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Counting systems of the Strickland-Bosavi languages, Papua New Guinea¹

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Abstract

Information on the counting systems of 12 East Strickland and Bosavi languages is collated. In seven cases the body-part tally system is symmetrical, with cycle lengths varying from 27 to 35. In four cases, the tally system is asymmetrical or truncated and in one case detailed information is not available. Methods of counting beyond one cycle have been described for all but one of the Bosavi languages but not for any of the East Strickland languages. An additional 2-cycle or 2, 5-cycle system is indicated for several East Strickland languages but not for any Bosavi language. Comparison with the counting systems of languages beyond the Strickland-Bosavi region – especially with Ok languages to the northwest and Huli to the northeast – suggests a process in which the terminology of body-part tally systems is progressively disembedded from bodily commitment such that counting words assume the status of cardinal numbers and, thereby, facilitate expressions of the commensurability of difference.

1. Introduction

The traditional counting systems of Papua New Guinea are very diverse. Many have been at least superficially described (Franklin and Franklin 1962, Wolfers 1972, Laycock 1975, Smith 1988, Lean 1992, Owens 2001, Rauff 2003) and, in some cases, they are known to have great practical, intellectual or cosmological significance in people's lives (e.g. Biersack 1982, Mimica 1988, Evans 2009; cf. Pospisil 1972). To go beyond documenting and classifying systems, however, and seek some understanding of how the diversity observed may have arisen and systems themselves changed, more detailed comparison of counting systems is needed. But that comparison must also be ethnographically informed. In this paper we present data on counting systems from a cohort of closely related languages in the Strickland-Bosavi region, an area on which much ethnographic research has been published but little information about counting previously collated. Based on

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comparison of those systems, and others further afield, we offer interpretations concerning processes of change in counting systems.

2. Background

Lean (1991a,b,c, 1992) collated and analysed information on the counting systems of 539 Papua New Guinea languages (351 Papuan, 188 Austronesian) though, in many cases, available information was meagre. He classed the vast majority as 'cyclic'. In many, for example, the words for numbers higher than 2 are derived from those for 1 and 2 (i.e. 1, 2, 2+1, 2+2, 2+2+1, etc) or there are words for 1, 2 and 5 (the last often a 'hand' morpheme) and the count proceeds as 1, 2, 2+1, 2+2, 5, 5+1, 5+2, etc. He named such systems, respectively, 2-cycle and 2, 5-cycle systems. Other variants occur (e.g. 2, 5, 20-; 5, 20-; 4-; and 6-cycle systems; Lean 1992, Owens 2001: 50). Digits, hands, feet and bodies often serve as mnemonics in these systems of cyclic counting and 5, 20-cycle and 2, 5, 20-cycle systems, in which fingers and toes are tallied and 'person' or 'man' is taken as the morpheme for 20, are treated as digit tally systems.

A minority of Papua New Guinean counting systems – about 15 percent of those considered by Lean (see 'Table of Counting Systems' available at http://www.uog.ac.pg/glec/counting_sys/t-counting_sys/t-counting_sys.htm, accessed 8 January 2016) – qualify as body-part tally systems. In these, the tally usually starts with the little finger of one hand, and proceeds via fingers and points on the arm, neck and head (or breast and sternum) before continuing in reverse order on the other side of the body. In most cases there is a unique mid-point (often the nose) on the vertical axis of the body. Multiple tally points on the mid-line and tally points below the navel are not common. However, Wassman and Dasen (1994) report that the elaborate body-part tally system of Yupno-speakers (on the border of Madang and Morobe Provinces) includes three mid-line points (nose, navel and penis) as well as points below the navel (toes, testicles and penis). Lean observed cycle length in 40 of these systems to vary from 18 to as high as 68 (Chapter 2: Table 12; Rauff, 2003:8, gives a range of 12 to 74 for a sample of 42 languages). On the New Guinea mainland, body-part tally systems are found in Papuan languages but not in Austronesian languages (Lean 1992: Chapter 2.5).

In some Papua New Guinea languages, especially in the east (e.g. Bougainville, New Britain, Milne Bay) the number morpheme alters with the class of objects that is being counted (Owens 2001: 52, Rauff 2003: 3). In many, tally counting words are modified when associated with a noun to express quantity; that is, they are modified to generate cardinal numbers (e.g. Cheetham 1978, Franklin 2012). It is of note too that in many languages at least two counting systems co-occur (e.g. a 2-cycle system and a body-part tally system) or a single system may be a hybrid (e.g. number words from a 2-cycle system are incorporated into a body-part tally system). And, finally, the description of these counting systems in terms of cycle length carries the implicit assumption that they do indeed cycle and, theoretically, as demonstrated in the Yagwoia (Iqwaye) case by Mimica (1988), could continue to infinity. There are relatively few cases, however, in which cycling beyond an initial base number – e.g. the terminus of a body-part tally – has been empirically confirmed.

Figures 1 and 2 map the distribution, within New Guinea, of 2-cycle and body-part tally systems. On both maps we direct attention to the area occupied by Trans-New Guinea languages of the closely related Bosavi and East Strickland families.² These are the focus of the present paper. The

² Ross, 2005, treats Trans-New Guinea languages as a family and downgrades Bosavi and East Strickland languages to subgroups within that family.

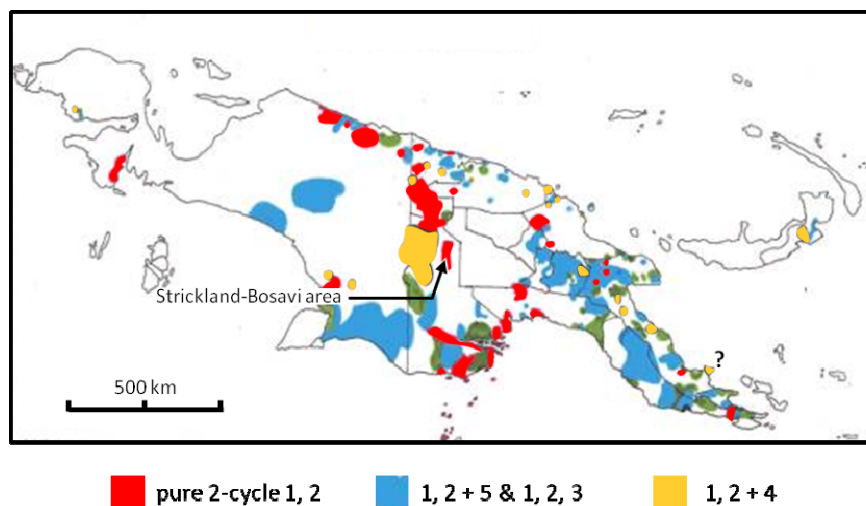


Fig. 1: Distribution of 2-cycle counting systems in New Guinea, showing variants (after Lean 1992, Chapter 2, Map 6).

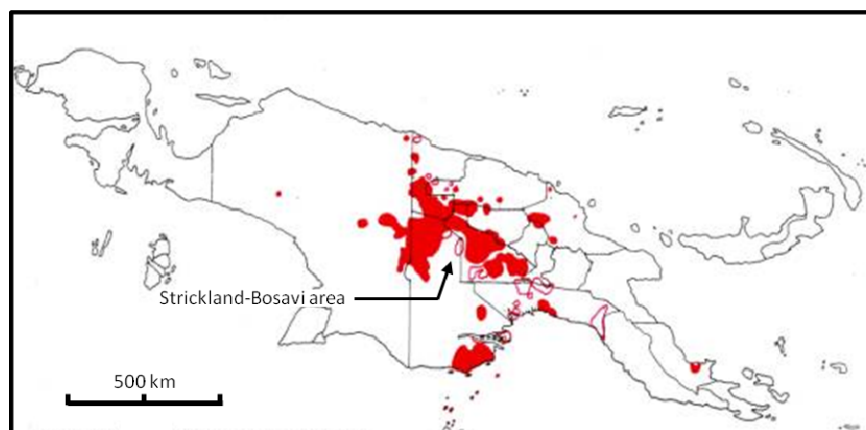


Fig. 2: Distribution of body-part tally counting systems in New Guinea (after Lean 1992, Chapter 2, Map 7).

Bosavi family includes Edolo, Bedamuni, Onobasulu, Kaluli, Sonia, Eibela and Kasua and the East Strickland family includes at least Konai, Febi, Kubo, Samo, Gobasi and Odoodee with some authors including Honibo and Oybae as separate languages to the southwest of Nomad.³ Population sizes of these language groups vary from less than 500 (e.g. Febi and Eibela) to reach 4,000 (Kaluli) and around 10,000 (Bedamuni). With the exception of Eibela, population sizes are larger for Bosavi language groups than for East Strickland language groups. Kelly (1993) brings together a great deal of information on the ethnography of the Strickland-Bosavi language groups.

Of the languages listed above, Lean (1991a,b) had access to very limited information – a few patchy word lists in the archives of the Summer Institute of Linguistics – for Bedamuni, Kaluli, Kasua,

³ Different authors, both past and present, recognise different language groups in this region and many different names continue to be found in the literature. Hesif, Honibo, Kabasi and Oybae are not listed by the Summer Institute of Linguistics (<http://www-01.sil.org/pacific/png>); Ethnologue lists Honibo and Oybae as dialects of Gobasi and Hesif (Tulusi) as an Odoodee village. Kabasi (Shaw 1986: 46; Knauft 1985: 6-11) continues to have currency (Knauft 2013) but is now probably also accommodated within Odoodee. Sonia is closely related to Kaluli and considered to be a “dying” language (Grosch and Grosch 2000: 2). Dibiyaso (Bainapi) has been treated as a member of the Bosavi family though it is south of Kamula and not geographically contiguous with any other language in this family (Reesink 1976; Shaw 1986; Hammarström 2010a: 196). No information is available on the counting systems of Sonia or Dibiyaso. We treat Edolo and Bedamuni as discrete languages rather than as dialects and we treat Kubo, Samo and Gebusi in the same way. Our judgements here are based on the perspectives of local people rather than on lexicostatistical analysis.

Febi, Konai, Kubo, Samo and Honibo. He treated the last three as dialects of a language named as Nomad. He did not detect a ‘hand’ morpheme in the few available counting words for any of these languages and, in each case, while stressing the need for more work, speculated that they would have a body-part tally system. In two cases (Samo and Honibo) he considered that there was some evidence of a 2-cycle counting system. Available data on the counting systems of people who speak East Strickland and Bosavi languages is now much more extensive though, to date, it remains dispersed and lacks synthesis. In this paper we bring that information together.

Figure 3 shows the distribution of language groups from the Strickland-Bosavi area that are discussed in the present paper. Table 1, based on Shaw (1986), shows relationships between 12 of those languages using estimates of shared vocabulary. The extent of sharing increased between 1971 and 1981 (Shaw 1973, 1986).

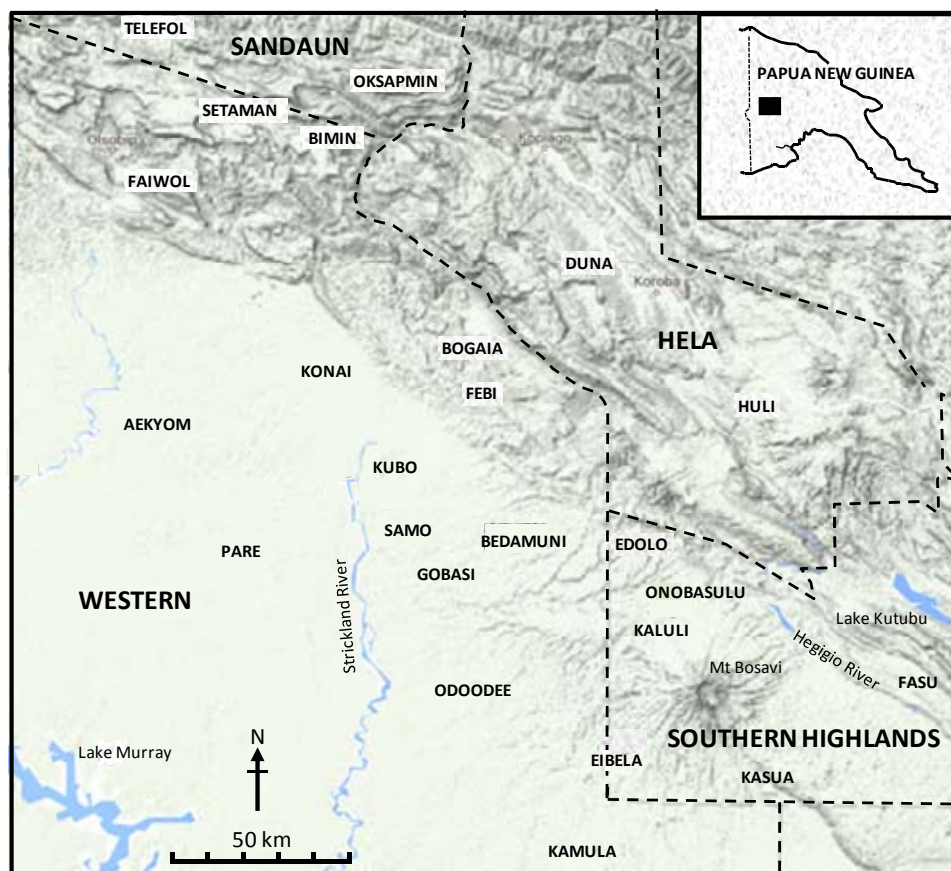


Fig. 3: Map of Strickland-Bosavi area showing distribution of Strickland-Bosavi and some neighbouring languages. Small capitals name languages; large capitals name Provinces.

