

The Evolution of Applicative Constructions and Proto-Austronesian Morphosyntax

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THE EVOLUTION OF APPLICATIVE CONSTRUCTIONS  
AND PROTO-AUSTRONESIAN MORPHOSYNTAX\*

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1. INTRODUCTION. *Applicative constructions* are a means some languages have for indicating that thematically peripheral objects have a morphosyntactic (and sometimes also discourse) status which differs from what would otherwise be expected for them. In terms of morphosyntax, thematically peripheral objects are treated in a more core or direct object manner, and in terms of discourse, they often have higher relative topicality in applicative constructions as compared to when they occur in non-applicative constructions.

One lexically restricted example of an applicative construction is the Dative Shift construction in English. In the non-Dative Shift example in 1a, the recipient is coded as an oblique, but in the Dative Shift case in 1b, the recipient appears as a bare noun phrase and can even be the subject of a passive version of the sentence, as seen in 2. Thus, in the Dative Shift example, the recipient has the status of a direct object rather than that of an oblique. Thompson 1990 also shows that there is a higher relative topicality for recipients in the Dative Shift-type sentences as compared to those in the non-Dative Shift-type sentences.

- (1) a. Non-Dative shift: John gave the book to Susan.  
b. Dative shift: John gave Susan the book.
- (2) Susan was given the book (by John).

A more prototypical applicative construction is seen in 3 for Chaga (Bresnan and Moshi 1990:148-9). Here, a variety of thematically peripheral objects are able to display more direct object-like properties, and the verb is marked with what is at least superficially the same piece of morphology. In cases like this, the construction is often quite productive, capable of being used with all verbs of the language or with a significant subset of them (e.g. with all transitive verbs).

- (3) a. Benefactive/malefactive applicative object:  
*n-á-í-lyì-í-à*                      *mì-kà*                      *k-élyà*  
 FOC-1S-PR-eat-APP-FV            1-wife                      7-food  
 'He is eating food for/on his wife.'
- b. Locative applicative object:  
*n-á-í-lyì-í-à*                      *mì-rì-nyì*                      *k-élyà*  
 FOC-1S-PR-eat-APP-FV            3-homestead                7-food  
 'He is eating food at the homestead.'
- c. Instrumental applicative object:  
*n-á-í-lyì-í-à*                      *mà-wòkó*                      *k-élyá*  
 FOC-1S-PR-eat-APP-FV            6-hand                      7-food  
 'He is eating food with his hands.'

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## d. Circumstantial applicative object:

*n-á-i-lyi-i-á*                      *njáá*                      *k-élya*  
 FOC-IS-PR-eat-APP-FV            9.hunger            7-food  
 'He is eating the food because of hunger.'

The Nomatsiguenga case in 4 (Wise 1971, as cited in Payne 1990:222-223) is similar to the Chaga case in terms of the types of objects that can participate in applicative constructions. In this case, however, each applicative construction is marked by a unique piece of verbal morphology. From this it can be seen that languages differ as to the kind of overlap there is between morphology and thematic role of the relevant object.

## (4) a. Benefactive applicative object:

*pablo i-pë-ne-ri*                      *ariberito*                      *tiapa*                      *singi*  
 Paul HE-give-BEN.APP-HIM            Albert                      chicken                      corn  
 'Paul gave the chickens corn for Albert.'

## b. Allative applicative object:

*pablo i-hoka-te-ta-be-ka-ri*  
 Paul HE-throw-TOWARD.APP-EP-FRUST-RFLEX-MASC

*ariberito*                      *i-gotsirote*  
 Albert                      HIS-knife  
 'Paul threw his knife toward Albert.'

## c. Locative applicative object:

*pablo i-kenga-mo-ta-h-i-ri*                      *ariberito*  
 Paul HE-narrate-IN.PRESENCE.OF.APP-EP-AGAIN-TENSE-MASC Albert  
 'Paul narrated it in Albert's presence.'

## d. Comitative applicative object:

*Juan i-komota-ka-k-e-ri*                      *pablo otsegoha*  
 John HE-dam.stream-COM.APP-INDIC-TENSE-MASC Paul river.branch  
 'John dammed the river branch with Paul.'

## e. Reason applicative object:

*pablo i-kisa-biri-k-e-ri*                      *juan*  
 Paul HE-be.angry-REASON.APP-INDIC-TENSE-MASC John  
 'Paul was angry on account of John.'

