Beyond cardinals and ordinals: A constructionist account of other numeral types in Akan[1]

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[1] We would like to thank the editor and two anonymous reviewers of NJAS for their insightful and relevant comments on an earlier version of this paper that have greatly improved the paper. We are solely responsible for any remaining shortcomings.

Abstract

Beyond the two usual types of numerals (i.e. cardinal and ordinal numerals) are other types like fractional, frequentative, distributive and multiplicative numerals which present very interesting linguistic properties. However, research on numerals usually focus on either cardinal or ordinal numerals. This paper provides a detailed description of the structure and formation of non-cardinal and non-ordinal numerals in Akan as well as a constructionist account of their properties. In the description of the facts, we show that the formal structure of the various classes of numerals is quite regular because they inherit their structure from already existing syntactic and morphological constructions in the language, including coordinate constructions, compounds and reduplicated forms. In the proposed theoretical account, we show that Construction Morphology provides the appropriate tools for the analysis of the numerals because the framework anticipates form-meaning disparities, thus making it possible to account for both compositional and extra-compositional properties of the numerals. The properties of the various types of numerals are captured in schemas which abstract over their general and idiosyncratic properties. We posit constructional idioms in which specific aspects of the numerals, regarded as constructional properties, are prespecified in the schemas and inherited by instantiating constructions.

Keywords: Akan, constructional idioms, distributive, fraction, frequentative, multiplicative numerals

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1. Introduction

The purpose of this paper is to present a detailed description of the formation and internal structure of four types of numeral expressions in Akan and to provide a Construction Morphology account of their properties. The numerals in focus in this paper are fractions, distributives, multiplicatives and frequentatives.

The term *numeral* has been characterized variously in the literature. Hammarström (2010:11), for example, defines numerals as "spoken normed expressions that are used to denote the exact number of objects for an open class of objects in an open class of social situations with the whole speech community in questions". Although this definition identifies salient features of numerals generally, we find the definition quite complex for a class of items that are said to be straightforwardly recognizable across languages and cultures (cf. von Mengden 2010). Relatively simpler characterizations of numerals include: "[a] number is a mathematical abstraction; a numeral is a word or phrase expressing a number" (Hurford 2001:10756), and "numeral [is] for linguistic expressions and number for meanings" (Huddleston & Pullum 2002:1715). For Gvozdanovic (2006:736), "[c]ognitive units of counting are numbers; their symbolic expressions in language are numerals".

The common feature of the relatively simpler definitions is the distinction between 'number' and 'numeral'. This is what makes it possible to understand why "*fifteen hundred* and *one thousand five hundred* are different numerals expressing the same number, '1500'" (Huddleston & Pullum 2002:1715). A numeral system is accordingly characterized as "the arrangement of individual numeral expressions together in a language" (Schapper & Klamer 2014:286) or "a part of a natural language, primarily devoted to the expression of positive whole number" (Hurford 2001:10756).

Numerals have been studied from many different perspectives across languages, revealing many types of numerals and their varying properties. However, most research on the linguistics of numerals focus on either cardinal numerals in attributive constructions (cf. Stampe 1976, Greenberg 1978, Heine 1997, Ionin & Matushansky 2006, von Mengden 2010, Epps et al. 2012, Klamer et al. 2014, Schapper & Klamer 2014) or on ordinal numerals (cf. Veselinova 1997, Wiese 2003, Barbiers 2007, Stump 2010, Stolz & Veselinova 2013). Indeed, cardinal and ordinal numerals are interesting constructions with regular patterns and properties. However, the set of numeral expressions in any language is more than the set used to express the cardinality of sets or the ordinality of the items within the sets. Additionally, other numeral expressions also present linguistically interesting properties (cf. Appah 2019). For completeness, therefore, a discussion of numerals in any language should take into account other numerals, aside from cardinals and the closely related ordinals.