Language chaining is prominent throughout the Strickland-Bosavi area with high levels of mutual intelligibility between neighbouring languages of the same family (Shaw 1973, Gossner 2010). Shaw (1973) considered Bosavi languages to be lexically more diverse than East Strickland languages and suggested a close relationship between some Bosavi languages and Fasu (West Kutubu family), in the Lake Kutubu area, to the east. Based on the data in Table 1 the averages for shared vocabulary in the Bosavi and East Strickland languages are, respectively, 52.1 percent and 69.8 percent; the former appear to be less closely related than the latter.

With respect to definitions we follow Mengden (2010: 12-71; see also Crump 1990: 6-11). Thus, ‘counting words’ are those that are used when a counting sequence is recited (e.g. the names of

Table 1: Comparison of some East Strickland and Bosavi languages based on percent shared basic vocabulary in 1981 (after Shaw 1986: 53).¹

EAST STRICKLAND LANGUAGES						BOSAVI LANGUAGES					
KONAI											
67	FEBI										
63	78	KUBO									
59	72	90	SAMO								
53.3	70	77.3	89.3	GOBASI							
48.5	58	62.5	70	69.5	ODOODEE						
26	29	32	36	39	35	BEDAMUNI					
28	28	26	34	37.7	38	67	EDOLO				
25	31	27	31	35.3	35.5	52	58	ONOBASULU			
30	32	34	36	38	43	46	48	64	KALULI		
33	39	41	44	43	47	41	42	47	61	EIBELA	
25	25	26	30	31	31	38	41	52	64	61	KASUA

¹ Shaw names Febi as Agala, Gobasi as Bibo, Odoodee as Kalamo, Bedamuni as Bedamini, Edolo as Etoro and Eibela as Aimele. For Gobasi we have averaged Shaw's values for Bibo, Honibo and Oibae; for Odoodee we have averaged Shaw's values for Kalamo and Hesif.

body parts in a body-part tally system). They are non-referential; they are defined only by being in a fixed order in relation to each other. 'Counting words' may be modified (lexically or by context) to form 'numerals' or 'numbers'. 'Numerals' are the well-distinguished elements of an ordered sequence (e.g. body parts, graphic symbols, knots, etc.) that instantiate numbers. They are used to specify the cardinality of a set (i.e. the size of a set measured by the number of its elements); they are referential and potentially, though not practically, infinite. 'Cardinal numbers', which may be expressed as counting words, as numerals or as modified numerals, are abstracted from the ordered sequence of numerals. They provide a means whereby sets of things such as five people, five pigs and five pearl shells may be understood as commensurate because they share the common property of containing five elements; they share their cardinality. Like counting words, cardinal numbers are non-referential. The lexical expressions that characterize 2-cycle, and similar, counting systems in Papua New Guinea – composite or not – facilitate expressions of commensurability, and hereafter are accepted as cardinal numbers.⁴

We have accessed information from the Trans New Guinea languages numeral data-base (<https://mpi-lingweb.shh.mpg.de/numeral/Trans-New%20Guinea.htm>) that is compiled by Eugene Chan and hosted by the Max Planck Institute. However, we have detected some errors of both transcription and recording and, where possible and as indicated in referencing that follows, have sought independent confirmation from relevant linguists or literature. We note also that it is commonly assumed that the names for numerals in a body-part tally system are, sometimes with the exception of fingers, the names of the indicated body part. The association of a named body part with number reflects a judgement by the person recording the counting system with respect to the name appropriate to the part of the body that has been touched or otherwise indicated. This is not always correct. For example, in the Bosavi languages, 'collar bone' is often recorded as the name

⁴ Hammarström (2010b: 12) wrote that "typically, body-tally systems are only used in special circumstances, such as bridal price negotiations, and in other cases you would use a different numeral system or not use exact enumeration at all. ... Body-tallying has to be done on a physically present person and to understand what number is referred to the process must be watched, so, for instance, body-tallying numerals would be infelicitous when it is dark". Hammarström did not include body-part tally names under his definition of numerals. Neither Edolo nor Kubo confined body-part tallying to special occasions. The former took pleasure in counting objects, the latter frequently counted small collections of objects. Edolo, and probably people of at least some other Bosavi languages, often counted without indicating the named body part and, hence, could certainly communicate 'number' in the dark.

associated with a particular indicated body part though, in fact, the ‘collar bone’ itself is never touched. Different recorders may make different judgements about the name appropriate to the body part that has been indicated. Further, the name that people give when indicating a particular counting word is not necessarily the name of the part of the body that they indicate. For example, in the Edolo case, *giwi* is the ninth counting word and is indicated by touching the skin at approximately the medial position of the collar bone but *giwi* is, in fact, the generic word for bone and not a specific referent to collar bone. Similarly, in the Konai case *dio* is the seventh counting word and is indicated by touching the lower arm but, like *giwi* in the Edolo case, *dio* is the generic word for bone.

In what follows we first deal with languages of the Bosavi family, then languages of the East Strickland family and, finally, provide a comparative perspective in which, initially, we make comparisons between languages within the Strickland-Bosavi set and then extend our comparative remarks to languages of neighbouring groups. Orthography is that used by authors of the documents cited. It is highly variable.

3. Bosavi languages

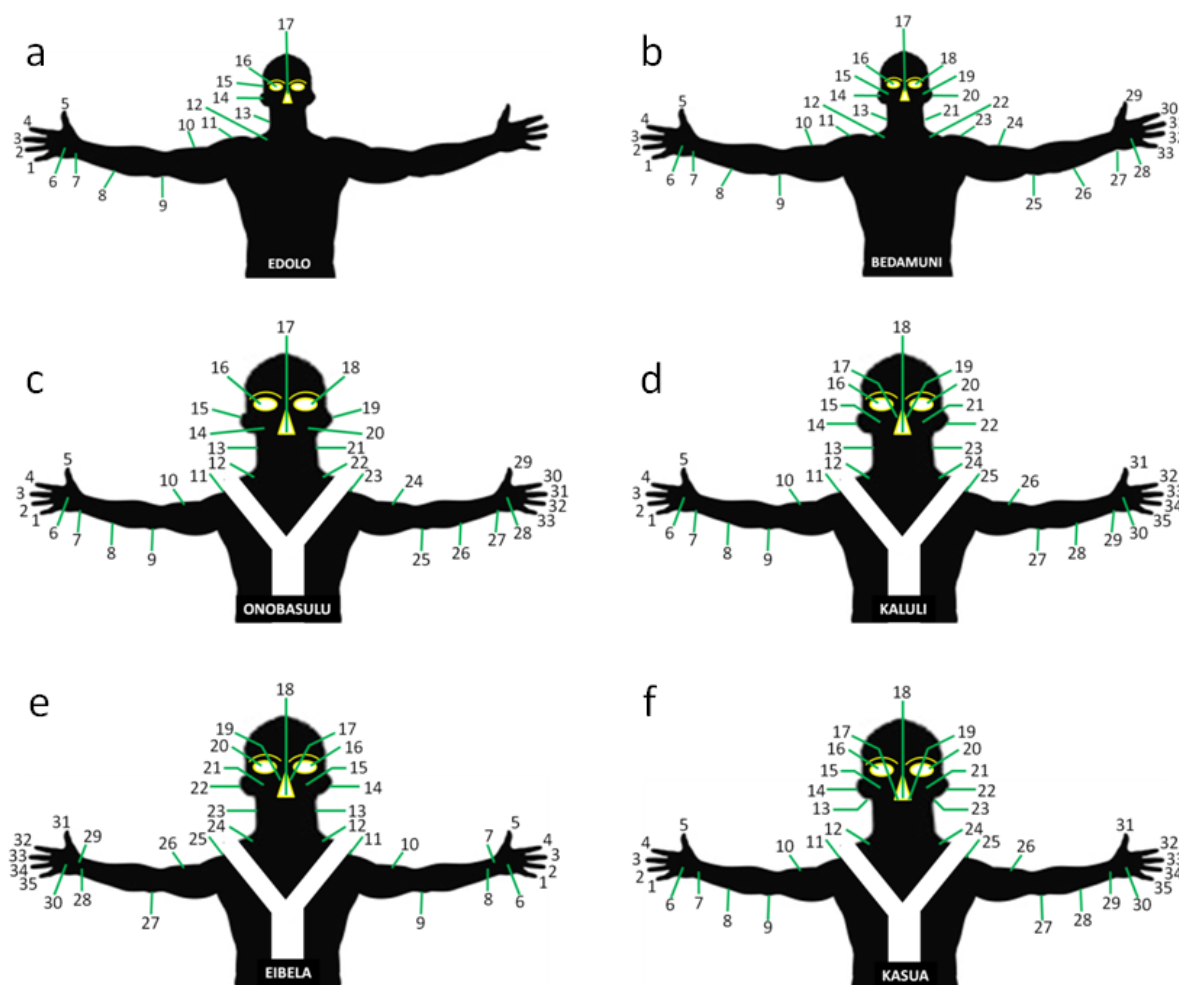


Fig. 4: Body-part tally systems of Bosavi languages. Edolo based on Dwyer (Table 2), Bedamuni based on Hoey (Table 5), Onobasulu based on Stoppels-Dondorp (Table 7), Kaluli based on Grosh (Table 8), Eibela based on Aiton (Table 9) and Kasua based on Logan (Table 10).

3.1 Edolo (Duguba, Etolo, Etoro, Kaumifi, ETR)

The counting system of Edolo was recorded by non-linguist Peter Dwyer (1990: 225-26, 228) at the village of Bobole during 15 months in 1979-80 and by linguist Jan Gossner (1994: 77-80, 2010, *pers. comm.* 7-20 January 2016) at the village of Aya during 15 months between 1990 and 1993. Bobole is located in the extreme northeast of Edolo territory, a day's walk to the land of Huli-speaking people (Fig. 3); Aya is located toward the west of Edolo territory less than 10 km from the land of Bedamuni-speakers. Both villages are within the eastern section of Edolo-speakers where "the average percentage of apparent cognates" between villages "is about 93" (Gossner 1994: 6).

Edolo employ a body-part tally system that commences with the right little finger, progresses to the thumb and then via the palm and wrist to the nose (Table 2, Fig. 4a).⁵ Gossner (1994: 79) notes that "the same body-part terms for one through seven are used for the foot and ankle when preceded by the word *emo* 'leg' but these are not used in counting". This implies that the counting words associated with fingers (including thumb) are, in fact, the names of those body-parts. Further, the inside toe in cassowaries has a dagger-like claw and Edolo name this toe *wida* (cassowary) *age*. Most of the other counting words are either the names of the indicated body-parts or, in the case of 17, incorporate the name of the relevant body-part (i.e. *mi* [nose] becomes *mimogo*).

Table 2: Body-part tally system of Edolo-speakers. Gossner used a tilde diacritic to mark nasalization of vowels; Dwyer used 'n' in cases where he detected nasalization. Spelling under J. Gossner follows Gossner (1994).

P. Dwyer		Body-part indicated		J. Gossner	
Bobole village		P. Dwyer	J. Gossner	Aya village	
		tally commences on right hand			
1	<i>age</i>	little finger	little finger	<i>age</i>	1
2	<i>agedu</i>	ring finger	ring finger	<i>agedu</i>	2
3	<i>asota</i>	middle finger	middle finger	<i>osoda</i>	3
4	<i>piadu</i>	index finger	index finger	<i>biidu</i>	4
5	<i>pi</i>	thumb	thumb	<i>bi</i>	5
6	<i>gafe</i>	palm	palm	<i>gafe</i>	6
7	<i>gafotanu</i>	wrist (ventral)	wrist	<i>gifalādalū</i>	7
8	<i>goton</i>	lower arm (ventral)	forearm	<i>gōdō</i>	8
9	<i>segen</i>	inner elbow	elbow	<i>sēgē</i>	9
10	<i>nabun</i>	upper arm, bicep	upper arm	<i>nabū</i>	10
11	<i>gita</i>	shoulder (laterad)	shoulder	<i>gīda</i>	11
12	<i>giwi</i>	jn. of clavicle with neck	(collar) bone	<i>giwi</i>	12
13	<i>garon</i>	neck ¹	side of neck	<i>galo</i>	13
14	<i>gehe</i>	ear, lower lobe	ear	<i>gēhē</i>	14
15	<i>pa</i>	temple ²	cheek	<i>ba</i>	15
16	<i>si</i>	eye	eye	<i>si</i>	16
17	<i>mimogo</i>	tip of nose	nose	<i>mimogo</i>	17

¹ Usually indicated by placing fingers around front of neck; less often by touching side of neck.

² Either the temple or 'high cheek' (zygomatic bone) was indicated.

⁵ In some accounts of Papua New Guinea body-part tally systems observers state or imply that the 'start side' is invariant. In other accounts there is much within-language variation in the 'start side'. In the first case, 'left' and 'right' may be associated with gender or 'purity' (e.g. Mimica 1988: 65-67). In the second case, handedness may influence choice of start side (e.g. Franklin 2012: 37). Within-language variation in 'start side' has been observed in a number of Strickland-Bosavi languages but left-right symbolism has not been reported.

At Bobole, Dwyer recorded one variant of the above system (Table 3) in which 14 and 15 were marked by different positions on the ear with the latter replacing the temple (*pa*).

