Rarities in Numeral Systems

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1 Introduction

The paper surveys rarities in numeral systems across the world. Space permits us only to look at the most interesting kinds of rarities that exist in gigantic set of languages in the world. The study aims at a high level of preciseness as to what counts as a numeral and what counts as rare, and doubtful cases will be treated pre-emptively in footnotes.

1.1 Numerals

1.2 What are Numerals?

In this paper, I define mumerals as:

1. *spoken*
2. *normed expressions* that are used to denote the
3. *exact number* of objects for an
4. *open class of objects* in an
5. *open class of social situations* with
6. *the whole speech community* in question

With the first point I mean to disregard symbol combination systems, e.g. Roman numerals, that are confined to written communication, but of

course most (actually all) of our primary data come from written representations of the spoken language.

The second point serves to exclude expressions that also denote exact numbers, but are not the normal or neutral way to say those numbers, e.g. 'eight-times-nine-and-another-two' for the normal 'seventy-four', but also to demarcate the area where the numeral system ends, which is, when there aren't any normed expressions.

As for the third point, languages usually have a rich set of expressions for inexact quantities, 'a lot', 'few', 'really many', 'about fifty' (but hardly *'about fifty-one') that have relatively high frequency in discourse. These are interesting in themselves but will not be included here because of their different fuzzy nature compared to exact number expressions.

Concerning the fourth point, some languages have special counting systems for a restricted class of objects (e.g. in Wavulu (Hafford 1999) for counting coconuts). These can be quite idiosyncratic and since all languages which have exact enumeration must have a means for counting an open class of objects it is better to study that.

The reason for the fifth point, the requirement on social situations, is to take a stand on so-called body-tally systems (cf. Laycock 1975). A body-tally-system may be defined as follows. Assume a sequence of body parts beginning with the fingers of one hand continuing with some points along the lower and upper arm, reaching one or more points of the head, then ending with the corresponding body-parts on the opposite arm and finally hand. A number n is then denoted by the nth body-part-term in the sequence, e.g. 'nose' or 'elbow on the other side'. There are features that distinguish body-tally systems from other counting systems with etymologies from body parts. Non-body-tally systems use only fingers, toes, hands, occasionally eye and head, whereas body-tally systems always use some intermediate points, such as elbow, shoulder or nose, and let them form a sequential order from one side of the body to the other. 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. The information on the social status of the body-tally numeral systems is very incomplete; I can say that for the vast majority we do not have such information, but for those in which we do, the social situation restriction applies. 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. For in-

stance, de Vries (1998) found that body-tally numerals in a Bible translation could not be understood, i.e., were often mis-translated back to Indonesian by bilingual persons. Of course, there could be some other language(s), unknown to me at present, where body-tally numerals can be used in a fully open class of social situations; such a body-tally system would accordingly be included in the study. Body tally systems are attested in abundance in Papua New Guinea and Irian Jaya, especially in the highlands Lean (1992) and, even if in decline, are still used today. Although many writers have neglected to mention it, there are also indisputable attestations of long extinct body-tally systems from the Torres Straits (Haddon 1890) (Ray 1907, 46,86-87) and mainland Australia(!) (Howitt 1889; Howitt 1904).

Finally, regarding the sixth point, I am not interested in numeral systems which are particular to some small subsets of the speakers of the language in question (e.g. professional mathematicians) because such systems might not respond to the conditions and needs of the majority of a society.

Numerals provide a good testing bed for patterns across languages given their comparatively clear semantics and modularity. As to numeral semantics, languages may differ as to which quantificational meanings they express/lexicalize, notably in approximate numeration and whether a counted set of objects constitute a group or not, but these matters are minor compared to differences languages show e.g. in verbal tense/aspect. Likewise, although not universally, numerals tend to have uniform, clearly identifiable, syntactic behaviour within a language. Also, if two languages have exact numeration for a certain range of numbers, one expects the two to give a similar functional load to these expressions, excluding possibilities such as numbers also being used for, say, colours or as metaphors significantly wider in one language or the other. This appears sound also in the light of the only corpus study of numeral frequencies in a language with a small numeral system (McGregor 2004, 204), which shows that 'one' and 'two' in Gooniyandi occur with comparable frequency to 'one' and 'two' in English.

1.3 Rareness

The basic meaning of rare would be simply 'present in few languages'. Unfortunately, as is well-known, languages of the world are not independent observations, so this view is infelicitous for those who want to understand rare as in 'present in few independent languages'. To overcome this, we shall take rare to mean 'present in few geographical spheres' so that features which

exist in many places in the world (thus presumably being independent innovations) will not count as rare, but, features which are restricted to only one or a few places in the world will count as rare even though they may be spread onto many languages (most likely due to contact and/or inheritance).