These other numerals include multiplicative, iterative, frequentative, distributive and fractional numerals. They are described by Gil (2013) as "series of numerals, whose forms are derived from cardinal numerals, and whose denotations combine the concept of number with other concepts of a variety of different kinds." Such numerals tend to be complex expressions not just because they may contain complex cardinal numerals, but also because they normally come in the form of morphological constructions (e.g., compounds or reduplicated words) or syntactic constructions (e.g., NPs, VPs, coordinate constructions, etc.). For example, Huddleston & Pullum (2002:1716) observe that, "[i]n English, fractions are expressed by NPs in which the numerator functions as determiner and the denominator is head: ½ '(a/one) half'".

The study of such non-cardinal and non-ordinal numerals may proceed along various lines, including studying the internal structure of the numeral, the distribution of the numeral constituents, the semantics of the numeral and the type of constructions in which the numeral occurs (cf. Gil 1982, 2013, Klamer et al. 2014). In this study, our interest is in the internal structure of the numeral *per se* and how the numerals are constructed in Akan, a Kwa (Niger-Congo) language spoken in Ghana. As noted above, our purpose is to describe and provide a constructionist modeling of the properties of fractions, distributives, multiplicatives and frequentatives in Akan. Because these expressions are usually not the focus of studies on numerals, there is hardly any literature on some of them, especially frequentative (or iterative) numerals, as the discussion below will show.

The point has often been made that the syntactic structure of numerals is significantly different from those of other phrases. For example, Huddleston & Pullum (2002:1716) observe that "[t]he syntactic structure of the latter [numerals expressing numbers higher than 100] is to a significant extent distinct from that of other phrases". Hurford (2001:10757) also observes that "[n]umeral systems, though well integrated into their host languages, are nevertheless somewhat atypical of language subsystems as a whole". However, our studies have shown that Akan complex numerals actually have very regular formal structures (Appah 2019). The present study shows that even non-cardinal and non-ordinal numerals have quite regular structures, because they are regular syntactic or morphological constructions with cardinal numeral constituents. From a constructionist perspective, we argue that they inherit their formal structure from already existing constructions in the language.

The numeral constructions discussed in this paper tend to have properties that cannot be accounted for through a simple compositional analysis of their constituents. Ordinarily, such properties would be regarded as unusual, compared to other aspects of the grammar (cf. Hurford 2001, Huddleston & Pullum 2002). However, the constructionist framework adopted makes it possible to account for both the compositional and the extra-compositional properties of the various classes of numerals, because the framework anticipates constructions with holistic properties which do not come from their constituents, as the discussion in section 3 shows.

The rest of the paper is structured as follows: The theoretical framework employed for this study is briefly introduced in section 2. The four classes of numeral expressions in focus are discussed in section 3, based on data drawn from a variety of written sources, including Christaller (1875), Balmer & Grant (1929), Dolphyne (1996) and Akan (Asante and Fante) translations of the Holy Bible. Illustrative constructions are mostly taken from the Akan translations of the Holy Bible, because it is in the Bible that we find extended examples of numerals used in context along with direct English translations. The paper is concluded in section 4.

2. Construction Morphology

The present study employs formalism from Construction Morphology (Booij 2009, 2010, 2012, 2013, 2018), a word-based theory of linguistic morphology which builds on insights from Construction Grammar (Goldberg 1995, 2006, Michaelis & Lambrecht 1996, Fried & Östman 2004, Bybee 2013, Hoffmann & Trousdale 2013, Jackendoff 2008, 2013, Andersson & Blensenius 2018, De Wit 2018, Dugas 2018, Gould & Michaelis 2018). The aim is to provide a framework in which the differences and commonalities of word-level constructs and phrase-level constructs can be accounted for adequately (Booij 2010).

Central to Construction Morphology (CxM) is the notion of *construction*, as developed in Construction Grammar (CxG), which refers to a paring of form and meaning that is built by means of a schema, which abstracts over sets of existing complex forms and also serve as a recipe for forming other constructions of comparable complexity (Booij 2007, 2010, Appah 2013). This is shown by the schema in (1) which generalizes over all right-headed compounds.

(1) $\langle\ [[a]_{Xi}\ [b]_{Yj}]_{Yk} \leftrightarrow [\text{SEM}_j \text{ with relation R to SEM}_i]_k\ \rangle$

The upper-case variables X and Y stand for the major lexical categories (N, V & A). The lower-case variable *a* and *b* stand for arbitrary strings of sound segments, whilst *i*, *j* and *k* are indexes for the matching properties of the compound and its constituents.