## f. Purpose applicative object:

*ni-ganta-si-t-ë-ri*                      *hompiki*  
 I-send-PURP.APP-EP-TENSE-MASC pills  
 'I sent him for pills.'

## g. Instrumental applicative object:

*ora pi-nets-an-t-i-ma-ri*  
 that YOU-look.at-INST.APP-EP-TENSE-FUT.RFLEX-MASC

*hitatsia*                      *negativo*  
 name                      negative

'Look at it (the sun during an eclipse) with that which is called a negative.'

The goals of this paper are first to illustrate the types of morphology that markers of applicative constructions tend to grammaticalize from and to demonstrate what types of constructions applicative constructions evolve into. Then I will show how this development may be relevant to our understanding of the origin and later development of Proto-Austronesian verbal morphology.

2. THE EVOLUTION OF APPLICATIVE CONSTRUCTIONS. The issue of where the morphology which marks applicative constructions comes from has been dealt with in a number of papers (Garrett 1990, Craig and Hale 1988, Rude 1991), so I will just briefly touch on it here. Basically, when we can tell what the source of the morphology is, it is always either adpositional or verbal.

5 shows an instance of the adpositional source type in Kinyarwanda (Kimenyi 1980:89). 5a contains an allative argument in a prepositional phrase. In 5b the prepositional material is instead suffixed to the verb; the allative argument has the morphosyntactic status of a direct object, making this variant an applicative construction.

(5) Adpositional source:

- |    |   |                      |                |                  |                |
|----|---|----------------------|----------------|------------------|----------------|
| a. | <i>úmwáana</i>                                  | <i>y-a-taa-ye</i>    | <i>igitabo</i> | <u><i>mú</i></u> | <i>máazi</i>   |
|    | child   | HE-PST-throw-ASP     | book           | <u>IN</u>        | water          |
|    | ‘The child has thrown the book into the water.’ |                      |                |                  |                |
|    |   |                      |                |                  |                |
| b. | <i>úmwáana</i>                                  | <i>y-a-taa-yé-mo</i> |                | <i>ámáazi</i>    | <i>igitabo</i> |
|    | child   | HE-PST-throw-ASP-APP |                | water            | book           |
|    | ‘The child has thrown the book into the water.’ |                      |                |                  |                |

On the other hand, the Papuan language Awtuw has a benefactive applicative marker (see 6) which is “transparently derived from the root kow ‘give’” (Feldman 1986:102). This verb is an extremely common source for benefactive applicative markers.

(6) Verbal source:

- |  |              |            |                    |
|--|--------------|------------|--------------------|
| <i>wawpey</i>                                | <i>yen-e</i> | <i>yaw</i> | <i>də-kə-kow-o</i> |
| Wawpey                                       | 2SG-O        | pig        | FA-get-BEN-P       |
| ‘Wawpey got a pig for you (behalf/benefit).’ |              |            |                    |

It is thus fairly clear where applicative constructions develop from. However, what they develop into when they stop being synchronic applicative constructions is a less studied area. In what follows, I will show that the applicative morphology is often reinterpreted as marking a construction which indicates high topicality of an oblique.

2.1. NADÈB: APPLICATIVE > RELATIVIZER. In the Brazilian language Nadèb, Weir 1986 has shown that there are a number of applicatives which derive from adpositions. 7 shows a non-applicative case, in which a locative is expressed obliquely. In 8, the adpositional morphology of 7 is either preposed to the verb or actually phonologically incorporated into the verb, and the locative argument has the usual sentence-initial position for direct objects, yielding an applicative construction.

(7) Non-applicative occurrence of an adposition:

- |   |                      |               |                  |
|---|----------------------|---------------|------------------|
| <i>kalapée</i>                            | <i>a-sooh</i>        | <i>bxaaah</i> | <u><i>yó</i></u> |
| child                                     | FORMATIVE-be.sitting | tree          | <u>ON.TOP.OF</u> |
| ‘The child is sitting on the tree.’ (299) |                      |               |                  |

- (8) Grammaticalized applicative occurrence of the adposition:  
*bxaah*      *kalapée*      *yó*      *sooh*  
 tree          child              ON.TOP.OF [APP]      be.sitting (299)  
*bxaah*      *kalapée*      *ya-sooh*  
 tree          child              ON.TOP.OF.[APP]-be.sitting  
 'The child is sitting on the tree.' (300)

But there are also adpositions in Nadëb, like the one in 9, which do not have a simple main clause applicative use corresponding to that in 8 (note the unacceptability of 10). Instead, such adpositions can *only* be found as applicatives which allow relativization on an appropriate oblique object, as in 11.