Table 3: A variant of the Edolo body-part tally system

	Edolo name	Body-part indicated
1-13	as in Table 2	as in Table 2
14	<i>gehe</i>	right ear, lower lobe
15	<i>amale gehe</i>	right ear, upper lobe (behind the ear)
16	<i>amale si</i>	right eye
17	<i>mimogo</i>	tip of nose

With two exceptions the records of Dwyer and Gossner are the same. First, Dwyer recorded 15 (*pa*) as ‘temple’ or ‘high cheek’; Gossner recorded 15 (*ba*) as ‘cheek’. Second, Dwyer considered that the body-part tally system qualified as a 17-cycle system because, after the nose, the count did not continue on the other side of the body. Gossner considered that, after the nose, the count did continue on the other side of the body to finish at the little finger of the left hand. He wrote that “in counting down the left side of the body in the traditional system the word *nai* is repeated before each of the numbers. *Nai* is apparently from *naiado* ‘opposite’” (1994: 78). He wrote also, however, that this gave a base of thirty-four and, in support of this assertion, referred to Ray Kelly’s account of an Edolo myth in which a prospective bride’s brother said “The marriage payment will be this many pigs [counting]: 34 once, 34 twice, 34 thrice, 34 fourfold, 34 fivefold in all, but no cowrie strings or pearl shells” (Kelly 1993: 200). However, a symmetrical body-part tally system that has a mid-point representing the odd number 17 will, in fact, have a base of 33 not 34. In an earlier work, Kelly (1977: 38, 213) reported that “seventeen smoked marsupials are required for reciprocal exchanges between a betrothed man and his prospective wife’s father” and observed that in about 1953 “an appropriate brideprice consisted of 17 items” (Kelly 1977: 215). The reference to 34 in the myth referred to by Gossner does not indicate the base of the Edolo counting system but, rather, should be read as two lots of seventeen. At Bobole in 1979-80 there was no occasion when a person was observed to employ both sides of the body when counting though on one occasion, at Namosado, which interacted often with Onobasulu to the south and included Onobasulu residents, a man was heard counting beyond 17 as follows: *age, agedu ... gehe, pa, si, mimogo* (17), *si* (18), *pa* (19), *gehe* (20), etc. No suffixes were added to the numbers after 17.⁶

At Bobole, in 1979-80, when counting beyond 17, Edolo proceeded as follows:⁷

<i>mimogo fisi afate</i>	$1 \times 17 = 17$
<i>mimogo fisi afate ie afate</i>	$1 \times 17 + 1 = 18$
... etc.	
<i>mimogo fisi auda</i>	$2 \times 17 = 34$
<i>mimogo fisi auda ie afate</i>	$2 \times 17 + 1 = 35$
... etc.	
<i>mimogo fisi hotowa</i>	$3 \times 17 = 51$
... etc.	
<i>mimogo fisi mimogolasi</i>	$17 \times 17 = 289$
<i>mimogo fisi mimogolasi ie afate</i>	$17 \times 17 + 1 = 290$
... etc.	

⁶ In 1968-69, Mary Pfender considered the counting system of Edolo people living at Gabulosado to be a 17-cycle system (R. Kelly pers. comm.). People living at Gabulosado subsequently relocated to Aya (Gossner 1994: 8).

⁷ Efala Babe provided the list of numbers beyond 17. He did so without touching body parts.

Gossner (1994: 79) wrote that “in counting large quantities the counting is ‘left off’ when the little finger of the left hand is reached and it starts over again on the right side. One complete cycle is called *fisi afäde* ‘leave-PAST one’, or ‘one leaving off’”. He provided no further details.

In the tabulation above, the words representing 1 (*afate*) and 2 (*auda*) differ from those shown in Table 2 (*age* and *agedu*). Following Gossner (1994: 79) these words qualify as ‘modifiers’ in that they are used to quantify nouns in responding to questions such as “how many [*abelaia*] people came?” or in expressions such as “*helebe afäde* ‘machete one’ or *sugua ohodoa* ‘pig three’”. The modifiers recorded at Bobole and Aya, respectively, are shown in Table 4; they are used to express cardinal numbers. At Bobole, above five the two systems converged. At Aya “when the numbers eight through seventeen are used as modifiers the suffix *-lasi* is attached to them as in *malö gödö-lasi* ‘child eight-total’” (Gossner 1994: 79).

Table 4: Noun modifiers recorded at the Edolo villages of Bobole and Aya

No.	Bobole	Aya	No.
1	<i>afate</i>	<i>afäde</i>	1
2	<i>auda</i>	<i>äüda</i>	2
3	<i>hotowa</i>	<i>ohodoa</i>	3
4	<i>bīdia</i>	<i>biidia</i>	4
5	<i>bia</i>	<i>biya</i>	5
		<i>gafea</i>	6
		<i>gifalädalia</i>	7
		<i>gödö-lasi</i>	8
		etc.	

In 1979-80, at Bobole, the Edolo counting system was being modified to both the Huli base 15 system and to the decimal system. When adapting the Edolo system to that of Huli it was usual that the terms *garon* (right side of neck) and *pa* (right temple) were dropped; occasionally *garon* was retained and *giwi* (junction of right clavicle with neck) was dropped instead. When adapting the Edolo system to decimal counting people used the standard Edolo counting words *age* (1) to *segen* (9) and then continued as follows:

- 10 *nabuna si afate*
 11 *nabuna si afate je afate*
 [see Table 2 for form of 12, 13, 14, etc.]
 20 *nabuna si auda*
 30 *nabuna si hotowa*
 etc.

Gossner reported that, at Aya, in the early 1990s there was some confusion with respect to the traditional counting system and that this led to uncertainty with respect to the base of the system. Some people at Aya asserted that two body-parts (either collar bone or side of neck and either ear or cheek) were not included in a “new” way of counting (1994: 77-78). Gossner attributed this confusion to the fact that the tally system based in body-parts had been modified as a decimal system and traditional numbers beyond 10 were seldom used. In fact, it probably reflected adaptation to the Huli system. In addition, tallying on both sides of the body at Aya may well be a recent borrowing from Bedamuni to the west.

In 1979-80, Edolo people at Bobole counted often and did so with pleasure (*ti demo* and *ni demo* are, respectively, “I count” and “you count” but, in 1979-80, were used also for “I read” and “you

read"). It is noteworthy that very often people counted in the 17-cycle system without recourse to touching body-parts. Though they prioritized their own 17-cycle system there were some people who could very rapidly convert from numbers such as 27 in a decimal system to its equivalent (*mimogo fisi afate ie nabun*) in the base 17 system. Younger men might do so when asked by an older man to translate a count that they had just made. Early in 1980 it was decided to clear land for a possible airstrip. It was first necessary to measure the airstrip at Komo, in Huli territory. This was achieved by borrowing Dwyer's 30 metre tape but, at the request of those who would make the measurement, only after the tape had been recalibrated to a base-17 system (Dwyer 1990: 228).

Gossner reported that the body-part counting system was used to indicate both days of the week and months (1994: 29, 79). In the first case, the days are numbered from one to seven and indicated using the locative *-gi* as in, for example, *afāde-gi* (Monday) and *gifalādalū-gi* (Friday). If, for example, a person knew that a particular event would occur in *x* days time, then starting with the present day (say 'middle finger' for Wednesday) he or she could count off the days from Wednesday always circling back from 'wrist' (Sunday) to 'little finger' (Monday) to determine the day of the week on which the event would take place. In the second case, the month of June, for example, would be expressed as *aube gafe-gi* 'moon six-locative'.

At Bobole, in 1979-80, there was a set of words that specified the number of days, up to four in either direction, from the present day (*walio*). These were *ayo*, (*ayo*) *gahata*, *amoi:e gahata* and *gamoi:e gahata* for, respectively, one, two, three and four 'days removed'. The words used were unrelated to body-part numerals, and tense of the main verb indicated direction (Gossner 1994: 21, 90). In addition, at Bobole, there were sets of terms that indicated the birth order of children born to a particular woman. These always commenced with *abulumi* for first child and, irrespective of the number of children, ended with *ufi toto fisi* for the last child. Again, the words used were unrelated to body-part numbers. *Ufi toto fisi*, however, refers to the fact that the mother's breasts are now dry and, hence, that this is the last child possible.

3.2 Bedamuni (Bedamini, Beami, Biami, BEO)

Bedamuni territory is west of, but contiguous with, Edolo territory (Fig. 3). Their counting system was recorded by the non-linguists Peter Dwyer and Monica Minnegal at the village of Ga:misi during two months in 1996-97 and by the missionaries-Bible translators Tom and Salome Hoey through a 25 year period when, based at Mougulu, they lived and worked with Bedamuni speakers (T. & S. Hoey n.d.a).

Bedamuni employ a body-part tally system that commences with the little finger, progresses to the thumb and then, via the wrist, to the nose from where it continues in reverse order down the other side of the body to end at the little finger of the other hand (Table 5, Fig. 4b). In most cases the words used as numerals, including those for fingers and thumb, appear to be the names of the indicated body-parts. This generates a 33-cycle system. T. & S. Hoey briefly indicate how Bedamuni move from one complete cycle to the next to express numbers greater than 33 (Table 5).

Details of the Bedamuni counting system recorded by Dwyer and Minnegal closely match those recorded by T. & S. Hoey and, indeed, to the count of 17 are very similar to the Edolo system. Dwyer and Minnegal record 17 as *mi* (nose or tip of nose); T. & S. Hoey record 17 as *halida* (nose) but in the Bedamuni dictionary give *mi* as an alternative for nose. The most notable difference between the two lists is that Dwyer and Minnegal associate 'temple', with 15 (*ba:*) while T. & S. Hoey associate

Table 5: Body-part tally system for Bedamuni-speakers

PD & MM		Body-part indicated		T & S Hoey	
Start on right side		PD & MM	T & S Hoey	Start side not specified	
1	<i>age</i>	little finger		<i>age</i>	1
2	<i>agedu</i>	ring finger		<i>agedu</i>	2
3	<i>asoda</i>	middle finger		<i>osoda</i>	3
4	<i>biadu</i>	index finger		<i>biadu</i>	4
5	<i>bi</i>	thumb		<i>bi</i>	5
6	<i>gafe</i>	palm		<i>gafe</i>	6
7	<i>lobobasolo</i>	wrist (ventral)		<i>lobofasele</i>	7
8	<i>godo</i>	lower arm (ventral, half way along length)		<i>godo</i>	8
9	<i>sesege</i>	inner elbow		<i>sesege</i>	9
10	<i>nabu</i>	bicep	upper arm	<i>nabu</i>	10
11	<i>gida</i>	shoulder		<i>gida, hu</i>	11
12	<i>fago</i>	jn of clavicle with neck	collar bone	<i>fago</i>	12
13	<i>galo</i>	neck		<i>galo</i>	13
14	<i>ge</i>	ear, lower lobe	ear	<i>gehe, aida</i>	14
15	<i>ba:</i>	temple	cheek	<i>ba:</i>	15
16	<i>si</i>	eye		<i>si</i>	16
17	<i>mi</i>	(tip of) nose	nose	<i>halida</i>	17
18	<i>lei si</i>	other eye		<i>lai si</i>	18
	... etc			...	
33	<i>age</i>	other little finger		<i>lai age</i>	33
				finished	<i>fusuli fasi</i>
				going round again	<i>amalu bu agesa</i>
				once around	<i>age fawane fusui</i>
				twice around	<i>ageyadu fusui</i>
				thrice around	<i>osoda fusui - fusudigi</i>

'cheek' with 15 (*ba:*). The same difference was evident in the two Edolo reports (Table 2). Dwyer is confident that, at Bobole, people touched their 'temple' or 'high cheek' when marking 15. He is not confident, however, that his knowledge of the Edolo system did not prejudice his recording of the Bedamuni system. It may be that, in the Edolo case, the body-marker for 15 has 'drifted' while the original name associated with that numeral has been retained. The Bedamuni name for 'bone at temple' (*gelaba:gi*) incorporates the name for 'cheek'. Note also that where Bedamuni employ the suffix *lai-* to mark the 'other side' of the body, western Edolo employ the cognate *nai-*.

Modifiers used to quantify nouns for Bedamuni are shown in Table 6.

Table 6: Noun modifiers recorded for Bedamuni

	PD & MM	T & S Hoey	
1	<i>afae</i>	<i>afai, afadafa, -isu</i>	1
2	<i>aduna</i>	<i>aduna, elela</i>	2
3	<i>udiana</i>	<i>udiana</i>	3
4	<i>bjaduale</i>		
5	<i>biale</i>		
6	<i>gafeale</i>		
etc	... name of body-part with <i>ale</i> suffix		

Bedamuni specify the number of days, up to five in either direction, from the present day (*waha*) as follows: *aya*, *gasida*, *gomohalia*, *usi* and *dialehabe* for, respectively, one, two, three, four and five days from the present day (T. & S. Hoey n.d.b: 25). *Aya* and *gasida* are close to the Edolo equivalents, *ayo* and *gahata*.

3.3 Onobasulu (Onobasulu, Waragu, ONN)

Onobasulu are located southeast of Edolo (Fig. 3). Their counting system was recorded by Tom Ernst in the course of extended anthropological research between 1969 and 1971 and by the linguist Anne Stoppels-Dondorp in the late 1990s (Ernst 1996, Stoppels-Dondorp 2010).