Schemas and their instantiating constructions co-exist in a hierarchically structured lexicon, where two types of relations hold – "instantiation", which exists between a schema and a construction that is formed by the schema and "part of", which obtains between a construction and its constituents. These are illustrated in (2), where each dominated constructional schema is an instantiation of the one that dominates it and the individual constituents, *school* and *bag* are 'part of' the compound *school bag*.

(2) $\langle\ [[a]_{Xi}\ [b]_{Yj}]_{Nk} \leftrightarrow [\text{SEM}_j \text{ with relation R to SEM}_i]_k\ \rangle$

|

$\langle\ [[N]_i\ [N]_j]_{Nk} \leftrightarrow [\text{SEM}_j \text{ meant for SEM}_i]_k\ \rangle$

|

$\langle\ [[\text{school}]_i\ [\text{bag}]_j]_{Nk} \leftrightarrow [\text{bag}_j \text{ meant for school}_i]_k\ \rangle$

/ \

$[\text{school}]_N$ $[\text{bag}]_N$

Constructions may have properties that do not derive from the properties of the constituents. Such properties are referred to as *holistic properties* of the constructions (Booij 2010, 2012, Appah 2015, 2017). Thus, in CxM, all compositional and extra-compositional properties of constructions can be accounted for without having to posit abstract categories as the source of extra-compositional semantic properties (cf. Jackendoff 1997, 2008, Goldberg & van der Auwera 2012, Appah 2013, 2016, 2017, Lawer 2017, Dugas 2018, De Wit 2018, Gould & Michaelis 2018, Broohm 2019).

A schema that has one of the slots lexically filled is called a *constructional idiom*. Here, the form that fills the slot lexically is deemed to be part of the constructional schema, so that it is only the variable slot that would be available to be filled, on occasion, to form different instantiations of the construction. We employ this feature prominently in the analysis to show that the general properties of the various classes of numerals discussed in this paper may be captured straightforwardly in schemas and constructional idioms that abstract over the properties of the classes of numeral constructions. This also shows how straightforwardly the regular and idiosyncratic properties of the constructions can be accounted for in CxM.

3. Classes of non-cardinal and non-ordinal numerals

In this section, we discuss the four classes of non-cardinal and non-ordinal numerals. Because the numerals discussed in this paper may also involve cardinal numerals, we start by providing an inventory of cardinal numerals in Akan, focusing on the simple or primary numerals from which complex cardinal numerals are formed. As Table 1 shows, the primary cardinal numerals divide into atoms or digital numerals (1-9), and bases (10, 100 and 1000), because the Akan numeral system is decimal (cf. Balmer & Grant 1929, Christaller 1875, Nyst 2007). Complex cardinal numerals, which are formed from simple cardinal numerals, include *duanan* ‘14’, *aha ebien* ‘200’ and *apem ɔha na duawɔtwe* ‘1118’, where the form *na* is the coordinating conjunction ‘and’, so that 1118 has the literal meaning, ‘thousand one-hundred **and** eighteen’.

Table 1: Simple/Primary cardinal numerals in Akan

Digital/Atoms									***Non-digital/bases***[2]		
ɛkor/baako	*ebien/enu*	*ebiasa*	*anan*	*enum*	*esia*	*esuon*	*awɔtwe*	*akron*	*du*	*ɔha*	*apem*
‘1’	‘2’	‘3’	‘4’	‘5’	‘6’	‘7’.	‘8’	‘9’	‘10’	‘100’	1000’

The combination of atoms and bases in complex numeral formation is mediated by arithmetic operations which are also needed for their semantic interpretation. Four fundamental arithmetic operations are identified – addition, subtraction, multiplication and division – and all of them are well attested in the languages of the world. Greenberg (1978) captures their possible occurrence in the formation of numerals in a particular language in his generalization #9.

(3) *Greenberg’s generalization #9*

Of the four fundamental arithmetic operations – addition and its inverse, subtraction, and multiplication and its inverse, division – the existence of either inverse operation implies the existence of both direct operations.