- (9) Non-applicative occurrence of a different adposition:  
*ée*      *a-gú*                                      *tób*      *bú*  
 father    FORMATIVE-be.in.hammock      house    ABLATIVE  
 'My father is in the house.' (305)
- (10) Ungrammaticality of corresponding applicative in a main clause:  
 \**tób*      *ée*                      *ba-gú*  
 house          father                      ABLATIVE [LOC APP]-be.in.hammock  
 'My father is in the house.' (305)
- (11) The same applicative *allowed* in a relative clause:  
*ée*                      *ba-gú*                                      *doo*  
 father              ABLATIVE [LOC APP]-be.in.hammock      THE.ONE  
 'the one in which my father is' (305)

Nadëb applicatives like the one in 11 presumably had a main clause use (like the one in 8), but have come to be restricted to relative clauses, where they indicate relativization on an oblique.

**2.2. KALKATUNGU: APPLICATIVE > RELATIVIZER/SUBORDINATOR.** A similar development is seen in the Australian language Kalkatungu. What Blake 1977 describes as an instrumental applicative is almost always found in subordinate clauses, as seen in 12.

- (12) Applicative restricted to a subordinate clause:  
*ŋa-tu*    *ŋini*    *kunka*    *aŋa*    *tuku-u*                      *a-ni*                      *lai-manti*  
 I-ERG YOU    stick    gave    dog-DAT                      COMP-YOU                      hit-INST APP  
 'I gave you a stick to hit the dog with.' (Blake 1977:50)

Like the applicative in Nadëb, the instrumental applicative in Kalkatungu was presumably once widespread in main clauses; however, it is now used almost exclusively in subordinate clauses.

**2.3. CHICHEWA: APPLICATIVE > TOPICALIZER.** A less commonly attested development is the one seen in 13a and b for one of the dialects of Chichewa. Here, a simple main clause use of one of the language's instrumental applicatives is impossible, as indicated in 13a. The instrumental applicative morphology must always be accompanied by the passive morphology (13b), so that, in effect, the applicative has been reanalyzed as part of a kind of complex instrument-topicalizer.

(13) Applicative restricted to use with passive:

- a. \**Joni a-ma-lemb-ets-a* peni  
 John HE-HABIT-write-INST APP-INDIC pen  
 'John writes with a pen.' (Trithart 1976:58)
- b. *khasu li-ma-lim-its-idw-a* ndi Joni  
 hoe IT-HABIT-farm-INST APP-PASS-INDIC BY John  
 'The hoe is farmed with by John.' (57)

This instrumental applicative must have once occurred in non-passive clauses (as it still does in other Bantu languages with cognate instrumental applicative morphology), but has now been restricted to cooccurrence with the passive, i.e. to where there is topicalization of the instrument.

#### 2.4. MAYAN: APPLICATIVE > RELATIVIZER/FOCUS CONSTRUCTION MARKER.

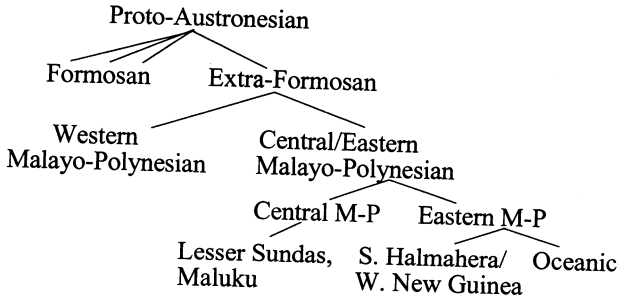
In Western Mayan, there is a benefactive applicative construction (Aissen 1983). In the Mamean and Quichean languages of the *Eastern* branch of the family it is likely that the benefactive applicative use of this morphology found in Western Mayan languages previously existed. Dayley notes that in Tzutujil, for instance, non-productive uses of the cognate morphology have semantics "reminiscent of the dative or referential voice found in Western Mayan languages" (1985:124). The productive use of the applicative morphology in the Eastern part of the family, though, is not the marking of benefactive applicative constructions, but the marking of *instrumental* applicative constructions.