1.4 Survey

Lots of data is available in one form or another for numerals. It seems that numerals together with pronouns, kinship terms, body part terms, and other basic vocabulary (sun, water, etc), and perhaps "sketchy" phonological inventory, are the parts of language where there exists empirical data for a really large subset of the world's known languages. One may legitimately ask just how large this subset is when it comes to numerals – for how many languages do we have data on numerals? Let's say we count about 7000 attested native spoken languages for the world. A definite lower bound is 3880, since I can produce a list of references to numeral data from 3880 definitely distinct languages. An upper bound is harder to give. I entertain the rather time-consuming methodology of trying to obtain every first-hand descriptive data reference found in any handbook or relevant publication whatsoever. The survey that this paper is based on the data I have collected so far. I currently have about 8000 references, some describing numeral systems of many languages in the same publication, but it is impossible to say at this point how many languages they account for since they attest dialectal varieties, varieties from the same location but different centuries, partial data, data of varying quality, duplicated data, etc. I also have about a 1300 more references that I have not yet been able to obtain (which may contain further references).

In addition to first hand sources, I have also drawn inspiration from the rich existing literature on numerals in general. The subject, in fact, goes back more than 200 years in time – the first major work being the remarkable *Aritmetica Delle Nazioni* by Hervás y Panduro (1785). Since then, my bibliography counts some 11 PhD:s, 64 monographs and 400+ articles to have appeared. These range from purely descriptive accounts to areal, comparative-historical, typological, and deep syntactic studies – solely devoted to spoken language numerals as defined above. (The literature on written symbol systems for mathematics is even more voluminous.) However, since most of the literature just re-hashes the same data, the recourse to first-hand sources is essential in order to understand the true diversity in

1	tz'ui	11	tz'ui-sofa
2	tz'ana	12	tz'ui-ana
3	dato	13	datui'a
4	na	14	nei'a
5	tano	15	tamud'a
6	tz'uinho	16	nemol'a
7	tz'aio	17	tz'ai-nhoba *or* tuai-nhoba
8	sebereto	18	tz'ui-munho *or* sebereto
9	moia	19	mola-moia
10	mola	20	-

Table 1: A unique attestation of Kwadi numerals which show a peculiar mix or borrowings and peculiar formations for 11-19.

numerals in the world's languages.

There are many first-hand sources which are the only independent source for the numerals in the language in question. A couple of these show such peculiar features that I think there must be some error, wherefore they are excluded from this presentation, but it is also possible that they are instances of rare features. A good example of such a case is Kwadi, whose numerals (shown in Table 1) were taken up by adventurers (Capelo and Ivens 1886). It is not likely that there exist any other attestations of the numerals above two in fieldnotes and the language is presumed extinct (p.c Tom Güldemann 2006).

2 Rarities

2.1 Rare Bases

Perhaps the most salient single characteristic of a numeral system its base, or more correctly speaking, its set of bases. The *set of bases* of a natural language numeral system may be defined as follows.

> the number n is a base iff
>
> 1. the next higher base (or the end of the normed expressions) is a multiple of n; and

2. a proper majority of the expressions for numbers between n and the next higher base are formed by (a single) addition or subtraction of n or a multiple of n with expressions for numbers smaller than n.

This assumes that for any expression the linguist can unambiguously analyze each numeral expression into its constituent parts (or analyze it as consisting of only one part). As an example, for Swedish we would begin by finding the biggest part of the highest normed expression, which according to my own knowledge is *miljard* (10^{12}). Thereafter we can find the next lower base by trying divisors x of 10^{12} to see if the numbers between x and 10^{12} are expressed in the required form. E.g. $x = 5 \cdot 10^{11}$ is not because we do not say **en-halv-miljard plus ett* (*half-a-billion plus one) or the like for $5 \cdot 10^{11} + 1$ or any, let alone a majority, of the numbers between $5 \cdot 10^{11}$ and 10^{12}. However, 'miljon' (10^9) fulfils the requirements and, continuing with the same analysis for lower and lower numbers, we arrive at the conclusion that Swedish has $\{10, 10^2, 10^3, 10^6, 10^9, 10^{12}\}$ as its set of bases.

The definition of base as stated gives unambiguous decisions for formations which are sometimes (and sometimes not) called base by other authors; systematic subtractions, special lexemes for base-multiples, or isolated cases of addition, e.g. only 7=6+1 but otherwise no additions involving 6. Examples of such cases and their systematic resolution with my definition are given in Table 2. It is important here to note that there doesn't have to be a monomorphemic word for something that is a base. In the case of Kare, at least if we assume that the numbers above 20 are formed parallel to 30, then 20 is a base. Further, 10 or 15 are not bases even though the words for them monomorphemic – the definition interprets them as special words for multiples of 5, just like some base-10 systems have monomorphemic words for 20, 30, ..., 90.