Out of the four identified arithmetic operations, the two that are commonly employed cross-linguistically are addition and multiplication; these are the two principal operations involved in the formation of Akan numerals, too. However, the formation of a subgroup of fractions in Akan is based on subtraction, which seems well-motivated, given that fractions refer to portions of wholes that may be arrived at by taking out other portions or simply splitting a whole into parts by some means. This is exemplified in (10) below.

Arithmetic operations are usually not overtly marked in numerals. Where they are marked, there are various lexical options available, including ***with*** & ***and***, for addition, ***upon*** for multiplication, ***from*** for subtraction, etc., for English. In Akan, addition is formally marked only

[2] It is worth pointing out that Akan non-digital primary cardinal numerals are number-marked formally, so that *ɔha* ‘100’ and *apem* ‘1000’ become *aha* and *mpem* in the plural.

in numerals greater than one hundred (>100) and in fractions. Thus, excluding fractions which may be lower than 100, the presence of a formal marker of addition identifies the boundary between numbers greater than 100 and numbers less than 100.[3] The marker for addition in Akan is the coordinating conjunction *n*à/*n*é (cf. Amfo 2007, 2010), as shown in (7) below. This makes the numerals that bear the marker subtypes or instantiations of coordinate constructions in Akan.

(4)	a.	*Kofi*	*na*	*Ama*	b.	*apem*	*na*	*eduasa*	*kor*
		Kofi	CONJ	Ama		thous	and	CONJ	thirtyone
		'Kofi and Ama'				'a/one thousand and thirty-one'.			

(5) $\langle\, [\mathrm{Num}_C{}^{i}\ (\mathrm{na})\ \mathrm{Num}_j]_k \leftrightarrow [\mathrm{NUM}^{i} + \mathrm{NUM}_j]_k \,\rangle$

The schema in (5) is the CxM representation of numerals that are greater than 100. The conjunction *na* 'and' marks addition, but it is parenthesized because it may be possible to do without the conjunction, so that (4b) may be realised simply as *apem eduasa kor* 'one thousand and thirty-one'. NUM is the value of the corresponding numeral, and Num_C refers to numerals greater than or equal to 100). We will show later that in Akan, division is marked by the nominal *nkyɛmu* and multiplication by the nominal *mbɔho*.

In the rest of this section we discuss fractions in section 3.1, distributives in section 3.2, multiplicatives in section 3.3 and frequentatives in section 3.4. It is worth noting that, although the examples are mostly in the Fante dialect of Akan, the claims made and conclusions drawn can be generalized to all dialects of Akan.

3.1 Fractions

The first point to note in the discussions of fractions is that 'half' is regarded as the "unmarked fraction" and that it is almost always signalled by a simplex lexical item which, in some languages, derives from expressions meaning, 'to split', 'to break' or something of the sort (cf. Greenberg 1978:261). 'Half' is realised as *afã̃* in Ewe, and as *fã̃* in Ga and Dangme, which are Kwa languages just like Akan, as will be shown later. Klamer et al. (2014:354-56) make the following observations about fractions in the Alor-Pantar (AP) languages:

> Expressions for fractions show much variety across the AP languages. Western Pantar, Teiwa and Adang express fractions using a verb, while Kamang uses fractional adverbs, and no fractions appear to exist in Abui. Western Pantar derives fractions productively with the verb 'divide'. In Teiwa, expressions for fractions contain an applicative verb derived from a cardinal base by prefixing *g-un-*, a fossilized combination of a 3SG ob-

[3] Per the packing strategy (Hurford 1987, 2007), higher-valued numerals end up with a "terraced" structure where, for example, one moves from millions, to thousands, to hundreds, to tens, etc. Thus, in Akan, it is possible in deliberate speech for one to follow each group with the marker *na* 'and' down to the hundreds, as in *apem na ɔha na duawɔtwe* '1118' (lit. a thousand and a hundred and eighteen). In practice, however, *na* usually occurs only once, after the hundred, as in *apem ɔha na duawɔtwe* '1118' (lit. a thousand one hundred and eighteen).