Onobasulu employ a body-part tally system that, following Stoppels-Dondorp, commences with the little finger, usually on the right side, progresses to the thumb and then, via the palm and wrist, to the nose from where it continues in reverse order down the other side of the body to end at the little finger of the other hand (Table 7, Fig. 4c). In most cases, the words used as numerals, including those for fingers and thumb, appear to be the names of the indicated body-parts. This generates a 33-cycle system.

Table 7: Body-part tally system of Onobasulu-speakers.

T. Ernst usually starts on right side			A. Stoppels-Dondorp starts on right side		
1	<i>agali</i>	little finger	little finger	<i>a'gele</i>	1
2	<i>aganebo</i>	ring finger	ring finger	<i>aga'nebo</i>	2
3	<i>osolo(a)</i>	middle finger	middle finger	<i>o'solo</i>	3
4	<i>binibo</i>	index finger	index finger	<i>bi'nibo</i>	4
5	<i>bi</i>	thumb	thumb	<i>bi</i>	5
6	<i>kabe</i>	palm	palm	<i>'kabe</i>	6
7	<i>tomo</i>	mid forearm	wrist (inner)	<i>'domo</i>	7
8	<i>aiyo</i>	elbow	forearm	<i>'aiyo</i>	8
9	<i>yo</i>	mid upper arm	elbow (inner)	<i>ago'fola</i>	9
10	<i>tabula</i>	side deltoid	bicep	<i>'dabulu</i>	10
11	<i>kileli</i>	trapezius	shoulder (joint)	<i>ki'lele</i>	11
12	<i>hugalu</i>	clavicle (medial end)	collarbone	<i>'hugulu</i>	12
13	<i>gifigi</i>	neck	neck	<i>gifo'golo</i>	13
14	<i>boroboro</i>	cheek	cheek	<i>bolo'bolo</i>	14
15	<i>koneni</i>	ear	ear	<i>ko'neni</i>	15
16	<i>tsi</i>	eye	eye	<i>si</i>	16
17	<i>mi(-lolea)</i>	nose	nose	<i>mi</i>	17
18	<i>tsi</i>	eye	eye (other side)	<i>si no</i>	18
	... etc			... etc	
33	<i>agali</i>	little finger	little finger (other side)	<i>agele no</i>	33

The two versions on Onobasulu body-part counting shown in Table 7 agree in most particulars and, other than reversing the order in which cheek and ear appear, conform closely to the Bedamuni system. In Ernst's version the numerals 7 and 8 are given as *tomo* and *aiyo* and translated, respectively, as 'mid forearm' and 'elbow'. In Stoppels-Dondorp's version these two numerals are given as *'domo* and *'aiyo* and translated, respectively, as 'wrist' and 'forearm'. The Kaluli word for 'wrist' (*dom*) corresponds to Stoppels-Dondorp's translations. It is possible that Ernst mistranslated

tomo and that, from 7 to 10 (and 24 to 27) he has misattributed body parts to numbers. Note, for example, that both Ernst and Stoppels-Dondorp give the same word for 10 but Ernst translates this as 'side deltoid' while Stoppels-Dondorp translates it as 'bicep' (i.e. mid-point of upper arm).

Ernst (1996: 62) states that counting may progress beyond 33 with "sets of bodies. For example, one body and right hand's little finger = 34. It can indefinitely continue in sets of 33s plus a number from between 1 and 33". Stoppels-Dondorp does not discuss this matter but comments that "it is not unusual, with older people especially, to see someone touch their particular part of the arm, neck or face to answer a question of how many people or things were involved in some action". The use of body-parts for counting "makes non-verbal indication of numbers easy". She notes as well that the word *fula* may be used to indicate a full count (i.e. of 33) though, by the 2000s, it was also used to refer to one hundred. By this time people tended to use Onobasulu words for numerals from one to 12 but, from 13, switched to English words or, when indicating how many things (or people) were being referred to, used Onobasulu words in a 10-cycle (decimal) system.

Stoppels-Dondorp notes that numerals are modified to quantify nouns, with *ule* and *aida* used respectively for one and two, *osoloa*, *biniba* and *bia* used respectively for three, four and five, and the suffix *-ba* added to body-part words used for numerals greater than five (e.g. *dofena domo-ba* for 'seven pigs').

3.4 Kaluli (Bosavi, BCO)

Kaluli are located south of Onobasulu on the lower northern slopes of Mount Bosavi (Fig. 3). Their counting system was recorded by the linguists Andrew and Sylvia Grosh who lived with Kaluli people in the early and mid-1990s (Grosh 2004, Grosh and Grosh 2004; see also Schieffelin and Feld 1998: 173). Kaluli employ a body-part tally system that commences with the little finger, usually on the left side, progresses to the thumb and then, via the wrist, to the left side of the nose and the nose tip from where it continues in reverse order down the other side of the body to end at the little finger of the other hand (Table 8, Fig. 4d). With the exception of the terminating little finger the words used as numerals appear to be the names of the indicated body-parts. This generates a 35-cycle system.

The Kaluli system differs from that of neighbouring Onobasulu in being a 35-cycle system rather than a 33-cycle system and in incorporating both sides and the tip of the nose in the body-part tally. Grosh observes that "in theory [Kaluli] can continue counting above 35 by starting again on the left hand with the phrase '*fudɔ: imilise eɛteɛɛ imilise*' 'one "thirty-five" and one"'. However, at the time of Grosh's study most people used the English base 10 system though they still used Kaluli words for the numerals 1 to 10. Noun modifiers are listed in Column 4 of Table 8. Different lexical forms are used for the numbers one to four but, thereafter, the suffix *-ɛfo* is added to the body-part tally word.

Grosh commented that the word *fudɔ:*, which in customary practice indicated 35, was, by 2010, also used to mean one-hundred. "This double usage sometimes caused confusion: more than one bride price negotiation has come to grief over this problem in recent days!"

Table 8: Body-part tally system of Kaluli-speakers.

	Name	Body-part indicated usually starts on left side	Modifiers
1	<i>agel</i>	little finger	<i>imilisi</i>
2	<i>aⁿdep̄</i>	ring finger	<i>εlel</i>
3	<i>asɔl</i>	middle finger	<i>ot^halen</i>
4	<i>fεledamal</i>	index finger	<i>fεledein</i>
5	<i>bi</i>	thumb	<i>bilefo</i>
6	<i>dɔgɔfe</i>	palm	<i>dɔgɔfelefo</i>
7	<i>dom</i>	wrist (inner)	<i>domεlefo</i>
8	<i>o</i>	forearm	<i>olefo</i>
9	<i>agat^hɔ</i>	elbow (inner)	<i>agat^hɔlefo</i>
10	<i>dɔ</i>	bicep	<i>dɔlefo</i>
11	<i>k^helen</i>	shoulder (joint)	<i>k^helenlefo</i>
12	<i>k^hugu</i>	collarbone	<i>k^hugulefo</i>
13	<i>dagas</i>	neck (side)	<i>dagaselefo</i>
14	<i>k^hεlen</i>	ear	<i>k^hεlenεlefo</i>
15	<i>babo</i>	cheek	<i>babolefo</i>
16	<i>si</i>	eye	<i>silefo</i>
17	<i>mio</i>	nose (side)	<i>miolefo</i>
18	<i>milifile</i>	nose tip	<i>milifilelefo</i>
19	<i>no mio</i>	nose (other side)	<i>no miolefo</i>
	... etc		
34	<i>no aⁿdep̄</i>	ring finger (other side)	<i>no εlelelefo</i>
35	<i>fudɔ</i>	little finger (other side)	
40	<i>fudɔ εletege bilefo</i>	35 and 5	
50	<i>fudɔ εletege babolefo</i>	35 and 15	
	... etc		

3.5 Eibela (Aimele, Kware, AIL)

Eibela-speakers occupy land to the southwest of Mount Bosavi (Fig. 3). Their counting system was recorded by the linguist Grant Aiton (2014, *pers. comm.* 6-10 January 2015). Available information is presented in Table 9 (see also Fig. 4e). A body-part tally system is indicated with a mid-point of 18 represented by the ridge of the nose. As in the Kaluli system both sides of the nose are incorporated into the count to yield the numbers 17 and 19. The tally commences on the left side and, again as with Kaluli, a 35-cycle system is indicated.

There is one notable difference from the Kaluli system. The named body-parts recorded in Table 9 for the numerals seven, eight and nine are, respectively, heel of hand (*donu*), wrist (*o:*) and elbow (*agota:*). The equivalent body-parts listed for Kaluli are wrist (*dom*), forearm (*o*) and elbow (*agat^hɔ*) (Table 9). Some Eibela-speakers use *omusia* for nine, and point to the forearm.

Imili and *a:ni*, which are not body-part names, serve as the cardinal numbers 1 and 2 and, for larger numbers, the suffixes *-εli* and *-εija* are added to the relevant body-part name to produce noun modifiers.

Table 9: Body-part tally system of Eibela-speakers.

	Name	Body-part indicated
1	<i>agri</i>	little finger
2	<i>agriwəri</i>	ring finger
3	<i>binibi /binisusu</i> ¹	middle finger
4	<i>binibi /binisusu</i> ¹	index finger
5	<i>sa:mi</i>	thumb
6	<i>diga:phi</i>	palm
7	<i>donu</i>	heel of hand
8	<i>o:</i>	wrist (inner)
9	<i>agota:</i>	elbow
10	<i>da:ki</i>	upper arm
11	<i>kidi</i>	shoulder
12	<i>kugu</i>	collar bone
13	<i>gfji</i>	neck
14	<i>klɛnɛ</i>	ear
15	<i>ba:bu</i>	cheek
16	<i>si:</i>	eye
17	<i>mio</i>	side of nose
18	<i>mifide</i>	ridge of nose
19	<i>nolomio</i>	nose (other side)
	... etc:	
35	<i>noagri</i>	little finger (other side)

¹ Most speakers used *binibi* for three and *binisusu* for four; some did the reverse.

3.6 Kasua (KHS)

Kasua-speakers occupy land to the south of Mount Bosavi (Fig. 3). Their counting system was recorded by the linguist-Bible translators Tommy and Konni Logan who have worked with Kasua for 25 years (*pers. comm.* 3 & 5 January 2016). Available information is presented in Tables 10 and 11 (see also Fig. 4f).

Kasua employ a body-part tally system that commences with the little finger, progresses to the thumb and then, via the wrist, to the nostril and the nose tip from where it continues in reverse order down the other side of the body to end at the little finger of the other hand. This generates a 35-cycle system.

From 4 to 33 the words for numerals carry the suffix *-ipe*, indicating that they have been listed as cardinal numbers. Thus, *kasolo taloipe* translates as ‘ten dogs’ and *sena talo pipe* as ‘fifty men’. T. Logan commented that “the suffix is always used in counting except when using a combination of numbers, where the first numbers will not have it and the last one will”. At least half the body-part terms listed in Table 10 are cognate with equivalent body-part terms among both Kaluli and Eibela (Tables 8 and 9). Kasua do not indicate ‘neck’ but, rather, indicate 13 by pointing to the underside of the ear lobe. Both nostrils are incorporated into the count to yield the numbers 17 and 19. On these counts Kasua differ from Kaluli and Eibela where 13 is indicated by the side of the neck and it is both sides of the nose, rather than the nostrils, that are included in the tally.

Table 10: Body-part tally system of Kasua-speakers.

	Name	Body part indicated
1	<i>semetei</i>	little finger
2	<i>elipei</i>	ring finger
3	<i>usulupe</i>	middle finger
4	<i>pinipe</i>	index finger
5	<i>piipe</i>	thumb
6	<i>tekapeipe</i>	palm
7	<i>tomoipe</i>	wrist
8	<i>oloipe</i>	middle of forearm
9	<i>akotaipe</i>	elbow (inside joint)
10	<i>taloipe</i>	bicep
11	<i>kena:nipe</i>	shoulder
12	<i>kukulupe</i>	collar bone
13	<i>kekeipe</i>	underneath ear lobe
14	<i>kena:na:ipe</i>	ear
15	<i>papoipe</i>	cheek
16	<i>siipe</i>	eye
17	<i>mina:kena:neipe</i>	nostril
18	<i>mi</i>	tip of nose
19	<i>mina:kena:neipe</i>	nostril (other side)
	... etc	
35	<i>semetei</i>	little finger (other side)

Table 11 shows how Kasua have adapted their own counting terminology to the English decimal system.

Table 11: Adaptation of Kasua terminology to English decimal counting system

	Term	Translation
10	<i>talo semetei</i>	lit. ten one
19	<i>talo semetei epela: akotaipe</i>	lit. ten one and nine
20	<i>talo elepei</i>	lit. ten two
25	<i>talo elipei epela: piipe</i>	lit. ten two and five
100	<i>sakopolo</i>	

4. East Strickland languages

4.1 Kubo (Hæibasū, Koobo, Kubor, JKO)

The counting system of Kubo was recorded by non-linguists Peter Dwyer and Monica Minnegal at the village of Gwaimasi (Komagato) during 15 months in 1986-87 and by the missionary Tom Covington (2011) when, for about 10 years to 2004, he was based at the village of Suabi (Fig. 3). Gwaimasi is located on the Strickland River in the far west of Kubo territory; Suabi is located on the Baia River in the far east of Kubo territory.