The expression 'base-x system' will be used to mean that 'x is in the set of bases' for the numeral system in question. Similarly, 'base-x_1-...-x_n' system will mean that all of x_i is in the set of bases, without any commitment that the $x_1, \ldots, x_n$ should exhaust the set of bases.

2.1.1 Rare Bases #1: No Base

There are a number of languages, all in the Amazon, for which there is an explicit statement that they lack (exact) numerals above one. These are

	Lutuami (Klamath-Modoc) (Dixon and Kroeber 1907, 673)		**Nyokon** (Niger-Congo) (Richardson 1957, 30)		**Kare** (Niger-Congo) (Dijkmans 1974, 147)		**Ainu** (Isolate) (Refsing 1986, 110)	
	Analysis	Expression	Analysis	Expression	Analysis	Expression	Analysis	Expression
1	1	nas	1	ámɔ̀	1	emotí	1	sine
2	2	lap	2	àfɔ́ɔ̀	2	ibili	2	tu
3	3	ndan	3	átár	3	etotu	3	re
4	4	umit	4	ɟnnɲs	4	biu	4	ine
5	5	tunip	5	ɟtɔ́ɔr	5	etano	5	asikne
6	5+1	nas-ksapt	6	átʃɟn	5+1	etano na emoti	10-4	iwan
7	5+2	lap-ksapt	6+1	ɟtʃɟn námɔ̀	5+2	etano na ibili	10-3	arwan
8	5+3	ndan-ksapt	?	ɟyáá nɲ màn	5+3	etano na etotu	10-2	tupesan
9	10-1	nas-xept	8+1	ɟyáá nɲ màn námɔ̀	5+4	etano na bînu	10-1	sinepesan
10	10	te-unip	10	àwát	10	la-ato	10	wan
11	10+1	taunep-anta nas	10+1	àwát ámɔ̀	10+1	laäto na emoti	10+1	sine ikasma wan
...	...	...	...	...	...	...	...	...
15	...	...	...	...	15	sanga		
16	...	...	...	...	15+1	sanga-na-emoti		
...	...	...	...	...	...	...		
20	2x10	lap-eni taunep	20	nɲtʃɟn	2x10	atumbili	20	hot
21	2x10+1	lap-eni taunep-anta nas	20+1	nɲtʃɟn ámɔ̀	...	...	20+1	sine ikasma hot
...	...	...	...	...	...	...	...	...
30	3x10	nda-ni taunep	3x10	àwát átár	2x10+10	atumbili na laato	20+10	wan e tu hot
...	...	...	...	...	...	...	...	...
40	...	...	...	...	...	...	2x20	tu hot
Base	**5-10**		**10**		**5-20**		**5-10-20**	

Table 2: Examples of formation types and outcomes of the definition of base.

Nadëb (Weir 1984, 103-104), pre-contact Mocovi (Grondona 1998, 91) (cf. (Gualdieri 1998, 294-295) and for the related Pilagá (Vidal 2001, 129)), pre-contact Jarawara (Dixon 2004, 559), Jabutí (Aikhenvald and Dixon 1999, 358) (cf. van der Voort 2004, 212), Canela-Krahô (Green 1997, 181), Krenák (Loukotka 1955, 125), Chiquitano (Adam and Henry 1880, 19) (cf. Tormo 1993) as well as "all" Campa and Machiguenga groups, Arawán Culina, Arabela and Achuar (Wise and Riggle 1979, 88).[1] The Papuan Fuyuge language probably belongs here too, as one description says the the 'two' word is also used for a small number (Ray 1912, 313-314) – the uncertainty lies in the fact that there is a word listed as 'three' but no explicit statement to the fact that this, like 'two', also has an inexact meaning.

To lack numerals above one means that the normed expressions for the quantities above one are inexact. In these languages, it may (I daresay is), possible to communicate a higher exact quantity successfully, perhaps using gestures, context, one-to-one pairings, repetition or a specialized lexical item e.g. 'twin' for a certain kind of exact quantity. However, in these languages, the normed expressions are still 'one', 'a few', 'many', ... when these quantities occur in discourse. In no case does it appear to be possible, or normed, to say few+1, 1+1 or few+few to designate an exact number, so there is no base.

Pirahã, also in the Amazon, stands apart from these cases in that the documentation is much more elaborate and that it is argued to lack all exact numerals, i.e. there is no normed way to denote the exact quantity 'one'. There are two words which prototypically mean 'one' and 'a couple' respectively, but it has been checked fairly extensively that their meanings are fuzzy 'one' and 'two' rather than discrete quantities (Everett 2005; Everett

[1]Further possible cases include Esmeralda (Barriga Puente 1998, 263), but this is contradicted in (Lehmann 1920, 37). It is hard to know whether the Guayakí variety recorded from two youths by Vogt extended to a whole community of speakers (Vogt 1903, 861). On the grounds that the present-day numerals can be etymologized to 'that', 'pair/couple', 'few' and 'another', proto-Tupi (Schleicher 1998, 12-13) may be argued to lack numerals. Bernatzik (1942) claims that Yumbri lacked numerals above one. There is no further material on this variety but the closely related Minor Mlabri (Rischel 1995) has numerals up to three. Bernatzik's account has a sweeping and condescending flavour, and also has other doubtful claims of the same kind, e.g. lack of fiction which does not hold for Minor Mlabri either. Another complicating factor is that he is able to discuss twin births at length with the people he says cannot comprehend any more distinctions than 'one' and 'many'. The oft-repeated lack of numerals in Vedda (Parker 1909) appears, on closer scrutiny of the underlying sources, to be hearsay.

