicative ones in the verbal morphology as follows.

A stem vowel of [-ATR] in applicative forms becomes a vowel of [+ATR] in its qualitative counterparts, while a stem vowel of [+ATR] in applicative forms remains a vowel of [+ATR] in its qualitative counterparts: *ŋɔt* [-ATR] "to cut sth." (applicative) > *ŋùdò* [+ATR] "to do cutting" (qualitative), *bil* [+ATR] "to soak sth." (applicative) > *bìdo* [+ATR] "to do soaking" (qualitative). With the exception of liquids, a stem final consonant in applicative forms remains the same in its qualitative counterparts. A liquid in applicative forms becomes a dental or alveolar voiced plosive in qualitative ones: *gɛ́ɛr* [-ATR] "to build sth." (applicative) > *gèedò* [+ATR] "to do building" (qualitative), *ɟɔr* [-ATR] "to raise ground level" (applicative) > *ɟùɖò* [+ATR] "to do raising" (qualitative) (Reh 1996: 222–4).[28]

A stem initial consonant in applicative forms remains unchanged in its qualitative counterparts with one exception. Only one irregular qualitative form is recorded in Anywa: *ʈàal* [-ATR] "to cook sth." (applicative) > *téedó* [+ATR] "to do cooking" (qualitative) (Reh 1996: 226). The applicative form has a dental voiceless plosive /ʈ/, while the qualitative counterpart has an alveolar voiceless plosive /t/ in the stem initial position.

Shilluk has a similar verbal morphology as Anywa. A stem vowel of [-ATR] in applicative forms becomes a [+ATR] vowel in its qualitative counterparts, while a stem vowel of [+ATR] in applicative forms remain a [+ATR] vowel in qualitative counterparts. A stem final consonant in applicative forms remains the same in qualitative forms with the exception of liquids. A stem initial consonant in applicative forms remains unchanged in qualitative forms with one exception (Kohnen 1933: 124–7). In Shilluk, one irregular qualitative form is recorded: *ʈal* [-ATR] "to cook" (applicative) > *tado* [+ATR] "to do cooking" (qualitative).[29]

This irregularity in Anywa and Shilluk verbal morphology can be explained as follows. The applicative form has a stem vowel of [-ATR], while the qualitative counterpart has a stem vowel of [+ATR] in the verbal derivation. As we observed in the previous section, dental plosives usually appear before [-ATR] vowels and alveolar plosives usually appear before [+ATR] vowels. The dental voiceless plosive of the applicative form and the alveolar voiceless plosive of the qualitative form in the stem initial position of the verb "to cook" conform to the environments in which dental and alveolar plosives appear.

From the above fact, we come to the following conclusion. The qualitative form of the verb "to cook" historically had the same consonant as the one the applicative form had in the stem initial position. This consonant phoneme might have been a voiceless plosive at a dental-alveolar point of articulation. The phoneme was pronounced phonetically as dental before a [-ATR] vowel, and as alveolar before a [+ATR] vowel.

The reconstructed phoneme split into two phonemes: a dental and an alveolar voiceless plosive phoneme. Before the phonemic split, the reconstructed dental-alveolar plosive phoneme was pronounced as dental before a [-ATR] vowel in applicative forms and as alveolar before a [+ATR] vowel in qualitative counterparts. After the phonemic split, the dental voiceless plosive phoneme was always pronounced as dental before a [-ATR] vowel in applicative forms and even before a [+ATR] vowel

in qualitative forms, such as *t̪ɔm* [-ATR] "to cut" (applicative) and *t̪umo* [+ATR] "to do cutting" (qualitative) in Anywa. After the phonemic split, the alveolar voiceless plosive phoneme was pronounced as alveolar even before a [-ATR] vowel in applicative forms as well as before a [+ATR] vowel in qualitative forms such as *tɪmɔ* [-ATR] "to make" (applicative) and *timo* [+ATR] "to do making" (qualitative) in Anywa. Except for the irregular verb "to cook," dental or alveolar voiceless plosive phonemes in the stem initial positions of applicative forms remained the same in their qualitative counterparts after phonemic splitting.[30]