Kubo employ a body-part tally system that commences with the little finger, progresses to the thumb and then, via the wrist, to the nose from where it continues in reverse order down the other side of the body to end at the little finger of the other hand (Table 12, Fig. 5c). Dwyer and Minnegal considered that the count commenced on the right side; Covington considered that it commenced on the left side. The prefix *eyɔ* (*ea*) is used when the tally switches sides. With the possible exception

of the fingers (including thumb) the words used as numerals appear to be the names of the indicated body-parts. *Sesa* and *sesamæ* (but not *dano* and *beau*) may be the names of little finger and ring finger. The tally reaches 27 but there is no evidence that it continues beyond this number and, at Gwaimasi, one informant with considerable language skills asserted that this was not possible.

Table 12: Body-part tally system of Kubo-speakers.

PD & MM		Body-part indicated		T. Covington	
		PD & MM	T. Covington		
1	<i>dano</i>	little finger (right hand)	5th finger (left hand)	<i>sesa</i>	1
2	<i>beau</i>	ring finger	4th finger	<i>sesamæ</i>	2
3	<i>koma</i>	middle finger	3rd finger	<i>kɔmae</i>	3
4	<i>daso</i>	index finger	2nd finger	<i>dɔsɔu</i>	4
5	<i>hau</i>	thumb		<i>hau</i>	5
6	<i>waien</i>	wrist		<i>wãĩ</i>	6
7	<i>djua</i>	lower arm	forearm	<i>diu</i>	7
8	<i>duma</i>	elbow (inner)	elbow	<i>dɔma</i>	8
9	<i>dobe</i>	upper arm		<i>dɔbe</i>	9
10	<i>oi</i>	shoulder		<i>ɔi</i>	10
11	<i>gabai</i>	side of neck	neck	<i>gɔbai</i>	11
12	<i>du</i>	ear		<i>du</i>	12
13	<i>dihɔ</i>	eye		<i>dihĩĩ</i>	13
14	<i>mi</i>	nose		<i>mĩ</i>	14
15	<i>ea diho</i>	eye (left)	eye (right)	<i>eyɔ dihĩĩ</i>	15
	... etc				
24	<i>ea daso</i>	index finger	2nd finger	<i>eyɔ dɔsɔu</i>	24
25	<i>(ea) koma¹</i>	middle finger	3rd finger	<i>eyɔ kɔmae</i>	25
26	<i>(ea) sasamai¹</i>	ring finger	4th finger	<i>eyɔ sesamæ</i>	26
27	<i>(ea) sasafai¹</i>	little finger	5th finger (right hand)	<i>eyɔ sesa</i>	27

¹ Uncertain whether, at Gwaimasi, these terms, for 25, 26 and 27, carried the prefix 'ea'.

With one minor exception the system recorded by Dwyer and Minnegal matches that recorded by Covington with respect to both the names used and the body parts indicated. Dwyer and Minnegal recorded 1 and 2 as, respectively, *dano* and *beau* while Covington recorded these numbers as, respectively, *sesa* (little finger) and *sesamæ* (ring finger). However, Dwyer and Minnegal recorded the final numbers in the sequence as *sasamai* (27) and *sasafai* (28) and on one occasion a youth counted to three using *sasafai* (1), *sasamai* (2) and *koma* (3). Covington considered that *tano* and *beyãũ* – *dano* and *beau* as rendered by Dwyer and Minnegal – were noun modifiers. At Gwaimasi, in 1986-87, noun modifiers were given by *dano* for one, *beau* for two and, thereafter, by adding the suffix *-dia* to the name for the relevant body part. It appears that people at Gwaimasi have incorporated noun modifiers for 1 and 2 into their body-part tally system.

Kubo were not passionate about counting in the way that Edolo were and it was only in a few contexts, when deliberately attempting to elicit the counting system, that we obtained all the terms recorded in Table 12. In 1986-87, people seldom counted beyond about 10 using Kubo terms. They did not count in Pidgin but sometimes counted in English though, when they did so, they added the suffix *-dia* to all numerals, including 1, 2 and 3. Covington noted that by about 2000 people used Kubo terms for the numbers 1 to 5 but switched to English for higher numbers. In several visits to Suabi in the years 2011-14 we did not hear anyone using words from the traditional counting system.

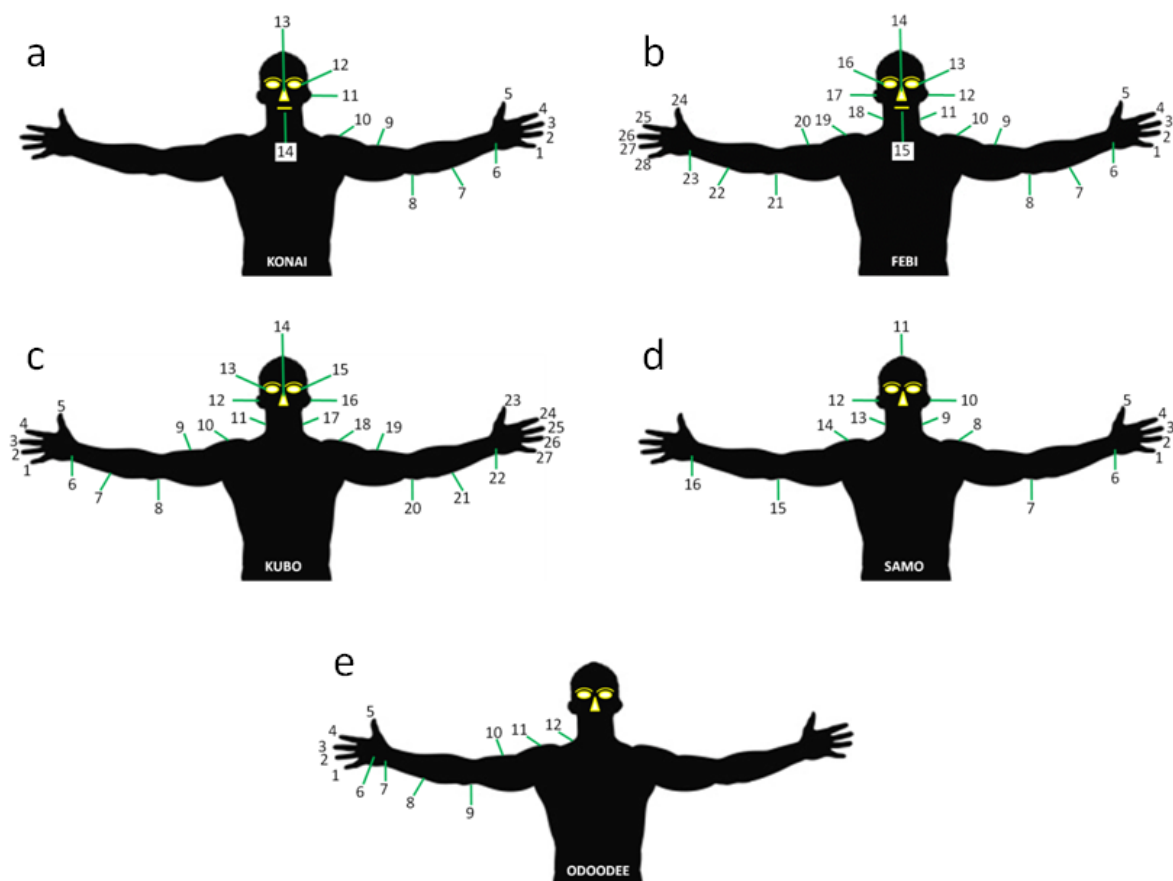


Fig. 5: Body-part tally systems of some East Strickland languages. Konai based on Årsjö (Table 13), Febi based on Gerard (Table 15), Kubo based on Dwyer and Minnegal (Table 12), Samo based on Shaw (Table 17) and Odoodee based on Hays (Table 20).

In 1986-87, when indicating days of the week people at Gwaimasi used the body-part counting words for 1 to 7 to mark Monday to Sunday, returning as necessary to ‘right little finger’ to mark ‘the first Monday after the present day’. For example, a person discussing travel plans might say that s/he would ‘sleep away from the village today’ (indicating right wrist for Saturday), ‘sleep away from the village tomorrow’ (indicating right lower arm for Sunday) and ‘return to the village the next day’ (indicating right little finger for Monday). We did not record a case in which a person cycled through more than seven days in this way. By 2011, they did not employ body-part prompts when indicating days of the week.

At Gwaimasi in 1986-87, different words were used to indicate days before and after the present day (*aufi*). These were *idiba* and *woidiba* for ‘tomorrow’ and the ‘day after tomorrow’ and *i* and *woi-i* for ‘yesterday’ and ‘the day before yesterday’. They were not related to terms used in counting.

4.2 Konai (Kanai, Mirapmin, KXW)

Konai-speakers occupy land west of the Strickland River and contiguous with Kubo territory (Fig. 3, S. & B. Årsjö 2000: 30). Their counting system was recorded by the linguist-Bible translators Soren and Britten Årsjö who worked with Konai for 20 years from 1994 (B. Årsjö 2016).

Konai employ an asymmetrical body-part tally system that commences with the little finger, progresses to the thumb and then, via the wrist, to the shoulder, ear, eye, nose and, as the

fourteenth tally point, the mouth (Table 13; Fig. 5a). B. Årsjö (2016) records *dobogôu ta* as representing numbers equal to or greater than 15.

Table 13: Body-part tally system of Konai-speakers.

	Name	Body part indicated
1	<i>sasafej</i>	little finger
2	<i>sasama</i>	ring finger
3	<i>koma</i>	middle finger
4	<i>dosôu</i>	index finger
5	<i>hou</i>	thumb
6	<i>walaj</i>	wrist
7	<i>dio</i>	lower arm
8	<i>dima</i>	elbow
9	<i>dese</i>	upper arm
10	<i>yetou</i>	shoulder
11	<i>kehe</i>	ear
12	<i>dihô</i>	eye
13	<i>mukuô</i>	nose
14	<i>mogou</i>	mouth
≥ 15	<i>dobogôu ta</i>	“the other hand”

The numerals listed in Table 13 serve as ordinals but may be modified, by adding the suffixes *-yosi* or *-dia* together with the demonstrative verb *kege* (“be like that”), to serve as cardinals. They are used in modern contexts when naming days of the week or months of the year. An additional 2-cycle system of cardinal numbers is also employed by Konai-speakers (Table 14). B. Årsjö did not record a term for 5 in the traditional expression of this system but reported that when adapted to English the word for thumb (*hou*) was used. However, in 1981 Dan Shaw recorded terms for the numerals 1 to 5 (SIL 1979). Those for 1 to 4 match the equivalent cardinals reported by B. Årsjö and 5, in Shaw’s list, is given by the word for thumb. Shaw elicited the expression *dnbagô gogô dô* for 10. This probably translates as ‘all hands’. (*Dibi’gô*, recorded at the Konai community of Sesanabi for ‘hand’, and *dabaga*, our rendering of ‘hand’ in Kubo, will be different transcriptions of *dnbagô*. *Go’g’w’:* was recorded at Sesanabi for ‘many’, while *gogung* is our rendering of ‘all’ or ‘many’ for Kubo.) The expression *dnbagô gogô dô* was probably elicited in response to being shown all fingers (i.e. both hands); that is, it was not given as standing for the numeral 10.

Table 14: Konai cardinal numbers.

‘Traditional’ (B. Årsjö)		‘Modern’ (B. Årsjö)		SIL word list (D. Shaw)	
1	<i>tanôu</i>	1	<i>tanôu</i>	1	<i>‘tano</i>
2	<i>bolou</i>	2	<i>bolou</i>	2	<i>bu’no</i>
3	<i>komadia</i>	3	<i>komadia</i>	3	<i>kn’madia</i>
4	<i>bolou bolou</i>	4	<i>bolou bolou</i>	4	<i>da’sô dia</i>
		5	<i>houyosi</i>	5	<i>hçu</i>
6	<i>bolou bolou bolou de</i>	>5	English word + <i>kege</i>	10	<i>dnbagô gogô dô</i>

In Table 14, the words used for 1, 3, 4 and 5 in the SIL list are the same as those used by Kubo-speakers, though all but *hou* for 5 have been expressed in the form of noun modifiers. The word for 2 is probably cognate with the Kubo word *beyãũ* (*beau*). S. and B. Årsjö (2005: 2) give *dosø* as the name of the index finger; *da'so* in Table 14 is probably the same word and, hence, numerals associated with the 3rd, 4th and 5th fingers may be the names of those fingers.

4.3 Febi (Agala, Fembe, Kalain, Sinale, Tsinali, AGL)

The Febi language group occupies land to the north of Kubo territory (Fig. 3, Dwyer *et al.* 1993). The counting system of Febi was recorded from a single informant by anthropologist Anaïs Gerard at the village of Gesesu in December 2009 (Table 15; *pers. comm.* 31 December 2015).

Table 15: Body-part tally system of Febi-speakers.

	Name	Body part indicated
1	<i>sesafeng</i>	little finger (left hand)
2	<i>sesame</i>	ring finger
3	<i>kama</i>	middle finger
4	<i>dosso</i>	index finger
5	<i>hou</i>	thumb
6	<i>weyay</i>	wrist
7	<i>dyo</i>	forearm
8	<i>doumay</i>	elbow
9	<i>dobey</i>	biceps
10	<i>ey</i>	shoulder
11	<i>gobay</i>	neck (left side)
12	<i>douwo</i>	ear
13	<i>dihon</i>	eye (left side)
14	<i>miou</i>	nose
15	<i>meugaou</i>	mouth
16	<i>eyo dihon</i>	eye (right side)
	... etc	
28	<i>eyo sesafeng</i>	little finger (right hand)

Febi employ a body-part tally system that commences with the little finger of the left hand, progresses to the thumb and then, via the wrist, to the nose and mouth from where it continues in reverse order down the other side of the body to end at the little finger of the right hand (Fig. 5b). The prefix *eyo* (cf. Kubo *eyo*) is used when the tally switches sides. Because both nose and mouth are included as singularities in the counting system the complete tally reaches 28 rather than, as with Kubo, 27. The inclusion of 'mouth', as in the Febi and Konai body-part tally systems, is unusual. 'Mouth' does not appear in any Western Province, Sandaun Province or Southern Highlands Province counting systems reported by Lean (1991a,b,c) but, together with nose, is reported from Baruga (Oro Province; Rauff, 2003: 8).