2004). It is not possible to combine or repeat them to denote higher (inexact?) quantities either (Gordon 2004). The Pirahã have the same cognitive capabilities as other humans and they are able to perform tasks which require discerning exact numeration up to the subitizing limit, i.e. about 3 (Gordon 2004). They just do not have normed expressions even for low quantities, and live their life happily without paying much attention to exact numbers. It does not appear to be possible to express an exact quantity simply by repeating an expression the appropriate number of times, like one can and often does in e.g. Sanuma (Borgman 1990, 152) for 2 and 3. If one says "I'll be back after it gets dark and it gets dark again" this might just as well be interpreted as two days or as three days (p.c Daniel L. Everett 2005). It is quite possible that there are more cases like Pirahã that have gone unnoticed because of the documentational depth required to assure that the meanings of the numerals are fuzzy rather than exact. A wordlist of the only known relative of Pirahã, the extinct Mura language, features words glossed 'one' and 'two' (Nimuendajú 1932). The 'one'-word is an obvious cognate to the Pirahã fuzzy one, and the 'two'-word is an obvious loan from some Tupi language. I am not aware of any further information.

There are anywhere between 500-1500 attested languages with 1,2,many-systems, from Australia, Southeast Asia, Papua New Guinea, South America and a few in North America. In all the cases I can remember, either the source explicitly gives formations like 2+1 and 2+2 or the source is silent on the possibilities to do so. Within all these cases it would be surprising if there weren't more cases where such formations are illegal, and thus base would be lacking.

2.1.2 Rare Bases #2: Base-3, Base-4

In contrast to base-2 and base-4, base-3 appears to be very rare. I know of only two cases[2]. The first is Waimirí (Atroarí dialect) according to Green (1997, 6-7) who cites personal communication with Ana Carla de Bruno Santos. (I was not able to find more information about this is in the more recent grammar by Bruno (2003, 140-142), which states that Portuguese loans are used above 3.) The second case is Som in Papua New Guinea (Smith 1988, 29). Both the Waimirí-Atroarí and Som systems end at approximately

[2]There may be one more case – an Abulas dialect survey (Wilson 1976) says that the Wingei dialect counts in units of three, but the actual forms are not given there. I was not able to access further Abulas materials to clarify the case.

9.

In contrast, base-4 systems are attested on four continents:

North America: Ventureño Chumash in North America (Beeler 1967; Beeler 1963) which ran up to 32.

South America: Lule (Clark 1937, 102) and poorly attested Churrúa (Ibarra Grasso 1939b, 202) appears to have had base-4 up to 10, at which point counting is quinary-decimal. It cannot be inferred from the data hand that there was ever true base-4 system here. A couple of descriptions of a Guaraní variety in Paraguay show base-4 up to 10, but the expressions for numbers above 10 are not shown (Ibarra Grasso 1938, 278) (Ibarra Grasso 1939a, 590). Other old and new descriptions of any varieties of Guaraní (there are too many to list) do not show any traces of base-4. All these cases occur within a relatively small area of South America, but there is otherwise little evidence for an areal connection.

Papua New Guinea: Cases are discussed by Lean (1992, Ch.5).

Africa: Kutsch Lojenga (1994, 353-357) gives a good attestation of an almost obsolete 4-32 system in Ngiti (shown in Table 3). There are further poor attestations/traces of base-4 in both Central Sudanic and Bantu languages in the same narrow region (Struck 1910; van Geluwe 1960; Johnston 1902; Johnston 1920; Lojenga 1994; Bokula 1970; Bokula and Ngandi 1985). I do not want to say anything definite until I have had the chance to access other descriptions of languages in the same area, but an areal connection seems very likely.

The language called ¯Afúdu by Koelle (1854) uses some additions with 4 in the numbers below 10 but is decimal in the range 10-20, so it is not base-4 according to my definition. The language has never been sighted again (p.c Jouni Filip Maho 2004). Also, the Tibeto-Burman language Bodo has some additions with 4 in some sources but is not base-4 according to my definition (Bhattacharya 1977; Bhat 1968).