The applicative and qualitative forms of the irregular verb "to cook" maintained the archaic phonetic representations of the reconstructed dental-alveolar voiceless plosive phoneme. The phonetic dental variant followed by a [-ATR] vowel became the dental voiceless plosive phoneme /t̪/ in the stem initial position of the applicative form, while the phonetic alveolar voiceless plosive followed by a [+ATR] vowel became the alveolar voiceless plosive phoneme /t/ in the stem initial position of the qualitative form. The linguistic change causing phonetic variants of a single phoneme to be phonologized into two independent phonemes occurred in the course of the development of modern languages. Thus, we can reconstruct the dental-alveolar voiceless plosive *t in PWN. The proto phoneme *t was pronounced as a dental [t̪] before a [-ATR] vowel and as an alveolar [t] before a [+ATR] vowel.

Dinka has a similar verbal morphology to that of Anywa and Shilluk. However, unlike Anywa and Shilluk, Dinka did not maintain an irregular verb with regard to the derivation of qualitative forms. A stem vowel of [-ATR] in applicative forms becomes a [+ATR] vowel in qualitative ones, while a stem vowel of [+ATR] in applicative forms remains a [+ATR] vowel in qualitative forms.[31] Phonemic split of PWN dental-alveolar *t into a dental and an alveolar voiceless plosive occurred in Dinka. After the split, when an applicative form had a dental voiceless plosive in the stem initial position, the dental voiceless plosive remained the same in the qualitative counterpart: *t̪al* [-ATR] "to cook sth." (applicative) > *t̪at* [+ATR] "to do cooking" (qualitative) (Nebel 1948: 25).

Dinka has similar irregularities to those observed in Anywa and Shilluk. An alveolar voiceless plosive /t/ is followed by a [+ATR] vowel in the noun *tiet* "witchdoctor," while a dental voiceless plosive /t̪/ is followed by a [-ATR] vowel in the verb *t̪ɛɛt̪* "to bewitch." The distribution of dental and alveolar voiceless plosives conforms to the phonetic representations of the reconstructed dental-alveolar voiceless plosive *t. The Dinka noun *tiet* "witchdoctor" might have had the same phoneme in the stem initial position as that in the Dinka verb *t̪ɛɛt̪* [-ATR] "to bewitch." The agent noun *tiet* [+ATR] "witchdoctor" might have been derived from the verb *t̪ɛɛt̪* "to bewitch" by changing a stem [-ATR] vowel to a [+ATR] one. The alveolar pronunciation occurring before a [+ATR] vowel was phonologized into the alveolar voiceless phoneme in the stem initial position of the agent noun *tiet* [+ATR] "witchdoctor." The Dinka nominal derivation warrants further research.

Though we have no morphological evidence, we may reconstruct a dental-alveolar voiced plosive and a dental-alveolar nasal phoneme in PWN. The reconstructed dental-alveolar voiced plosive and the dental-alveolar nasal consonant might have been pronounced as dental before a [-ATR] vowel and as alveolar before a [+ATR] vowel. The PWN dental-alveolar voiced plosive phoneme might have split into a dental and an alveolar voiced phoneme, and the PWN dental-alveolar nasal might have split into a dental and an alveolar nasal phoneme, in the course of development of the modern languages.

PWN dental-alveolar	*t	*d	*n
	↙ ↘	↙ ↘	↙ ↘
WN dental and alveolar	t̪ t	d̪ d	n̪ n

Figure 1. Split of PWN dental-alveolar consonants

Once we reconstruct the PWN dental-alveolar voiceless and voiced plosive, and the dental-alveolar nasal, the distribution of dental and alveolar consonants in Tables 1–13 seems to demonstrate archaic pronunciations of proto-dental-alveolar phonemes. This distribution shows the kind of vowels that followed proto-phonemes. Specifically, it demonstrates which feature of the [ATR] category—negative or positive—the following vowels had. In Table 1, for example, Dinka *tim* "forest" might have been followed by a [+ATR] vowel in the past, because it has an alveolar voiceless plosive /t/ in the stem initial position. Anywa *ʈim* and Luo *ʈim* "forest" might have been followed by a [-ATR] vowel in the past because they have a dental voiceless plosive /t̪/ in the stem initial position. Historically, the [-ATR] vowel might have shifted to a [+ATR] vowel in Anywa and Luo, such that they have stem [+ATR] vowels now. In fact, Shilluk *ʈɪm* "forest" has a dental voiceless plosive followed by a [-ATR] vowel. The PWN form *tɪm "forest" is reconstructed via comparison with Anywa, Shilluk, and Luo. Dinka might have had a dental voiceless plosive followed by a [-ATR] vowel but the [-ATR] vowel might have shifted to a [+ATR] one in early periods. In Dinka, the proto-dental-alveolar voiceless plosive *t was pronounced as an alveolar before a [+ATR] vowel, and the phonetic representation of PWN *t before a [+ATR] vowel was phonologized into the alveolar voiceless phoneme /t/. Thus, this distribution of dental and alveolar consonants gives preliminary evidence toward clarifying the vowel shift in WN; this is an avenue for future research.