ject prefix and an applicative prefix *un-* … In Kamang, fractions are verbs derived by prefixing *wo-* '3.LOC' to the numeral base. In Western Pantar, 'half' can be a nominal *gamme* 'half, portion', but also a fraction involving the verb 'divide' … In Teiwa, 'half' may be a nominal (*qaas* 'side, half', *abaq* 'half'), but may also be expressed by an applicative verb derived from 'two'

Apart from lexical means of forming fractions, languages may express fractions by means of complex constructions, which may be morphological or syntactic, as found in English, where Huddleston & Pullum (2002:1716) observe that fractions are expressed by NPs in which the denominator is head and the numerator functions as determiner . The commonest morphological means of expressing fractions is through compounding, as found in a number of European languages (cf. Booij 2009), where fractions are formed by combining cardinal and ordinal numerals, as in English *one-eighth*. Our data show that, aside from the lexical means of forming fractions, most Akan fractions are constructed morphologically and/or syntactically. Thus, the discussion in this section confirms that the formation of fractions generally encompasses both morphology and syntax.

The unmarked fraction in Akan is *fa* 'half' (realised as [*fã*]). When it occurs in a complex numeral, it is invariably the last constituent and is preceded by a conjunction – *n*à/*n*é 'and'. Thus, *fa* is only added to cardinal numerals by means of coordination, so that a numeral construction in which *fa* occurs may be regarded as a subtype of coordinate constructions in Akan, as exemplified in (6) with numerals containing *fa* 'half'.

(6) a. *ebien na fa* 'two and a half (2½)'
b. *eduasa na fa* 'thirty and half (30½)'
c. *apem na fa* 'one thousand and a half (1000½)'

With regard to the CxM representation, we start by acknowledging coordination as the primary means of expressing addition. This way, we can treat the fractional construction involving *fa* as an instantiation of the addition schema in (5). Again, because this is a special case of coordination in which the right constituent is filled by a specific lexical item, we assume a constructional idiom in which the final constituent is lexically specified as *fa*, as shown in (7).

(7)
$$\langle\, [[\mathrm{Num}]_i\ \mathrm{na}\ [\mathrm{Num}]_j]_k \leftrightarrow [\mathrm{NUM}_i + \mathrm{NUM}_j]_k \rangle$$
$$|$$
$$\langle\, [[\mathrm{Num}]_i\ \textit{na}\ [\textit{fa}]]_j \leftrightarrow [\mathrm{NUM}_i + \tfrac{1}{2}]_j \rangle$$

The schema in (7) specifies how numerals with the fraction ½ can be productively formed. It shows that a fractional numeral is formed by replacing the variable, NUM, with an actual numeral, usually, a cardinal numeral, which can be simplex or complex. It also shows that the meaning of a numeral construction containing the fractional word *fa*, is the sum of the arithmetical value of NUM and ½, where NUM is the arithmetical value of the corresponding numeral. The arithmetic operation at work in the formation of the fractional numerals is addition. This is shown in the semantic pole of the construction to the right of the double arrow in (8).

(8) ⟨ $[[\text{Num}]_i$ *na* $[$*fa*$]]_j \leftrightarrow [\text{NUM}_i + ½]_j$ ⟩
|
⟨ $[[\text{apem}]_i$ *na* $[$*fa*$]]_j \leftrightarrow [1000_i + ½]_j$ ⟩ (a thousand and half)

Apart from constructions containing *fa*, complex fractions of various sorts are formed in Akan. One class is formed by combining the complex nominal *nkyɛmu* or *ebupɛn* (9) both of which mean 'division of' and a cardinal numeral indicating the number of portions.