2.1.3 Rare Bases #3: Base-5-25, Base-6

Gumatj seems to be unique in the world having a 5-25 (upto 625) system. Although one would not usually use exact numbers for counting this high in this language, these numbers were known to older speakers, could be used

Ngiti (Central Sudanic) (Kutsch Lojenga 1994)

1	atdí	11	otsi-vi	21	àbà dɔ̀ atdì
2	ɔyɔ	12	otsi	22	àbà dɔ̀ ɔyɔ
3	ɨ̀bhʉ	13	otsi dɔ̀ atdì	23	àròtsí-vi
4	ɨ̀fɔ	14	otsi dɔ̀ ɔyɔ	24	àròtsí
5	imbo	15	ɔpɨ-vi	25	àròtsí dɔ̀ atdì
6	aza	16	ɔpɨ	26	àròtsí dɔ̀ ɔyɔ
7	àrʉ̀bhʉ̀	17	ɔpɨdɔ̀ atdì	...	...
8	àrʉ̀	18	ɔpɨdɔ̀ ɔyɔ	28	àdzòro
9	àrʉ̀gyètdí	19	àbà-vi	...	...
10	ɨdrɛ	20	àbà	32	wădhɨ̀

64	ɔ́yɔ̀ wădhɨ̀
96	ɨ̀bhʉ wădhɨ̀
128	ɨ̀fɔ wădhɨ̀

Table 3: An old, remembered only by the elderly, base-4 counting system in Ngiti.

for an open class of objects, and there existed a traditional cultural practice where they would frequently be used to count turtle eggs (Harris 1982; Sobek 2005). All others systems with base-5, and there are several thousand, have 5-10-20 or 5-20 if they go as far as 25.[3]

Three base-6 systems from Frederik-Hendrik-Eiland are given in Drabbe (1949), namely Kimaghama, Riantana and Ndom. The numerals given for Ndom are reproduced in Table 4, since it is less clear from the attestation for the other two that we are dealing with an unambiguous base-6 system. The three languages have generally assumed to be genetically related at least since Voorhoeve (1975) but the numeral morphemes in question have no obvious cognates. Kluge (1938, 148) reproduces vocabularies taken up from Frederik-Hendrik-Eiland by Nevermann in 1933-1934 (Nevermann 1935). These are of poor quality but partly contradict the more reliable ones taken up by Drabbe (who was not a trained linguist either). However, one vocabulary

[3]The extinct Saraveka has 'five hands' attested for 25 but no numerals 20-24 nor above 25 are recorded (de Créqui-Montfort and Rivet 1913). The 5-25-50 counting system referred to in Schmidl (1915, 181) was for counting pearls only (Laman 1968; Laman 1912; Laman 1936).

labeled Täri-Kalwa (= village names where Kimaghama is spoken (Drabbe 1949, 1)) provides an independent attestation of base-6 if one allows a likely 'correction' to be made (otherwise it is 6-13!). There is no information on the counting system in the more recent ethnographic work by Serpenti (1965).

Kanum, not very far from Frederik-Hendrik-Eiland, is argued to be base-6-36 in Boelaars (1950, 199), Galis (1969) and the Bädi variety Comrie (2005, 213), but I have not seen the full set of actual forms – though they presumably exist in Drabbe's and Donohue's fieldnotes. Furthermore, Williams (1936, 225-227) describes the use of a base-6 system used for counting taitu (a smaller variety of yams) with the groups he labels Keraki (nowadays better known as the Nambu group), who would normally use a base-5 system. The base-6 system was imported from the Gambadi and Semariji villages, where dialects of the same language, named Kunja, are spoken. Kunja is close linguistically and geographically to Kanum. The words for 1, 2, 36, 216 and 1216, all monomorphemic, can be found in the text. There must be some connection because the word for 36 is an obvious cognate to the Bädi Kanum counterpart given in Comrie (2005, 213), but the only other word shown in both places, viz. two, does not appear to be cognate. Note that, both the Nambu languages and the Kanum languages, are assumed to be genetically related since Wurm (1975, 330), based on lexicostatistical percentages in the approximate range 25% to 35%.

Balanta is sometimes claimed to be base-6 after Schmidl (1915, 192) who cites 1-12 from Koelle (1854) but as we do not know the continuation, it is unsure whether the 6:s generalize (cf. Wilson 1961a). Also, later attestations give different, non-base-6, forms (Wilson 1961b; Quintina 1961; Fudeman 1999).

2.1.4 Rare Bases #4: Base-12 Attestations

Dhivehi of the Maldives has a long extinct base-12 which is attested up to 96 thanks to the efforts of Fritz (2002, 107-123).[4] Apart from that case, there are base-12 systems in the Plateau area of northern Nigeria. The

[4]With some speculative etymologizing, Chepang may have had 12 atoms for a counting system associated with hunting (Caughley 1988; Hale 1973). One synopsis of Brúnkajk (Arroyo Soto 1972, 32) says that "también se cuenta por medio de docenas", but it is not clear to me on what this statement is based. It is not corroborated by a ten or so other descriptions of Brúnkajk, and it was not normed anyway, so it does not count as a base-12 system.