4. "CONSONANT HARMONY" AND THE DISTRIBUTION OF DENTAL AND ALVEOLAR CONSONANTS

In Anywa, alveolar consonants do not co-occur with dental consonants in the same stem: *tuut* [+ATR] "pus," *ʈʊ̀ɔɲ* [-ATR] "bull." This phenomenon is called "consonant harmony" by Reh (Reh 1996: 58). No lexical item in which an alveolar consonant co-occurs with a dental one is recorded in Shilluk: *toodo* [+ATR] "lies," *ɖaŋɔ* [-ATR] "person" (Heasty 1937: 30). No lexical item in which an alveolar plosive co-occurs with a dental consonant is recorded in Luo: *tiˆn* [-ATR] "small," *ɖɔɖɔ* [-ATR] "to suckle."[32] In Luo however, an alveolar nasal co-occurs with a dental consonant; this makes no contrastive distinction between the dental and alveolar nasals: *ɖánɔ̀*[-ATR] "person" (Tucker 1994: 500).

This phenomenon seems to represent a kind of assimilation, such that a preceding consonant alters its point of articulation in harmony with the following one, or vice versa. In fact, this phenomenon is due to vowel harmony. In WN, vowels have the same feature of [ATR] in a word. Namely, no [-ATR] vowel co-occurs with a [+ATR] vowel in the same word. In the previous section, I proposed that PWN dental-alveolar consonants were pronounced as dental before a [-ATR] vowel, and as alveolar before a [+ATR] vowel. WN languages frequently lost vowels in final positions of words. These lost vowels had the same features of [ATR] as did stem vowels, because vowels were subject to vowel harmony.[33] For instance, when all vowels were [-ATR] in a word, all dental-alveolar consonants in a word would have been pronounced as dental. On the other hand, when all vowels in a word were [+ATR], all dental-alveolar consonants would have been pronounced as alveolar. This phenomenon, called "consonant harmony," is a vestige of an archaic consonant system in PWN.

5. CONCLUDING REMARKS

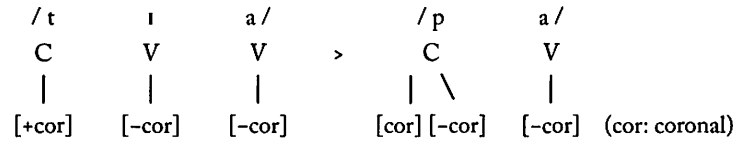
I have demonstrated reconstruction of dental-alveolar consonants in the PWN consonant system. Although this paper may be an untimely one—given that there is insufficient data about the consonant system of WN languages—it is nonetheless a step in the right direction, toward reconstructing the consonant system of PWN.

In conclusion, no distinction between dental and alveolar consonants existed in PWN. PWN dental-alveolar consonants had been pronounced phonetically as dental before a [-ATR] vowel and as alveolar before a [+ATR] vowel. They split into dental and alveolar consonant phonemes in the

course of development of the languages. PN had no contrastive opposition between dental and alveolar consonants either.