(9)	a.	*n-kyɛ-mu*	b.	*e-bu-pɛn*
		NMLZ-split-inside		NMLZ-break-time
		'division (of)'		'division (of)'

To aid understanding of the structure of this subset of fractions, it would be appropriate to discuss the structure of the two nominals – *nkyɛmu* and *abupɛn*. First, *nkyɛmu* is formed from the verb *kyɛ* and the noun *mu* which occur in the analogous verb phrase *kyɛ mu* 'split it', through prefixation of the nominalizing nasal prefix *n-*, as shown in (10). *Ebupɛn*, on the other hand, is formed from a verb and an adverb, through prefixation of the nominalizing operator *e-*, as shown in (11). The adverb designates the number of times that some unnamed entity is divided, including the portions of interest. Thus, *ebupɛn* and *nkyɛmu* clearly encapsulate the idea of breaking some whole entity a number of times, resulting in certain number/portions of the entity. The form *ebupɛn*, however, has a rather restricted distribution, occurring mostly in the Fante dialect of Akan and mostly in the context of the Christian religious practice of paying tithe; tithe is referred to as *ebupɛn du* 'a tenth'.

(10)	**NOMINAL**	**Analogous VP**	
	$[n\text{-}[ky\varepsilon]_V\text{-}[m(u)]_N]_N$	*kyɛ*	*mu*
	NMLZ-split-inside	split	inside
	'division (of)'	'to divide/share'	

(11)	**NOMINAL**	**Analogous VP**	
	$[e\text{-}[bu]_V\text{-}[p\varepsilon n]_{Adv}]_N$	*bu*	*pɛn*
	NMLZ-break-time	break	time
	'division (of)'		

Two construction types involving *nkyɛmu* can be identified. In the first, *nkyɛmu* is followed by a cardinal numeral which specifies the number of portions into which something is divided. This is followed by the relational noun *mu* 'inside (portion)' which is then followed by another cardinal numeral, specifying the portion(s) taken out of the whole set of portions, as shown in (12).

(12) *nkyɛm(u)* *du* *mu* *ebien*
division ten inside two
'two out of ten portions (two tenths)'

Here, what is actually divided is not specified. Rather, what is specified are the portions into which the whole is divided. For this, we can posit a constructional idiom in which the nominal *nkyɛm*(*u*) and the relational noun *mu* are pre-specified, and each is followed by an open slot that must be filled by a cardinal numeral. The construction in (12) instantiates this schema, as shown in (13).

(13) ⟨ [*nkyɛmu* $[x]_i$ *mu* $[y]_j]_k$ ↔ [NUM_j *out of* $NUM_i]_k$ ⟩
|
⟨ [*nkyɛmu* $[du]_i$ *mu* $[ebien]_j]_k$ ↔ [two_j *out of* $ten_i]_k$ ⟩

In the second use of *nkyɛmu* in fraction formation, the dividend is not specified. There are two open slots, one on either side of it. The preceding slot is filled by the *dividend* and the succeeding one by the *divider*. This is exemplified by the construction in (14). Additionally, in this fractional construction type, the nominal is preceded by the possessive marker *ne*, as in *ne nkyɛm(u)*, making it a possessive construction. The properties of the construction are captured in the constructional schema in (15).

(14) *Esia* *ne* *nkyɛmu* *anan*
Six 3POSS division four
'four portions out of six (four sixths)'

(15) ⟨ $[[x]_i$ *ne nkyɛmu* $[y]_j]_k$ ↔ [$NUM_i \div NUM_j]_k$ ⟩
|
⟨ [[esĩã$]_i$ *ne nkyɛmu* $[anan]_j]_k$ ↔ [$six_i \div four_j]_k$ ⟩ (four sixths)

Clearly the two means of constructing fractions with *nkyɛmu* are similar, except that in the first, the dividend is left unspecified. Additionally, for the second, there is an obvious underpinning arithmetic operation of division in the formation of the numerals, as shown in the semantic pole on the right-hand side of the double arrow in the constructional schema in (15). The instantiating schema in (15) exemplifies this class of fractions.

The discussion in this section has shown that the formation of fractions straddles the boundary between cardinal and non-cardinal numerical expressions in Akan, as fractions contain cardinal numeral constituents and their interpretation is underpinned by arithmetic operations just like cardinal numerals – *division* (and *addition* in the case of numerals with fractions, such as *fa* 'half'). But they also contain non-numeral constituents like, *nkyɛmu* and *ebupɛn*, which lexicalizes the arithmetic operation of division, and *mu* which links the dividend and the divider. Thus, in Akan numeral formation, fractions are unique in combining both cardinal and non-cardinal numerical expressions and in employing two arithmetic operations, one of which occurs only in fractions.