Ndom			
1	sas	18	töndör
2	thef	19	töndör abo sas
3	ithin	...	...
4	thonìth	24	töndör abo mer
5	merègh	...	...
6	mer	36	nif
7	(mer) abo sas	...	...
8	(mer) abo thef	72	nif thef
9	(mer) abo ithin	...	...
10	(mer) abo thonìth	108	nif ithìn
11	(mer) abo merègh	...	...
12	mer an thef	144	nif thonìth
13	mer an thef abo sas	...	...
...	...	180	nif merègh

Table 4: The base-6-36 system attested for Ndom.

first known attestations of such systems[5] come from the famous *Polyglotta Africana* by Koelle (1854) which includes numerals 1-20 in a number of West African languages. Since then I have not been able to find any independent attestations until 1917. As shown in Table 5, I have tried to collect all independent attestations beginning from 1917 (that have been published, or, unpublished but available on the internet). However, not all of them are necessarily independent as this information is not always deducible from the text. It is likely that there are a few more attestations in publications that I do not have access to.

As can be seen, the base-12 systems occur in languages that belong to different language (sub)families, but occur in the same area, namely the Jos Plateau of Nigeria. It seems certain that the existence in the Jarawan Bantu language(s) is due to borrowing (Maddieson and Williamson 1975, 136) (Gerhardt 1997, 140-141). Also, since Chadic is fairly well-known and (traces of) base-12 systems are not found in wider Chadic we may infer that the Chadic languages of this area borrowed them or invented them. Much

[5]However, vocabularies including 1-12 are listed for Hyam (there called 'Java') a few years earlier (de Castelnau 1851, 59).

Language	Source	Type	Family	Comment
Amo	(Luzio 1973)	Cont.-10	E. Kainji	
Birom	(Bouquiaux 1970)	12-144	Plateau	
Birom	(Thomas 1920a)	"12"	Plateau	
Burum	(Johnston 1921)	"12"	Plateau	
Tahoss	(Blench 2006g)	$\leq$ 12	Plateau	
Eloyi	(Mackay 1964)	12+	Idomoid	
Eloyi	(Armstrong 1983, 97)	"12"	Idomoid	
Aten	(Bouquiaux 1964)	12-144	Plateau	
Aten	(Blench 2006d)	$\leq$ 12	Plateau	
Nungu, Ninzam, Mama, S. Mada	(Mathews 1917)	12-144	Plateau	
Ninzam, Mada, Nungu, 4xMama, extinct Afu	(Thomas 1920b)	"12"	Plateau	Uncertain: Arago, Kagoma, Agatu, Apu
Mada	(Blench and Kato 2006)	$\leq$ 12	Plateau	
Kantana	(Gerhardt 1987)	"12"	Jarawan Bantu	
Mama	(Thomas 1927)	$\leq$ 12	Jarawan Bantu	
Sura	(Jungraithmayr 1963)	"12"	W. Chadic	
Ron von Daffo	(Seibert 1998)	12+	W. Chadic	Not confirmed in (Jungraithmayr 1970)
Hyam	(de Castelnau 1851, 59)	$\leq$ 12	Plateau	
Hyam	(Meek 1931)	12-144	Plateau	
Hyam	(Thomas 1920a)	$\leq$ 12	Plateau	
Tesu, Hyam	(Blench 2006f)	$\leq$ 12	Plateau	
Janji, Gure, Kahugu	(Meek 1931)	"12"	E. Kainji	
Janji	(Shimizu 1979)	$\leq$ 12	E. Kainji	
Iguta	(Shimizu 1979)	12+	E. Kainji	
Sanga	(Shimizu 1979)	$\leq$ 12	E. Kainji	
Lemoro	(Shimizu 1979)	$\leq$ 12	E. Kainji	Not Cokobo
Afo, Ganawuri, Irigwe, Jaba, Janji	(Bouquiaux 1962)	"12"	Plateau/E. Kainji	
Rop, Teria/Fachara, Afo, Ganawuri	(Meek 1925, 142-143)	12+	Plateau/E. Kainji	
Tyap (Gworok)	(Adwiraah 1989)	"12"	Plateau	
Tyap (Gworok)	(Gerhardt 1987)	$\leq$ 12	Plateau	Not confirmed in (Gerhardt 1968)
Eggon	(Blench and Hepburn 2006)	$\leq$ 12	Plateau	
Eggon	(Gerhardt 1983, 47)	"12"	Plateau	Not confirmed in (Sibomana 1985)
Eggon	(Gerhardt 1987)	"12"	Plateau	Cites Gospel 1935 + Lukas 1952 fieldnotes
Eggon	(Shimizu 1975)	"12"	Plateau	
Gwandara	(Shimizu 1975)	"12"	W. Chadic	Citing P. Newman p.c
Zarek-Gana	(Gerhardt 1987)	"12"	Plateau	Citing BCCWL
Koro	(Gerhardt 7273)	"12"	Plateau	
Koro	(Thomas 1920a)	12+	Plateau	
Jere	(Shimizu 1982)	$\leq$ 12	E. Kainji	Not Sheni, Ziriya, Gana, Taura, Shau, Gyem, Gamo
Boze	(Nengel 2004)	$\leq\leq$ 12	E. Kainji	
Akwẹrẹ clan of Boze	(Nengel 2004)	$\leq$ 12	E. Kainji	
Piti	(Matsushita 1998)	"12"	E. Kainji	
Mumuye	(Matsushita 1998)	"12"	Adamawa	Not Zing Mumuye pace (Shimizu 1983)
Nimbia-Gwandara	(Matsushita 1998)	12-144	W. Chadic	
Yeskwa	(Thomas 1920a; Gerhardt 2005)	12+	Plateau	Not confirmed in (Blench 2006h)
Kaningkom, Lungu	(Gerhardt 1987)	"12"	Plateau	
Rigwe	(Gerhardt 1987)	"12"	Plateau	
Rigwe	(Gerhardt 1969, 125ff)	$\leq$ 12	Plateau	
Che (Rukuba)	(Gerhardt 1987)	Spec.-12	Plateau	Cites BCCWL. Not confirmed in (Blench et al. 2006)
Dyarim	(Blench 2005)	Spec.-12	Chadic	Etymological Connection
Gwara	(Wolff 1975)	Spec.-12	Chadic	Has 12 atoms (but no other evidence for base-12)
Ninkyop	(Blench 2006e)	$\leq$ 12	Plateau	
Ganang	(Blench 2006c)	$\leq\leq$ 12	Plateau	
Cara	(Blench 2006b)	$\leq\leq$ 12	Plateau	
Ake	(Blench 2006a)	$\leq$ 12	Plateau	
More possible cases	(Migeod 1913, Vol. II)	Spec.-12	Chadic/Plateau	Partial Wordlists
More possible cases	(Williamson and Shimizu 1968; Williamson 1973)	Spec.-12	Chadic/Plateau	Partial Wordlists