Norman 1978 has shown, however, that in many languages in this part of the family (e.g. in Quiché), this instrumental applicative is not found in main clauses. I do not have space to repeat his examples here, but he demonstrates that the applicative construction requires either concomitant relativization on the applicative object, focusing of the applicative object, or questioning of the applicative object. These last two constructions essentially require relativization. The point is that in this part of Mayan, what was presumably once a productive main clause applicative is now restricted to relative clauses and related contexts.

2.5. SUMMARY. We have seen in this section that applicative markers typically develop from either adpositional or verbal morphology. When they cease to be main clause applicative markers, they tend to develop into markers of constructions which indicate the high topicality of obliques. In particular, they evolve into markers of oblique relativization.

3. VERBAL MORPHOLOGY IN AUSTRONESIAN. In this section I look at how the evolutionary tendency seen for applicative constructions in the preceding section may be of relevance to us in accounting for the development of reconstructed Proto-Austronesian verbal morphology. Figure 1 (following Pawley and Ross 1993 and Ross 1995b) gives the higher order subgroupings for the family.

FIGURE 1. AUSTRONESIAN SUBGROUPING



In the discussion below, following Pawley and Reid 1980, I divide the languages into two groups. One type, including the Formosan languages and, to a greater or lesser degree, the Western Malayo-Polynesian languages, is made up of languages which exhibit variations on the well-known "focus" system. The second group includes Austronesian languages in which this system is absent.

**3.1. THE "FOCUS" SYSTEM.** The focus system comprises a complex array of verbal morphology indicating the semantic role of one of the arguments appearing in a clause. This argument (traditionally called, confusingly enough, the "topic") has special properties. In terms of morphosyntax, it often appears with a special preposed particle and is uniquely accessible to certain constructions, such as relativization. In terms of discourse, it is usually definite. This system is well-known, but I will illustrate it here with some familiar Tagalog examples.

Beginning with the morphology which is most relevant for my purposes, in the Tagalog example in 14, the verb has a suffix *-an*, and topic properties are associated with the location argument. Note that the location argument occurs as the object of the topic particle *ang* and that it is definite. Moreover, if we tried to relativize on any argument in 14, only the location would be accessible.

(14) Location topic:

*d<-in->alh-an*                      *ng*   *lalake*   *ng*   *isda*   *ang*   *bata*  
 <PERF->bring-LOC TOPIC    PREP   man   PREP   fish   TOPIC child  
 'The man brought some fish to the child.' (Foley 1976:110)

In 15, the verb has a prefix *i-*, which indicates that an instrument argument holds the topic properties.

(15) Instrument topic:

*i-p<-in->utol*                      *ng*   *lalake*   *ng*   *isda*   *ang*   *kutsilyo*  
 INST TOPIC<-PERF->cut PREP   man   PREP   fish   TOPIC knife  
 'The man cut some fish with the knife.' (112)

Depending on the language, either the location or instrument topic morphology may also indicate that a *benefactive* argument is the topic.

Tagalog also has verbal morphology for signaling that an agent or actor is topic (16a), or for indicating that a patient or undergoer is topic (16b, from Schachter 1976:495).

(16) a. Agent topic:  
*p<-um->asok sa bahay ang lalake*  
 <AGT TOPIC->enter PREP house TOPIC man  
 'The man entered the house.' (Foley 1976:106)

b. Patient topic:  
*aalis-in ng babae ang bigas sa sako*  
 WILL.take.out-PAT TOPIC PREP woman TOPIC rice PREP sack  
 'A/The woman will take the rice out of a/the sack for a/the child.'

Finally, a verb marked with the "perfective aspect" infix typically indicates that a patient is the topic (17).

(17) Perfective aspect (Patient topic):  
*b<-in->asag ng bata ang laruan ng tungkod*  
 <PERF->break PREP child TOPIC toy PREP cane  
 'The child broke the toy with the cane.' (Foley 1976:108)

Combinations of one of the affixes in 14-16a and the perfective aspect infix signify an action in the past which has a non-patient entity as its topic.

Of course, I do not claim to have described all of the intricacies of the focus system here. In particular, there is much more morphology to the Formosan/Philippine verb. There are also limitations on which focus morphology a particular stem may occur with. Finally, Tagalog is not itself the most representative of the languages with a system of this sort. The purpose of citing these examples is simply to introduce the morphology and to demonstrate its verbal function.