3.2 Distributive numerals

The next class of numerals we deal with is the class of distributive numerals which, according to Gil (2013), has attracted relatively little attention in the theoretical linguistic literature. These are numeral expressions that refer to equal distribution of something to several entities. Christaller (1875:53) characterizes distributivity as "the equal distribution of the same number of a thing to several subjects and objects".

Gil (1982, 2013) provides various means by which distributive numerals may be formed. He indicates that they may be formed through reduplication, as in Georgian *sam-sami* 'three each/three by three' (see also, Schwaiger 2015). They may also be formed through affixation, like prefixation, as found in Tongan, where distributive numerals are marked with the prefix *taki*- (e.g., *takitolu*, from *tolu* 'three') or suffixation, as found in Maricopa, where distributive numerals are marked with the suffix *-xper*, (e.g., *xmokxper*, from *xmok* 'three'). Additionally, distributive numerals may be formed periphrastically by one or more separate words, coming before or after a cardinal number to which it applies. An example is found in Malagasy where distributive numerals are marked with the word *avy* following, *telo* 'three', as in *telo avy*. Of these approaches, reduplication is the commonest. In fact, of the 251 languages investigated by Gil (2013), 33% employ reduplication in forming distributives (see Klamer et al. 2014:345).

In Akan, distributive numerals are formed by the reduplication of cardinal numerals. For numbers that are greater than or equal to 2, the numerals are simply repeated, as in (16), and there is no limit to the formation of such numerals in terms of the value of the reduplicant. For *kor*/*baako* 'one', however, a plural marker is prefixed to the numeral, as shown in (17). We believe that the plural marker is needed to mark the plurality of the items or events in (17) because the bases are inherently singular, unlike those in (16),

(16) a.	*ebien~ebien*	b.	*enum~enum*	c.	*du~du*
	two~two		five~five		ten~ten
	'two each'		'five each'		'ten each'

d.	*apem*	*na*	*eduasa*	*kor~apem*	*na*	*eduasa*	*kor*
	thousand	CONJ	thirty	one~thousand	CONJ	thirty	one
	'a thousand and thirty one each'						

(17) a.	*n-kor~kor*	b.	*m-baako~m-baako*
	PL-one~one		PL-one~PL-one
	'one each'		'one each'

We find distributive numerals used in various stories in the Holy Bible. The first is found in the story of the deluge that occurred during Noah's time and the command to build an ark to save certain creatures. A certain number of some creatures were expected to enter the ark in a certain order. So, in Genesis Chapter 7, verses 2 & 9, we have the constructions in (18).

(18)	a.	*fa*	*hɔn*	*mu*	***esuon***	***esuon**,*	*onyin*	*nye*	*ne*	*ber*
		take	3PL	in	seven	seven,	male	CONJ	3SGPOSS	female

'take with you **seven each** ..., a male and his female (Gen. 7:2, NKJV)'[4]

	b.	***ebien***	***ebien***	*kɔ-r*	*Noah*	*nkyɛn*	*wɔ*	*hyɛn*	*no*	*mu*
		two	two	go-PAST	N.	side	LOC	vessel	DEF	in

'**two by two** they went into the ark to Noah' (Genesis 7:9, NKJV)

The second instance of the use of distributives in the Bible is found in the story of Jesus sending out His disciples in pairs in the chapter 10 of the Gospel according to Luke. In verse 2 of that chapter, we find the construction in (19) which designates the numbers within the groups that were sent out by Jesus.

(19)	*Na*	*ɔ-soma-a*	*hɔn*	***beenu***	***beenu***	*dzi-i*	*n-enyim*
	CONJ	3SG-send-PAST	3PLOBJ	two	two	assume-PAST	3POSS-face

'and sent them **two by two** before His face' (Luke 10:1, NKJV)

In all the examples above, the reduplicated numerals mark the distribution of the referent. As Gil (2013) points out, reduplication emerges as the most common morphological strategy for the formation of distributive numerals across the languages of the world because there is a clear iconic motivation for using reduplication to express distributivity. That is, the repeated copies of the numeral can be seen to correspond to multiple sets of objects, for example, three suitcases.