Key	Author Gives	Key	Author Gives
12-144	Forms $\leq$ 12, forms 12+x, multiples of 12, word for 144	"12"	Has/had a "duodecimal system" (no forms given)
12+	Forms $\leq$ 12, forms 12+x or multiples of 12	Cont.-10	10-system contaminated by forms following a "duodecimal system"
$\leq$ 12	Forms $\leq$ 12	Spec.-12	Some duodecimal connection can/has been speculated

Table 5: Published attestation of base-12 systems in the Plateau area from 1917 and on. Note: Aten = Ganawuri, Afo = Apu = Eloyi, Birom = Burum, Tahoss is a dialect of Birom, Kantana = Mama and Boze is mutually intelligible with Jere.

less is known about the Benue-Congo subfamilies involved and their history. Thus, even if we hold that polygenesis is less likely than borrowing, all we can say is that the base-12 systems were invented in the Jos plateau either by West Chadic or Benue-Congo speaking peoples which was subsequently borrowed. To judge from the present-day distribution and entrenchment of the base-12 systems the simplest explanation is that the Plateau subgroup invented them sometime after the Tarokoid split-off. After that there would have been many instances of borrrowing, as the sociolinguistic situation in the Jos plateau readily permits. It should be noted, however, that there is a multitude of different morphemes attested for 12 and other key words in a base-12 system, so any explanation in terms of borrowing must admit that the base-12 system can be borrowed with or without any actual morphemes being borrowed.

There are no obvious clues as to the unusual choice of 12 as a base. A few of the base-12 languages in Meek (1931) have hand gestures that often are used accompanying the spoken expression. A combination of fingers and eyes make up 12 in at least one of these cases, but no traces of words meaning eye, hand or finger can be found in the corresponding spoken expressions. On the other hand, although not a base, 12 bears a special position in several modern European languages too, with a special word like 'dozen' and an elevated frequency (Dehaene and Mehler 1992). The reason(s) for this is not well-understood either.

2.1.5 Rare Bases #5: Last Notes

A base-8 system in Northern Pame has recently been described by Avelino (2006). Forms are given up to 32 but not higher, because none of Avelino's informants could remember them.

As the second largest base, a few more rarities may be noted. The virtually unique cases of bases 15 (Cheetham 1978; Wolfers 1971) and 24, 36 (van Geluwe 1960; Bokula and Ngandi 1985) cannot be explained away as unsubstantiated. The next higher base after 20 in base-20 systems is more than rarely 40, 60 or 80 (Conzemius 1928; Closs 1986; Powell 1972; Bowers 1977; Calame-Griaule 1968; Carlson 1994; Delafosse 1928; Monteil 1932; Dombrowski and Dombrowski 1991; Welmers 1950). There is one good attestation of a 10-60 system, namely Ekagi (Drabbe 1952).