The use of the term *applicative* to describe the location and the instrument topic constructions has been gaining some currency in the literature on Austronesian languages. Mithun 1994, for instance, describes the location and instrument topic morphology as applicative markers, and their status as such is implicit in Gerds 1992. If one adopts a view of Formosan/Philippine syntax as essentially ergative (as argued for by Gerds 1988 and many others), this applicative characterization of the location and instrument topic constructions is straightforward. In an ergatively aligned language, the role of an applicative construction is to place an oblique in the absolutive relation. This is just what the location and instrument topic markers do, since, on an ergative analysis, the Formosan/Philippine topic corresponds to the absolutive relation.

**3.2. OCEANIC REFLEXES.** Because the morphology in 14 and 15 is found in multiple Formosan branches and also widely in Western Malayo-Polynesian, it is generally reconstructed to Proto-Austronesian, as we will see below. Here I will be concerned primarily with the instrument and location topic morphology.

The notable reflexes of this morphology outside of Western Malayo-Polynesian are in Oceanic instrument and location nominalizations (Pawley and Reid 1980:110). 18 shows reflexes of the instrument morphology, and 19 shows reflexes of the location morphology.

(18) a. Sa'a (South-East Solomon, Ivens 1918:143):  
*käu* 'to hook' *i-keu* 'a hook for gathering fruit'  
*dänu* 'to bale' *i-denu* 'a baler'

b. Mota (Remote Oceanic, Codrington 1885:262):

*sar* 'to pierce'                      *i-sar* 'a spear'  
*got* 'to cut'                            *i-got* 'a cutter'  
*ras* 'to bale'                            *i-ras* 'a baler'

c. Boumaa Fijian (Remote Oceanic, Dixon 1988:192):

*sele* 'cut, slice'                      *i-sele* 'knife'  
*cula* 'pierce'                         *i-cula* 'needle'  
*'aba* 'climb steep surface'        *i-'aba'aba* 'ladder'

(19) Roviana (Western Oceanic, Ray 1926:545):

*habotu* 'to sit'                        *habohabotu-ana* 'sitting places'  
*sigoto* 'to anchor'                 *sigoto-ana* 'anchorage'  
*huvehuve* 'to bathe'               *huvehuve-ana* 'bathing place'

The Central/Eastern Oceanic reflexes for the location morphology are not as obvious as the Western Oceanic reflexes in terms of their semantics (see 20). Here, the morphology has been reinterpreted as an abstract nominalizer.

(20) a. Baki (Remote Oceanic, Ray 1926:246):

*ili* 'say'                                 *ili-an* 'speech'  
*monea* 'believe'                    *monea-n* 'faith'  
*maro* 'die'                             *na mar-ian* 'death'

b. Inakona (South-East Solomonian, Capell 1930:114):

*dona* 'to know'                       *dodon-ana* 'knowledge'  
*dou* 'good'                            *dou-ana* 'goodness'  
*vaulu* 'new'                           *vaulu-na* 'newness'

4. THE EVOLUTION OF PROTO-AUSTRONESIAN MORPHOSYNTAX. Both Wolff 1973 and Ross 1995a reconstruct the proto-paradigm shown in Figure 2 for Proto-Austronesian.

FIGURE 2. PROTO-AUSTRONESIAN VERB MORPHOLOGY

Indicative	Actor voice	Undergoer voice	Location voice
Neutral aspect	*<um>	*-ən	*-an
Perfective aspect	*<um-in>	*<in>	*<in> -an

Non-Indicative	Actor voice	Undergoer voice	Location voice
Atemporal	*∅	*-u	*-i
Projective	*<um> -a	*-a-u	*-a-i

The morphology in the indicative portion of the paradigm should by now be familiar. The non-indicative is apparently the remains of an earlier system for marking grammatical relations which the reconstructed indicative has replaced. The evidence for the non-indicative is found mostly in imperatives and some subordinate clause forms. In addition, a third 'durative' aspect in the indicative, involving reduplication of the neutral aspect form, is posited, but I have omitted it here for ease of exposition. It may be noted that the instrument topic morphology is missing from this paradigm, an issue to which I will return below.

The standard account of the indicative portion of this system (Ross 1995a, following Starosta, Pawley, and Reid 1982), is that the basic Pre-Proto-

Austronesian use of this morphology was *nominalizing*; perfective, patient, location and, in some cases, instrument nominalizations were reanalyzed as finite forms as a “strategy of diathesis” (Ross 1995a:753). In other words, the claim is that the pre-*proto-language* took these three or four nominalizations and made them into finite forms in order to make voice distinctions.