Gerard's informant stated that, in their own language, Febi people did not count above 28. From 1 to 14, the names used for numerals (and their associated body parts) are the same as the names used by Kubo (see Table 12). For Febi, the expression "*oun sogã*" translates as "to count".

Three Febi word lists, recorded in the 1970s, are available in Summer Institute of Linguistics archives (SIL 1979). Available information about counting words is shown in Table 16.

Table 16: Some counting words used by Febi-speakers.

	Headwaters of Burnett River ¹	Kuobi at south fork of Liddle River ¹	Upper Strickland
	1971	1971	14 December 1979
1	<i>sate</i>	<i>sΛ'sa ĩ</i>	<i>sisafe</i>
2	<i>sa sa ma</i>	<i>sΛ'saina</i>	<i>sisama</i>
3	<i>kama</i>		<i>kōma</i>
4	<i>daso</i>		<i>doso</i>
5		<i>di'be</i>	
10			
	we two	<i>dabeyō</i>	
	you two	<i>ɔibeyō</i>	
	they two	<i>di 'ye beyō</i>	

¹ Recorded by Dan Shaw.

The names recorded for the numerals 1 to 4 are essentially the same as those recorded by Gerard. *Di'be*, shown in Table 16 against the numeral 5, does not appear as a counting word in Gerard's records. It is, however, probably cognate with *debe*, the Samo word for 'hand' (see below) and, less certainly, with the corresponding Kubo word – *dabaga*. It is probable that *di'be* was elicited in response to being shown a full set of five fingers which was interpreted by the informant as a 'hand'.

Gerard did not record noun modifiers. However, the Febi word used to denote two in 'we two' and 'you two' – *beyō* – is cognate with the Kubo noun modifier *beyū* (*beau*) for two.

4.4 Samo (Supei, SMQ)⁸

The Samo language group occupies land that is east of the Strickland River and immediately south of Kubo (Fig. 3). Information on the counting system of these people is provided by the anthropologist-linguist-Bible-translator Dan Shaw who has been closely associated with Samo people since 1970 and in the 12 years to 1982 spent half his time living among them (Shaw 1990, 2009).

Shaw (2009) has reported two counting systems used by Samo: a body-part tally system (Table 17, Fig. 5d) and a 2, 5-cycle system (Table 18). The body-part tally system commences with the little finger of the left hand, progresses to the thumb and then via wrist and shoulder to the crown of the head, as mid-point, from where it continues in reverse order to reach the right wrist. At this point, however, symmetry appears to break down and Shaw notes that he never observed people using body-part tally numbers that would correspond to 17, 18 and 19. Rather, it appears that after 16 the count is marked by two fists which Shaw interpreted as standing for 20. It is difficult, from these data, to decide the length of the body-part tally cycle. Shaw lived with Samo virtually from the time they were first contacted. It is unlikely that the body-tally system had already commenced eroding as a result of contact.

In the body-part tally system the counting words 1 to 4 are represented as 1, 2, 2+1 and 2+2. At the least, the words that indicate 3 and 4 cannot be the names of these digits. The word for 5 (*debēa*) is very likely to be a variant of the word *debe*, which Shaw translates as 'hand', and probably

⁸ Both Kubo and Samo have, at times, been named as Daba. In the late 1960s and early 1970s this name was used by patrol officers for Kubo and Febi people living near the Strickland River, north of Damami River. The name probably derives from 'Dabamisi', the name of a Kubo clan with land in the south of this area.

Table 17: Body-part tally system of Samo speakers.

	Name	Body part indicated
1	<i>helēu</i>	left little finger (pointing with right hand)
2	<i>bēau</i>	left ring finger
3	<i>behelo</i>	left middle finger
4	<i>bēauili bēauili</i>	left index finger
5	<i>debēa</i>	left thumb
6	<i>debēa mali</i>	left wrist
7	<i>dumane</i>	left elbow
8	<i>ɔdiɔ</i>	left shoulder
9	<i>gɔbɔgibi</i>	base of neck
10	<i>duli</i>	left ear
11	<i>ɔlɔɔ</i>	crown of head (pointing with right hand)
12	<i>duli helɔfo</i>	right ear (pointing with left hand)
13	<i>gɔbɔgibi helɔfo</i>	right neck
14	<i>ɔdiɔ helɔfo</i>	right shoulder
15	<i>dumane helɔfo</i>	right elbow
16	<i>mali helɔfo</i>	right wrist
17	-	not used
18	-	not used
19	-	not used
20	<i>debe helɔfo gogo</i>	“hand across, many”

Table 18: A Samo 2, 5-cycle counting system.

	Name	D. Shaw exegesis
1	<i>helēu</i>	
2	<i>bēau</i>	
3	<i>behelo</i>	translated as ‘few’ in non-numerical context
4	<i>bēauili bēauili</i>	four also given as <i>gogo</i> ‘many’
5 ¹	<i>debe helɔfo</i>	lit: ‘hand across’
6	<i>bēauili bēauili bēauili</i>	binary system of counting – two plus two plus two, etc.
10	<i>debe helɔfo bēau</i>	lit: ‘two hands’, said with two fists put together
20	<i>debe helɔfo gogo</i>	lit: ‘many hands’

¹ Based on a SIL list from the 1970s Lean (1991b) reported 5 as *benau-ili benau-ili mesantale* with *mesantale* translated as “one alone”.

cognate with the word for ‘hand’ among Kubo (*dabaga*) and Konai (*dibi’gɔ*). In a 1971 word list from the Samo village of Kwobi, Shaw gives *debe hou* for ‘thumb’. (The Kubo word for thumb [*hau*] is not predicated with the word for ‘hand’.) Note that the construction that Shaw interpreted as 20 (*debe helɔfo gogo*) is similar in form to that for 10 in Konai (Table 14). The remaining counting words are likely to be the names of the indicated body-part.

In the Kwobi word list, Shaw gives *oso ‘helenu, oso denau* and *oso be’helo* for, respectively, ‘man one’, ‘man two’ and ‘man three’ (SIL 1979). The first and third modifiers are clearly related to the body-part tally words, while *denau* (cf. *bēau*, Table 18) may be a mishearing.

The first four numbers of the Samo 2, 5-cycle system are the same as those used in the body-part tally system, with 4 given as 2+2 in both cases (Table 18). Thereafter, the systems diverge. In the 2, 5-cycle system, 5 is given as a single fist, 6 as 2+2+2 and so on to 10 which is expressed as “hand across two” and marked by both fists put together. Shaw commented that “the system can

theoretically be used to double the numbers to 40 by adding *hɔʔ* to each number”. He was told that this did happen but did not observe it. The name given for 20 is the same in both counting systems. A likely interpretation of Shaw’s observations is that at 16 in the body-part tally system people jumped to a 2, 5-cycle system.

4.5 Gobasi (Bibo, Gebusi, GOI)

Gobasi live to the immediate south of Samo and the immediate west of Bedamuni (Fig. 3). They have been the subject of long term anthropological research by Bruce Knauft (1985, 2002, 2016).

Available information about counting by Gobasi is limited to brief comments by Knauft (1985: 411 n.15, 2016: 29-30) and some items from a word list available in the Summer Institute of Linguistics archives (SIL 1979; Table 19). We include a single record from 1971 attributed to speakers of the closely related Honibo by Lean (1991b); Shaw (1986: 53) considered Honibo and Gobasi to share 92 percent of basic vocabulary.

Table 19: Some counting words used by Gobasi-speakers.

GOBASI				HONIBO	
Knauft		SIL word list, no author		Lean	
1	<i>hele</i>	1	<i>'dob</i>	1	<i>'helehai</i>
2	<i>benā</i>	2	<i>'bihi 'non</i>	2	<i>be'nabugu</i>
2+1	<i>bene bwar hele bwar</i>	3	<i>bi'hɔno</i>	3	<i>'behele</i>
many	<i>bihina</i>	4	<i>bi'hino</i>	4	<i>'susugab</i>
		5	<i>'de daga</i>	5	<i>'kwaimoido¹</i>
		10	<i>de do go</i>		

¹ Lean (1991b) reports that the SIL word list translated *'kwaimoido* as “many” or “plenty”. The word *kwa'imodo* appeared on a SIL Samo list against the numeral 10.

Knauft (2016: 29-30) reported that Gobasi “indigenous numbers were just three: ‘one’ (*hele*), ‘two’ (*benā*), and ‘two plus one’ (*bene bwar hele bwar*). Anything greater than that was simply ‘many’ (*bihina*). Counting was as irrelevant to the Gobasi as their physical skills were finely honed. As ad hoc engineers they were quite astonishing”. The unauthored, and undated, SIL list is slightly more expansive in providing counting words for 1 to 5 and 10. The word *'dob*, however, is the Gobasi word for arm (given as *dob*, Leroy *et al.* n.d.). Elsewhere, Knauft (1985: 411 n.15) elaborated. He wrote: “When asked specifically, Gebusi can count on their bodies ... but do not indicate a body part as a cardinal number; they always ‘count up to it’. No number concepts are associated with body parts per se, and body counting was exceedingly rare in any event”. Tally points on both sides of the body were included in the count (Knauft *pers. comm.* 1 March 2016).

Knauft’s *hele* for 1 and *benā* for 2 in Gobasi are cognate with Shaw’s *helēu* for 1 and *bēau* for 2 in Samo. The construction of 3 recorded by Knauft includes the conjunction ‘and’ which is elided in the Samo and Honibo records. With the possible exception of Knauft’s *bihina* for ‘many’ and SIL’s *bi'hino* for 4 there is little agreement between the two lists attributed to Gobasi in Table 19. The words for 1 and 2 in the Honibo list match those in Knauft’s list. Interestingly, the word for 3 in this list – *'behele* – is presumably cognate with the Gobasi and Samo words (*dehelol* and *behels*) for middle finger (Leroy *et al.* n.d.; Table 17). Knauft’s list hints at, at least, a 2-cycle system. If *'de daga* (which appears cognate with the Kubo word *dabaga*) is a ‘hand’ morpheme, the SIL list hints at a 5-cycle system.

4.6 Odoodee (Kabasi, Kalamo, Kramo, Ododei, Tomu, KKC)

Odoodee live west of Mount Bosavi and east of the Strickland on both sides of the Tomu River (Fig. 3; D. and K. Hays 2003). Information on the counting system of these people is provided by the linguists Darrell and Kerttu Hays (2002; see also Hays 2010) who worked with them in the late 1990s and early 2000s.

D. and K. Hays report two counting systems used by Odoodee: a body-part tally system and a 2- (or 2, 5-)cycle system (2002: 41; Table 20, Fig. 5e). D. Hays (2010) comments that the body-part tally system was no longer used and that “the Odoodee people did not know how to count past 12 using this system”. Relative to other languages in the East Strickland family the Odoodee body-part tally system is interesting in that the words for ‘2’ and ‘3’ are formed by the addition of the suffix *mākōlā* to the words for, respectively, ‘1’ and ‘4’ (*hō* and *wolu’gu*). This implies, first, that the counting words are the names of the associated fingers and that the first and fourth fingers have greater salience for Odoodee speakers than the second and third. In addition, the tally includes both ‘palm’ and ‘collar bone’, neither of which appears in the body-part tally systems of any of the other reported East Strickland languages though both appear in the body-part tally systems of all reported Bosavi languages.

Table 20: Body-part tally system of Odoodee speakers.

	Name	Body part indicated
1	<i>hō</i>	little finger
2	<i>’hōmākōlā</i>	ring finger
3	<i>wolu’gumākōlā</i>	middle finger
4	<i>wolu’gu</i>	index finger
5	<i>eme’di</i>	thumb
6	<i>de bō</i>	palm
7	<i>gebesigi’li</i>	wrist
8	<i>de tō</i>	forearm
9	<i>di’ma</i>	elbow
10	<i>debe’ge kā’lē</i>	upper arm
11	<i>εⁱ</i>	shoulder
12	<i>tebi’gi</i>	collar bone

The Odoodee 2-cycle system is shown in Table 21. Hays stated that these are the numbers that “Odoodee people are currently using” and that for numbers greater than 5 they use English terms. In this system the word for ‘5’ is not constructed from the words for ‘1’ and ‘2’. It is likely, therefore, that this system was originally a 2, 5-cycle.

Table 21: An Odoodee 2-cycle counting system.

1	<i>hede’pe</i>
2	<i>’bakad’ō</i>
3 [= 2 + 1]	<i>’bakad’ō hede’be</i>
4 [= 2 + 2]	<i>’bakad’ō ’bakad’ō</i>
5	<i>de ’t’ado</i>

In Table 20, with the possible exception of *εⁱ* for ‘shoulder’, and *debe* in the construction of ‘10’, there is no convincing evidence of cognates with other East Strickland languages (*ey* is ‘shoulder’ for Febi; *debe* is hand for Samo). In Table 21, *hede’pe* for ‘1’ corresponds to the usage of both Gobasi

(*hele*) and Samo (*helēu*). No cognatic links are evident in the number terminology of Odoodee and those of any languages in the Bosavi family.