1	ngū	6	šų̄	11	tǫ́
2	žú	7	žàadù	12	rxá
3	nīé	8	šį́	13	šé
4	ňų̄ǫ́	9	nīà	14	rxǫ̀
5	žǫ́	10	tè	15	rxǫ̀ʔ

Table 6: The monomorphemic numerals up to 15 in Chocho of Santa Catarina Ocotlán. 15-19 are formed as 15+1 etc and 20 is a base.

2.2 Other Rarities

Other than base, there are a few very interesting rarities.

2.3 Other Rarities #1: Streak of unanalyzable forms

Many of the base-12 languages have monomorphemic words for all of 1-12 (but many other have subtractions and additions in the words for 10 and 11). However, the record streak appears to be 15[6], as evidenced in Chocho of Santa Catarina Ocotlán in Table 6 (Veerman-Leichsenring 2000, 33-34) (Mock 1977, 153-154).

Nevertheless, there may be a case of monomorphemic numerals up to 20. Sharma (2003, 63) claims that

> We may say Munda speakers are the earliest known people who practised this system of counting which had monomorphemic units of counting upto twenty.

but gives no source, and the claim is not substantiated in the monograph on Munda numerals by Zide (1978). Nor are the monomorphemic numerals up to 20 shown in any of the ten or so other descriptive works I consulted for Kharia. Nevertheless, in an unpublished draft grammar sketch of Kharia by John Peterson (to appear in the handbook on Munda Languages edited by G. D. S. Anderson and N. H. Zide), a set of monomorphemic 11-19 are given as alternative forms alongside a set of composite forms. Peterson notes, however, that the monomorphemic forms were given to him by youths who all confirmed that they had be taught them in school (and they used Sadani loans themselves for the numbers in question).

[6]I wish to thank Thomas Hanke for bringing this case to my attention.

2.3.1 Other Rarities #2: Order of Additive Units

As we have seen, all languages which have numerals above 20 form the higher numbers using addition and multiplication of integers (and occasionally subtraction as well multiplication with fractions). Both addition and subtraction are commutative operations so languages are free to change the order of the operands. Not surprisingly, the order or multiplier and multiplicand is usually the same the order of numeral and noun in the language in question. For additive units the situation is more interesting. For expressions where the sum is less than, say, a 100, we find both smaller-precedes-larger and larger-precedes-smaller in the languages of the world. A lot of languages have one order for the teens and the opposite order for higher sums. For sums above 100, the situation is quite different. Almost all languages, and a multitude of the cases must be independent, show larger-precedes-smaller order. At least three ancient languages – Classicial Attic Greek, Classical Arabic, Sanskrit (as well as Vedic) – are attested with both orders possible. But Malagasy (Parker 1883) appears to be the only known modern language with invariable smaller-bigger order between additive units in numeral expressions ≥ 100.

2.3.2 Other Rarities #3: Cardinal Dominance?

In natural languages, it appears that cardinal numerals hold a primary position over other kinds of numerals, e.g. distributive numerals, and exact number marking in general, in the sense that they are morphosyntactically derived from the cardinals and that the cardinals run higher. The dominance appears to be exceptionless for all languages which have numerals above 3, but we will review two intereresting challenges below.

One description of a Great Andamanese variety explicitly says that there are more ordinals than cardinals (Man 1883a, 100), or to be more specific, that there are only 2 cardinals but 6 ordinals. But a closer inspection of the forms, reveals that this is not a true such example because the six "ordinals" are not true ordinals. 3-6 do not mean third-sixth but in the middle, the next one, last and so on. They only acquire the fixed ordinal meaning in the context of a game or the like when the number of patricipants is known (Man 1883b, 413).

One description of Wuddyāwūrru (Mathews 1904) says that there are more numbers (singular, plural, **trial**, and plural) than cardinals (one, two). This is not contradicted by other sources on the same or related languages

(Smyth 1878, 168) (Hercus 1969; Hercus 1986; Blake 2003; Blake 1998; Mathews 1903).

However, there is no linguistic data in this case to ascertain that the trial was a true trial (rather than a paucal) and Mathews has described many other Australian langages as having trials where this is questionable (p.c Barry Blake 2005). We will never know for sure whether this language had a true trial or not, since the language is extinct.

3 Conclusion

This paper has surveyed rarities for a number of structural properties of numeral systems. I have given full primacy to data presentation rather than interpretation because I think typologists have generally spent too little time assessing the empirical adequacy of their perceived rare features. I hope that, at least for numerals where a lot of data is available, I will be able to set the stage for future well-informed generalizations and interpretations of rareness.

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