NOTES

(1) The classification of WN is based on Köhler (1975).
(2) Dimmendaal (1988: 7) pointed out that the phonemic contrast between voiced dental and alveolar stops is less well established in PN.
(3) According to Tucker (1978: 4), an applicative verb is a transitive one with an expressed or unexpressed object, and a qualitative verb is used intransitively (i.e. without an object).
(4) Contrastive opposition between dental and alveolar nasals is considered to exist in Dinka, Anywa, and Shilluk, while this distinction does not exist in Luo.
(5) Cf. Mabaan *tɛɛm* "tree." A dental /t̪/ is written as t in Miller (1999: 101).
(6) Cf. Mabaan *ţebjo* "shadow." An alveolar /t/ is written as ţ in Miller (1999).
(7) Cf. Mabaan *ţyeŋŋo* "to shake off" (Miller 1999: 109).
(8) Cf. Mabaan *tyecco* "dew" (Miller 1999: 106).
(9) Cf. Mabaan *taale* "to cook in water" (Miller 1999: 100).
(10) Cf. Mabaan *ţwaŋ* "spear (sg.)" and *ţwaŋgo* "spear (pl.)" (Miller 1999: 105). The singular form might have a dental /t̪/ followed by a [-ATR] vowel, and the plural one an alveolar /t/ followed by a [+ATR] vowel in initial position. The [-ATR] category of vowel alters to [+ATR] in plural formation.
(11) Cf. Mabaan tuano "cock" (Miller 1999: 104).
(12) Cf Mabaan *taaŋɛ* "temple" (Miller 1999: 100).
(13) Nuer has a variant beginning with an alveolar /t/: *taaŋ* "side of face."
(14) Cf. Mabaan *ţuoŋo* "horn" (Miller 1999: 108).
(15) Cf. Mabaan *ţuoţ* "pus" (Miller 1999: 108).
(16) Cf. Mabaan *tyinnɛ* "breast" (Miller 1999: 106).
(17) Cf. Mabaan *ḍoogɔ* "three." An alveolar /d/ is written as *ḍ* in Miller (1999: 36)
(18) Cf. Mabaan *di diy* "numb." A dental /d̪/ is written as d in Miller (1999: 30)
(19) Cf. Mabaan *diaŋo* "cow" (Miller 1999: 30). Dinka /w/ originated from PWN *d through *b.
(20) Cf. Mabaan *daano* "old man" (Miller 1999: 28).
(21) Cf. Mabaan *ḍiɛllo* "goat" (Miller 1999: 35).
(22) Cf. Mabaan *dɔɔka* "to return" (Miller 1999: 31).
(23) Cf. Mabaan *niin* "to sleep." Miller (1999: 81) does not distinguish a dental nasal from an alveolar one.
(24) The word initial /w/ in Dinka is consonantal. A consonantal element always occupies the onset position of syllables in Dinka. Dinka words constitute one syllable consisting of CVC, though a few words are preceded by a prefix. There is no word beginning with a vowel, except for words with a prefix.
(25) The historical change of PWN dental-alveolar consonants to bilabial is as follows. A dental-alveolar consonant is characterized with [+coronal], while a bilabial one is characterized with [-coronal]. Vowels always contain [-coronal] feature. The [-coronal] feature of a diphthong is assigned to the preceding consonant in the process of monophthongization.



(26) This linguistic change is called rhotacism.
(27) Reh (1996) called qualitative forms "detransitivized" forms. I use the terms, applicative and qualitative, because the terms are widely known by researchers of Nilotic languages. The term applicative in Nilotic studies is different from the same term used in Bantu linguistics.
(28) "Consonant harmony" is applied to the stem final dental voiced plosive according to Reh.
(29) Kohnen pointed out that the stem vowel changes as follows. The low vowel in applicative forms becomes the low vowel with flat (low) and closed tone in its qualitative counterparts (Kohnen 1933: 124). The low vowel in the qualitative form must be [+ATR], because Kohnen recorded that other [-ATR] vowels than

the low in applicative forms become [+ATR] in the qualitative forms.

(30) The initial plosive /ʈ/ of Anywa *ʈɔm* "to cut" originated from the reconstructed *t, which was pronounced as dental before a [-ATR] vowel in PWN. The initial /t/ of Anywa tɪmɔ "to make" originated from the reconstructed *t, which was pronounced as alveolar before a [+ATR] vowel in PWN. Perhaps the dental and alveolar plosives were phonologized in Proto-Lwo periods.

(31) Nebel (1948) called qualitative forms intransitive ones.

(32) An exceptional lexical item is recorded in Tucker (1994): *ɖɔ́ɔ́t* "door." This is a compound consisting of *ɖɔ́k* "mouth" and *ɔ́t* "house."

(33) PWN might have had vowel harmony in its phonology, because all modern languages have vowel harmony.

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