5. Discussion

5.1 Comparisons within the Strickland-Bosavi region

All the languages discussed above have a body-part tally counting system. With three exceptions the tally includes both sides of the body. In Edolo, at Bobole, the tally ends at the nose. Among western Edolo, at Aya, it is likely that the symmetrical tally is a recent innovation, perhaps in mimicry of neighbouring Bedamuni. In Konai the tally ends at the mouth. The asymmetrical tally reported for Odoodee (Fig. 5e) is likely to have resulted from recent attrition.

In the Bosavi area, tally points on the head vary between languages such that for systems with left-right symmetry – all except Edolo at Bobole – cycle length is either 33 or 35 (Fig. 4). For these languages, with the exception of Eibela, methods of counting beyond one cycle have been described. In the East Strickland area, cycle length in the two cases with pure left-right symmetry is 27 (Kubo) and 28 (Febi). In Samo, the number of tally points is considerably reduced. The tally reaches 16 but is truncated at the wrist of the ‘opposite’ side (Fig. 4e); without truncation, cycle length would have been 21. In Odoodee, truncation at 12 appears to be a result of post-contact experiences. Methods of counting beyond one cycle have not been described for any of the East Strickland languages and in two cases (Kubo and Febi) single informants have said it is not possible.

In Onobasulu the numeral 33 is indicated with the word *ogele no* (little finger, other side) but a full count of 33 may be indicated with the word *fula*. In Kaluli, the word for 1 is *agel* but the word for 35, which is marked by the little finger on the other side, is given by *fudɔː*. *Fudɔː* is presumably cognate with *fula* and, like the latter, indicates the full count. Again, the complete count in Bedamuni may be expressed as *fusuli fasi* rather than as *lai age* (33). In at least these three languages, therefore, the ‘whole’ of 33 or 35 is expressed as a singularity (cf. Mimica 1988: 53-59).⁹

The number of named body parts that are included in the body-tally systems of sampled languages is greater in Bosavi languages (17-18) than in East Strickland languages (11-15). The low count for Odoodee (12) probably reflects recent attrition but this is not the case for Samo (11). All fingers, the wrist, elbow and shoulder appear in the body-part tallies of all ten languages. With two exceptions, all parts that are named in the tallies of East Strickland languages are named in most Bosavi language tallies. The exceptions are both mid-line body parts: the ‘mouth’ in Konai and Febi, and the ‘crown’ in Samo. ‘Palm’, ‘heel of hand’, ‘collar bone’, ‘underneath ear lobe’ and ‘nostril’ are named in from one to six Bosavi languages but, with the exception of ‘palm’ and ‘collar bone’ which are found in Odoodee, do not feature in the tally counts of East Strickland languages. And, further, to the cut-off at numeral 12, the body-part tally system of Odoodee is more like that of neighbouring Bosavi languages than it is like that of East Strickland languages. Odoodee is geographically close to three Bosavi language groups – Kaluli, Eibela and Kasua (Fig. 3). Five named body parts appear in only one tally system. These are ‘heel of hand’, ‘underneath ear lobe’, ‘temple’, ‘crown’ and ‘nostril’; ‘mouth’ appears in only two. ‘Temple’ and ‘nostril’ simply replace ‘cheek’ and ‘side of nose’ in other languages but ‘underneath ear lobe’, ‘crown’ and ‘mouth’ have no equivalent in the other languages. The first of these three appears in a Bosavi language, the other two in East Strickland languages.

⁹ In counting beyond 35, Kaluli indicate the number of 35s by combining *fudɔː* with numerals 1, 2, 3 or, for larger numbers, noun-modified body-part counting words.

Our tentative judgement of similarity between pairs of East Strickland or Bosavi languages with respect to the names associated with body parts that feature in their tally systems is that the ratio of ‘apparent cognates to total shared body parts’ attenuates from north to south to a greater extent in the former than in the latter languages. The Bosavi languages, Edolo and Bedamuni are the most similar in this respect, sharing 88 percent of body-part names; the East Strickland languages, Kubo and Odoodee are the least similar, sharing only 30 percent of body-part names. Only one body-part name features as a cognate in all these languages. Nose has been variously represented as *mi* and *mio* in Bosavi languages from Edolo in the north to Kasua in the south and as *miou* (Febi), *mukuo* (Konai), *mi* (Kubo), *mĩnĩ* (Samo), ‘*mini*’ (Honibo), ‘*m;na*’ (Gebusi) and *mudu* (Odoodee) in East Strickland languages from Febi in the north to Odoodee in the south. the term for ‘eye’ features as a cognate in the counting systems of all Bosavi languages (*si*) and three of the East Strickland languages (*diho*).

A 2-cycle system is indicated for the East Strickland languages Konai, Samo, Gobasi and Odoodee but not for Kubo or Febi and not for any of the Bosavi languages. In Samo, Gobasi and Odoodee this alternate counting system is probably a 2, 5-cycle system. With respect to the occurrence of both body-part tally and 2-cycle systems, Lean’s (1991a,b) speculations concerning Strickland-Bosavi languages were correct.

In the Bosavi languages the names for the first two or three numerals used as noun modifiers differ from their analogues in the body-part tally system (Table 22). At some point thereafter, though this varies between languages, noun modifiers are formed by adding a suffix to the relevant body-part name. In all these languages the body-part names used for the first five numerals in the tally system are the same as those used for the last five; that is, the initial two or three numerals used as noun modifiers do not feature in the body-part tally system.

In three of the East Strickland languages (Kubo, Konai and Febi), the names for the first two numerals used as noun modifiers differ from the names for the first two body-parts in the tally system though in the Kubo case numerals ‘one’ and ‘two’ can replace body-part names in the tally count (Table 22). In Konai this may hold as well for the fourth numeral. In Samo and Odoodee, the names for the first five numerals differ from the names of the first five body-parts in the tally system (not known for Gobasi). In Samo, but not in Odoodee, the 2, 5-cycle system has merged with the body-part tally system such that numerals ‘one’ to ‘five’ from the former have replaced analogous body-part names from the latter.

5.2 Comparisons beyond the Strickland-Bosavi region: a matter of change

Lean (1991b, under Faiwol) wrote that “it appears to be generally the case that cultures which possess body-part systems also possess a separate counting system or set of numerals and number words” and “it is occasionally found ... that the two systems have been ‘hybridized’ and that the numerals 1, 2, 2+1, 2+2 have displaced the words for the four fingers (not the thumb) at the beginning, but not the end, of the tally cycle”. ‘Hybridization’ or ‘displacement’ appears to take many forms. Here we briefly summarize potential cases in Trans New Guinea languages from Southern Highlands Province (including Hela), Western Province and Sandaun Province – excluding the Strickland-Bosavi cohort – that are known to have body-part tally systems.¹⁰

¹⁰ The approximate years by which the counting systems of the language groups discussed were recorded are as follows: Aekyom (by 1964), Bimin (1993), Fasu (by 1981), Faiwol (by 1980), Kewa (by 1962), Mianmin (mid-1970s), Ningerrum (by

Table 22: Numerals as noun modifiers in Bosavi and East Strickland languages.

	EDOLO	BEDAMUNI	ONOBASULU	KALULI	EIBELA	KASUA
1	<i>afate</i>	<i>afae</i>	<i>ule</i>	<i>imilisi</i>	<i>imili</i>	not known or absent
2	<i>auda</i>	<i>aduna</i>	<i>aida</i>	<i>elɛl</i>	<i>a:ni</i>	
3	<i>hotowa</i>	<i>udiana</i>		<i>ot^halen</i>		
Noun modifier [tally point at which modifier is initiated]						
	<i>-lasi</i> [8 etc]	<i>-ale</i> [4 etc]	<i>-ba</i> [5 etc]	<i>-lefo</i> [5 etc]	<i>-ɛli/-ɛija</i> [? etc]	<i>-ipe</i> [3 or 4 etc]
Numerals incorporated into body-part tally system						
	No	No	No	No	No	not known
Same names for initial and closing numbers in body-part tally						
	Yes ¹	Yes	Yes	Yes	Yes	Yes
	KUBO	KONAI	FEBI	SAMO	GOBASI	ODOODEE
1	<i>dano</i>	<i>tanôu</i>	?	<i>helëu</i>	<i>hele</i>	<i>hedɛ'pe</i>
2	<i>baeu</i>	<i>bolou</i>	<i>beyô</i>	<i>bëau</i>	<i>'bihi 'non</i>	<i>'bakad'ɔ</i>
3				<i>behelɔ</i>	<i>bi'hɔno</i>	<i>'bakad'ɔ hedɛ'be</i>
4		<i>bolou bolou</i>		<i>bëauili bëauili</i>	<i>bi'hino</i>	<i>'bakad'ɔ 'bakad'ɔ</i>
5				<i>debe helɔfo</i>	<i>'de daga</i>	<i>de 'tado</i>
			Gobasi (alternative): 1 as <i>hele</i> , 2 as <i>bena</i> , 3 as 2+1			
			Samo, Gobasi and Odoodee: '5' is probably a hand morpheme			
Noun modifier [tally point at which modifier is initiated]						
	<i>-dia</i> [3 etc]	<i>-dia</i> [3 etc]	not known	not known	not known	not known
Numerals incorporated into body-part tally system						
	Can be	No	No	Yes	not known	No
Same names for initial and closing numbers in body-part tally						
	sometimes	not known BT cuts off at 14	not known	not known BT cuts off at 16	not known	not known BT cuts off at 12

¹ Based on data from Aya village.

In Southern Highlands Province, Kewa (Engan family) and Fasu (West Kutubu) have body-part tally systems with cycle lengths of, respectively, 47 and 35 (Franklin and Franklin 1962, Lean 1991a, Rauff 2003: 10). The Fasu system is identical with respect to named body parts and cycle length to that of Kaluli. In both Kewa and Fasu the words used for the first five numerals are the same as those used for the last five numerals. Kewa also has a 4-cycle system in which numbers are marked off on fingers and hands and the names used are not those found in the body-part tally system. There is no evidence of an additional counting system in Fasu. Hybridization is not found in either of these languages.

In Western Province, Aekyom (Awin-Pare), Ningerrum and Yonggom (Lowland Mountain Ok) have body-part tally systems with cycle lengths of, respectively, 23, 31 and 25 (Lean 1991b, Christensen 2010, 2013, Oates 2011).¹¹ In Ningerrum and Yonggom, names for the first five numerals match those for the last five numerals. (Not known for Aekyom.) In all three languages, however, the word for 'three' is a composite of the words for 'two' and 'one' and, in at least Aekyom and Yonggom, the names for fingers are not the terms used in the count. The implication is that in

2010), Oksapmin (before 1979, 2004-06), Setamin (2009, Baktamin dialect 1967-68), Telefol (by 1965), Tifal (by 1971) and Yonggom (by 2000).

¹¹ Lean, 1991b, reported a 30-cycle body-part tally for Ningerrum.

these languages a 2-cycle system, which is no longer extant, has been partially absorbed into the body-part tally system.

Faiwol, Mianmin, Telefol, Tifal, Setamin (including Baktamin) and Bimin, are Mountain Ok languages found in Western and Sandaun Provinces (Healey 1964: 110-111, Barth 1975: 21, Saxe 1981, Lean 1991b, Loughnane 2008, 2009, Mecklenburg 2010, Spencer and Van Cott 2010, Boush 2011, Healey 2011, Smith 2011, Weber 2011). Oksapmin has been usually treated as an isolate (Okasapmin family) but, more recently, Loughnane and Fedden (2011) have argued that it shares a genetic origin with the Ok languages. All have a body-part tally system with a cycle length of 27. Most commence on the little finger of one hand and terminate on the little finger of the other hand but in Bimin and Oksapmin the count commences on the thumb of one hand and terminates on the little finger of the other. In all but Mianmin the indicated body-parts are the same as those recorded for the Kubo counting system.

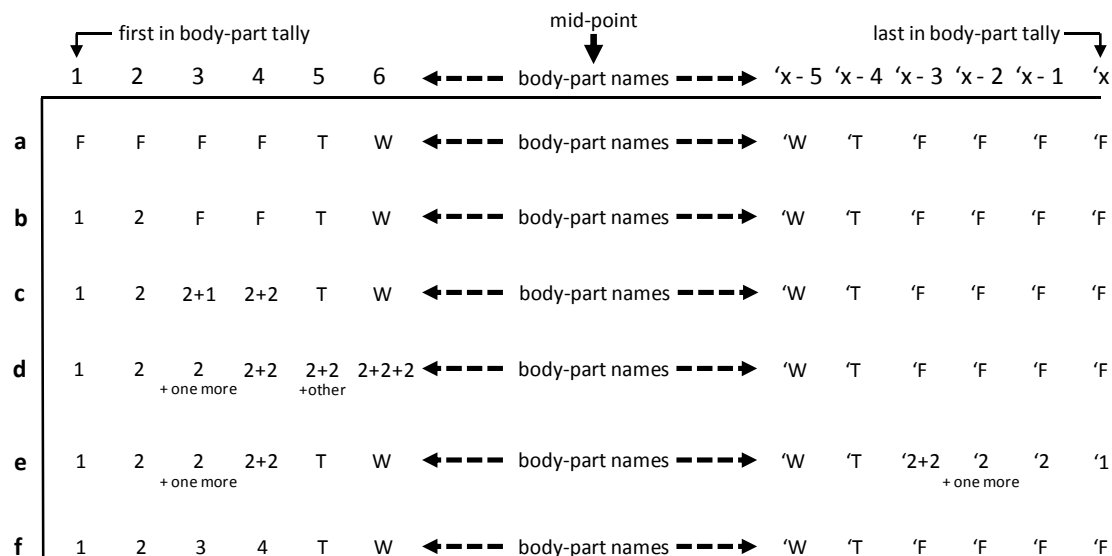
In Bimin and Oksapmin the names used for the first five numerals (1 to 5) are the same as those used for the last five numerals (23 to 27) and the tally numerals 2 to 5 and 24 to 27 are probably the names of the fingers. In Oksapmin, certainly, 1 and 23 are named for the thumb (tupən, Loughnane 2009: 335). There is no evidence of a 2-cycle system in Bimin. In Oksapmin, however, Saxe (2012: 205) indicates that a 2, 5-cycle system co-occurred with the body-part tally system “before Western contact” and notes that elements of this system remained in place by as late as 2001 (cf. Lean 1991c). The structure of the system is 1, 2, 3, 2+2, 5 where, as Loughnane (2009: 16-17) observed, 5 is given by the word for ‘fist’ (‘whole hand’).¹² The names for the numerals 1 to 5 in that system do not appear in the body-part tally system. Thus, in neither of these languages have elements from a 2-cycle system been incorporated into the body-part tally system (see Fig. 6a).