While I think this account may be justifiable in terms of the perfective and undergoer topic forms, I do not think that it is a likely route of development for the location and instrument topic forms. The alternative which I propose is that the location and instrument topic morphology in Proto-Austronesian arose via normal applicative grammaticalization routes and *not* from reanalysis of nominalizations as finite forms. The location topic morphology presumably came from a preposition, given its postverbal position in a verb-initial language. The instrument topic morphology probably came from an auxiliary; a good candidate is the reconstructed verbalizing element \**Si-*, which meant something like ‘have, possess, wear N’ (Ross 1995a:758).

One of the uses for this morphology in Austronesian languages which retain it is for forming relative clauses on peripheral objects. For example, in the Formosan language Bunun (Jeng 1977:185-6), we see that relativization on a location and an instrument requires use of the location topic (21a) and instrument topic (21b) forms in the relative clause.

(21) a. Relativization on location:

*m-unhaʔan sak sia [ba-baliv-an sanglav]*  
 AGT TOPIC-go to I the one RED-buy-LOC TOP vegetable  
 ‘I (am) going to the place where vegetables (are) frequently bought.’  
 ‘I (am) going to the market.’

b. Relativization on instrument:

*ʔukaʔ a sui [is-baliv δaku hulus]*  
 none NM money INST TOPIC-buy me clothes  
 ‘(There is) no money which (is to be) used by me to buy clothes.’

Now, a productive means of relativization like this could have easily been reinterpreted as nominalization, in particular if the relative clause was headless. It is likely that a nominalizing function had developed alongside the main clause use in Proto-Austronesian before its breakup, given that the focus morphology has a nominalizing function throughout the family.

We saw in section 2 that it is not uncommon for applicative morphology to become restricted to subordinate clauses, especially relative clauses. By, at latest, Pre-Proto-Oceanic, then, the applicative morphology was first restricted to relative clauses, and then it was reanalyzed as strictly nominalizing. In 22a and b, I show how this type of reanalysis of applicative morphology could have occurred using some modern forms.

(22) a. Roviana:

*habotu* ‘to sit’                    *habohabotu-ana* ‘where one sits’ > ‘sitting place(s)’  
*sigoto* ‘to anchor’                *sigoto-ana* ‘where one anchors’ > ‘anchorage’  
*huvehuve* ‘to bathe’                *huvehuve-ana* ‘where one bathes’ > ‘bathing place’

b. Boumaa Fijian:

*sele* 'cut, slice'

*cula* 'pierce'

*'aba* 'climb steep surface'

*i-sele* 'what one cuts with' > 'knife'

*i-cula* 'what one pierces with' > 'needle'

*i-'aba'aba* 'what one climbs with' > 'ladder'

Concerning the instrument topic forms, Ross 1995a concludes that there is not sufficient representation of the verbal use of the instrument topic prefix to reconstruct this function of the morphology to Proto-Austronesian. It is found widely in nominalizations, however. His account of this state of affairs is that the main clause use of the instrument topic morphology had not arisen at the Proto-Austronesian stage, but that after the breakup of the proto-language, its main clause use developed independently in the languages which have it (756-760).

Independent development is also compatible with the account suggested here, but an alternative is that the verbal use of the instrument topic morphology is archaic, and the reason that nominalizations are more widely found than main clause uses is that it has become reanalyzed as a nominalizer from its relativization use even in otherwise more conservative languages. Instrumental applicatives in particular, if the available examples of applicative development serve as any indication, have a propensity for losing their main clause applicative status and becoming trapped in subordinate clauses. Difficulties in reconstructing the vocalism of the instrument topic element to Proto-Austronesian, however, may speak against this interpretation.

**5. CONCLUSION.** The standard account is probably correct for the patient and perfective forms, which in turn may account for the development of Proto-Austronesian ergativity. Aside from the development of ergativity, nominalizations are commonly reanalyzed as finite forms (see Matisoff 1972, for example, for some Sino-Tibetan cases). However, I know of no cases in which this type of reanalysis ends up making the diathesis distinctions that are relevant in the standard nominalization > finite form account of the Proto-Austronesian verbal system. There is at least as much precedent for the account I have proposed here as there is for the standard one, and in the interest of stimulating further investigation into the matter and into the diachrony of voice systems in general, I cast my vote for a normal applicative origin for the location and instrument topic morphology.

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