In Setamin the process of incorporation has been carried further. The numerals 1 to 4 in the tally system are not body-part names and have the form 1, 2, 2+1 and 2+2. The numerals 23 to 27 are, however, body-part names (Fig. 6c). In Mianmin the first six numerals of the body tally are not body-part names but derive from a 2-cycle system; they have the form 1, 2, 2+one more, 2+2, 2+2+other, and 2+2+2. The word for 23 is ‘thumb’, and though names for 24 to 27 were not recorded it is very probable that they were body-part names (Fig. 6d). In Faiwol, incorporation of a 2-cycle system into the tally system is evident at both the beginning and the end of the tally. The numerals 1 to 4 are not body part names and the numerals 24 to 27 are, respectively, represented by ‘other 4’, ‘other 3’, ‘other 2’ and ‘other 1’ (Fig. 6e).¹³ In Telefol and Tifal names used for numerals 1 to 4 at the start of the cycle differ from those used for 27 to 24 at the end of the cycle and it appears that the latter but not the former are the names of body parts (Fig. 6f). There is no evidence, however, that the numeral set was once part of a 2-cycle system; that is, none of the names appears to be a composite.

There is much variation in the languages discussed above with respect to the incorporation of numerals from a pre-existing 2-cycle counting system into a body-part tally system. An implication of

¹² In the Oksapmin 2, 5-cycle system the words for 1 and 2 are, respectively, *tit* and *yot(a)*. They serve as cardinal numbers where, for example, one complete tally count is marked by exclaiming “*tit fu*” (one complete round) and two complete counts by exclaiming “*yot fu*” (cf. Edolo where cardinals that are independent of body-part terms are employed to mark the first three complete cycles of the tally count.)

¹³ *Makow* is 1 and ‘other *makow*’ is 27 in Faiwol; in Tifal and Telefol the word for 1 is, respectively, *makup* and *maagop*. These are not the words for ‘little finger’ and, presumably, the same applies to Faiwol. We have relied on Healey (1965: 51) and Healey and Steinkraus (1972), rather than Healey (2010) and Boush (2011), in our interpretation of Telefol and Tifal counting systems.



F = finger, T = thumb, W = wrist.
 1, 2, 3 etc = numerals co-opted from 2-cycle counting system.
 Apostrophe indicates 'other side of body'.

Fig. 6: Incorporation of presumed 2-cycle numerals into a body-part tally counting system. Several possibilities are shown. a – no cooption of 2-cycle numerals, all tally points are named for and correspond to body parts. b – the first two numerals on the starting side of the body count have been coopted from a 2-cycle system. c – the first four numerals on the starting side of the body count have been coopted from a 2-cycle system. d – the first six numerals on the starting side of the body count have been coopted from a 2-cycle system. e – the first four numerals coopted from a 2-cycle system appear on both the starting side and finishing sides of the body count. f – the first four numerals on the starting side of the body count differ from the last four numerals but there is no linguistic evidence that the initiating four derive from a 2-cycle system.

these comparative observations is that where 2-cycle systems co-exist with body-part tally systems it may be relatively common – more common than Lean (1991b) implied – that numerals from the former are incorporated into the latter and that the 2-cycle system is, simultaneously, eroded and eventually lost. Faiwol may represent an extreme of this process in that numerals have replaced body-part tally points at both the start and the finish of the tally such that the tally points 24 and 25 – indicated by touching the middle and ring fingers of the right hand – are named as, respectively, 'other (for other side) 2+2' and 'other 2+1'. The same is true of Ninggerum and Yonggom but only with respect to the third and third-to-last tally numerals which have the form '2+1' and 'other 2+1'. In these languages it appears that the initiating numerals from a 2-cycle system serve as noun modifiers for small numbers and, occasionally, for numerals at the finish of a body-part tally. They are, effectively, cardinal numbers.

Data concerning East Strickland languages is consistent with the foregoing interpretation. Samo, Gobasi and Odoodee have an extant 2, 5-cycle counting system and in Samo, though not in Odoodee, the first five numerals from this system appear as the first five counting words in the body-part tally system (cf. Fig. 6d with the exception that the Samo word for 5 is a hand morpheme). There is an extant 2-cycle system in Konai but no evidence of an equivalent system in Kubo or Febi. In each of the latter languages, however, there are numerals for 1 and 2 that are not body-part names, with the word for 2 cognate with numeral 2 in Konai, Samo, Gobasi and Odoodee. In at least the Kubo

case, the numerals 1 and 2 may replace body-part names at the beginning, but not the end, of the tally count (Fig. 6b). In the Bosavi languages there is no direct evidence of a former 2-cycle counting system. The first two or three words used as noun modifiers bear no relationship to body-part names, and are not composites; they do not replace body-part names in the tally counts of any of the Bosavi languages. In Telefol and Tifal the initiating terms in the tally system are not body-part names and, though there is no evidence of an extant or former 2-cycle system, comparison with other Ok languages suggests that those terms do derive from an alternate counting system. The same, we suggest, is likely to be true of the initiating noun modifiers in the Bosavi languages.

Both before and since colonization the counting systems of Papua New Guinea have been prone to, sometimes rapid, change. This is evident in the observation that closely related languages may have distinct counting systems (Laycock 1975: 219), in Smith's (1988) analysis of Morobe counting systems, in the detailed study of changes among Oksapmin associated with shifts in introduced currency (Saxes and Esmonde 2005), in the move by eastern Edolo to match their counting system to that of their Huli neighbours, and in the many cases where local counting systems have either merged with, or been replaced by, Tok Pisin or English decimal systems. In different places, and at different times, the factors influencing change – and the trajectory of change if that exists – may vary. Lean (1992: Chapter 7), for example, promoted the role of diffusion, expressed as both borrowing and displacement. Smith (1988: 53) argued that in northeast Papua New Guinea, as speakers of Austronesian languages moved inland, and with increasing frequency established exchange relations with speakers of Papuan languages, “the means of computing exact totals and manipulating abstract amounts became redundant” such that their own decimal-series counting systems atrophied and “progressively came to resemble those of their non-Austronesian-speaking neighbours”. Mimica (1988: 141-42), by contrast, is attracted to the role of in situ individual creativity in generating alterations to local counting systems and, more recently, Saxe (2012) argues that selection favours (often metaphoric) variants which solve locally-emergent problems. Here, we suggest a process of change that differs from these accounts.

Numeral counting systems (e.g. 2-cycle systems and their variants) and body-part counting systems are different in one fundamental respect. In the former, but not in the latter, the words used may qualify as cardinal numbers without requiring the addition of a modifying suffix. On this count, numeral counting systems are more abstract, or abstract in different ways, than body-part counting systems. As Biersack (1982: 811) showed, however, the logic of the Paiela body-part counting system is “founded on concepts such as information and pattern” and, in this way, is an alternative to, rather than inferior to, the logic inherent in a numeral counting system. There is no suggestion of a separate numeral system in Paiela, but Biersack does not devalue a ‘logic of the concrete’.

In languages where 2- or 5-cycle and body-tally systems either co-occur or come into contact it seems likely that the former may be appreciated – may have utilitarian benefits – with respect to their elements being free of referents, but have the disadvantage (not insurmountable) that they become cumbersome as counting progresses to larger numbers. By contrast, in circumstances of contact, body-part tallies may be appreciated in that named body-parts provide an immediate mnemonic to tally points and in the (potential) ease of progression to large tallies, but may have the disadvantage that they are necessarily referential and, hence, not readily divorced from a commitment to bodily embeddedness and expression. The counting systems of the East Strickland and Ok languages, together with Aekyom (Awin-Pare), reveal to different degrees a process in which

the counting words of a tally system may be progressively disembedded from the body, a process in which tally points on the body may achieve the status of, at least, quasi-cardinal numbers. Indeed, the relatively rapid take-up of the English decimal system in Papua New Guinea – often translated into local languages and irrespective of its easy interpretation with regard to asymmetrical power relations – may be often underwritten by the same process.

At first sight, this argument cannot be easily extended to Bosavi languages. But here, perhaps, change may have followed a somewhat different trajectory. Among Edolo, by at least the late 1960s, the body-part tally system differed from that of related, neighbouring languages in being asymmetrical – in having a cycle length of 17 rather than 33. In addition, by at least the later 1970s, people were adapting their 17-cycle system to the 15-cycle system of Huli and, very often, were entirely comfortable counting to high numbers without touching, or otherwise indicating, body parts. In practice, therefore, though not in the implicit association of counting words with body parts, Edolo too were dissociating counting from bodily commitment.¹⁴ In Bosavi languages, more generally, such dissociation was evident in another way. Several reports (discussed above) direct attention to variation between individuals in the body parts that are touched or otherwise indicated in the course of tallying (e.g. eastern Edolo indicate 15 by touching the temple, western Edolo and Bedamuni touch the cheek; some Edolo people do not touch the neck to indicate 13 but, rather, indicate two positions on the ear; the Edolo word *giwi* is the generic word for ‘bone’ though the numeral it represents is indicated by touching the skin above the medial end of the ‘collar bone’; Eibela people touch ‘heel of hand’ and ‘wrist’ to indicate 7 and 8 but use words that are cognate with those that neighbouring Kaluli use for the tally points ‘wrist’ and forearm’ when the latter are counting). The implication is that the sequence of counting words in tallying has assumed greater salience than commitment to a one-to-one correspondence between indicated body part and its name. These features are seen to an even greater degree among neighbouring Huli (Enga family). When counting, Huli may indicate fingers and the toes on one foot to reach the tally terminus of 15 but, though they can and do count to high numbers, seldom use gestures beyond 15 (Cheetham 1978: 24). Nor are the counting words the names of fingers and toes. However, at least three of them are the names of body parts – ‘ear’, ‘nose’ and ‘eye’ – even though these body parts do not feature in the tally and even though one of Cheetham’s “elderly informants went so far as to suggest that any resemblance between the numerals and words for body-parts was purely coincidental” (1978: 16). Cheetham suggested that the counting system he observed was derived from a body-part tally system.¹⁵ Lean (1991a) suggested that the 14-cycle counting system of Duna was, similarly, derived from an earlier body-part tally system (see also San Roque 2008: 82-83).

In the pre-colonization era there were extensive relations of trade between Huli people and people of several Bosavi languages (Kelly 1993). Where exchanges that occur within groups, or

¹⁴ Among Onobasulu, as Stoppels-Dondorp (2010) observed, the number of people or things could be communicated non-verbally, and without tallying, merely by touching the appropriate part of the body. Gesture implicitly modified the noun.

¹⁵ Lomas (1988: 193-194) includes ‘chest’ as a named body part and states that “the system is taught by counting first the fingers and thumb of one hand, and then proceeding up the arm, across to the chest, and then on to the head, the final unit counted being the nose, *ngwi* – which is the name given to 15. Hammarström (2010b: 31) asserts that the Huli counting system “is clearly an original body-tally system with a cycle of 29 – midway/centerpoint is thus 15 – which under influence from a Tok Pisin base-system turned into base-15”. We see no evidence for the second of these assertions. Indeed, by 1977, Huli had already adopted a decimal system in which, for example, using their own counting words, 25 would be given as “ten, two, -add, five” (Cheetham 1978: 23). Goldman’s (1983: 250-251) discussion of sanctions associated with sexual intercourse and the notion of time among Huli suggests that their 15-cycle system may, in fact, be linked to the lunar cycle.

between closely related groups, are likely to prioritize equivalence of the items exchanged and the relationality of transactors (Ernst, 1978, on Onobasulu) the exchanges that occur between unrelated groups may be increasingly based on the commensurability of difference and the anonymity of transactors (e.g. Jorgensen 1991: 268-69, Minnegal and Dwyer 1999). As Smith (1988) suggested in his discussion of Morobe counting systems, patterns of trade may indeed influence patterns of change in counting systems. Exposure to the counting system of Huli, in a context of trade, could well have provided Bosavi language groups with the impetus to initiate a process of disembedding their counting systems from commitment to bodily referents and, thereby, progressively foreground cardinality which is the ground upon which the commensurability of difference may be expressed.

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