Regarding the CxM representation, we assume that distributive numerals instantiate a constructional schema that has slots for two juxtaposed numerals of the same value and form, as shown in (20).

(20)

$$\langle\ [\mathrm{Num}_i\ \mathrm{Num}_i]_j \leftrightarrow [\mathrm{NUM}_i\ \mathrm{each}]_j\ \rangle^{5}$$

$$|$$

$$\langle\ [[\mathrm{anan}]_i\ [\mathrm{anan}]_i]_j \leftrightarrow [\mathrm{four}_i\ \mathrm{each}]_j\ \rangle$$

To end the discussion of distributives, we would like to note two features of the numerals above

[4] All free translations taken from the Bible are from the New King James Version (NKJV).

[5] This formalization is very much like the approach to the formal representation of reduplication, as proposed by Booij (2010) for the data adduced and the analyses presented in Inkelas & Zoll (2005) and Botha (1988).

that are worth highlighting. The first is the form of *beenu* 'two' in (19). This is formed from the root of the cardinal numeral two in Akan *enu* (see Table 1) and the prefix *ba-*, whose single vowel coalesces with the vowel of the numeral root and occurs with only simplex digital numerals ranging from 1-9. The prefix *ba-* is said to derive from the Akan word *ɔba* 'child' (cf. Christaller 1875:52). Therefore, numerals containing the form *ba-*, modify only human nouns, as found in the example in (19), where the referents are the human beings sent out by Jesus, but not those in (18), whose referents are animals. In fact, Christaller (1875:52) argues that it is the same form *ba* which occurs in the realization of one as *baako*, which is mostly used in the Akuapem and Asante dialects in Akan. Indeed, Christaller's position seems well-motivated because the root *-ko*, also realized in Fante as *-kor*, is found occurring alone elsewhere in the grammar, see example (33). What we need to add, however, is that presently the form *baako* seems to have lexicalized (Lehmann 2002, Himmelmann 2004, Brinton & Traugott 2005, Amfo & Appah 2019), such that speakers do not seem to be aware of or care about the pre-lexicalization internal structure of the word.

The other feature is a slight dialectal difference that is worth pointing out. The form *kor* 'one', in (17), has the plural marked only once on the initial occurrence of the form, unlike the form *baako* for which plurality is marked on each instance in the context of distributivity. This raises an interesting theoretical morphology question about the order of occurrence of the plural marking and the duplication in the formation of the distributive numeral. The question is this: Does the plural marking occur before or after the duplication? Either order has implications for the lexical integrity of the numeral, assuming that the numerals are lexical items. It also has implications for the received knowledge about the order of occurrence of derivation and inflection proposed by Greenberg as *Universal #28* (Greenberg 1966), and underpinning many works on the distinction between derivation and inflection (cf. Booij 1996, 2006, Haspelmath 1996, Stump 2005, Štekauer, Valera & Körtvélyessy 2012, ten Hacken 2014, Körtvélyessy & Štekauer 2018), if we assume that the reduplication witnessed in the formation of the numerals is a derivational process. A detailed discussion of these issues is beyond the scope of this paper. Suffice it to indicate that we have to assume that pluralization occurs before duplication in the case of *mbaako-mbaako* and after duplication in *n-kor kor* in (17).[6]

3.3 Multiplicative expressions

Multiplicative expressions show the rate at which a certain quantity increases through multiplication. In English, multiplicatives are composed of cardinal numbers and the form *fold*, as in *twofold*, which means two times. The rate of multiplication may be definite or indefinite. Thus, we may distinguish between definite multiplicatives and indefinite multiplicatives, which may be formed in many different ways in Akan. We discuss the two classes in turn.

3.3.1 Definite multiplicative expressions

Definite multiplicative numerals designate known rates of increase. In Akan, definite multiplicatives are composed of a cardinal numeral and the complex nominal *mbɔho* [m̀bɔ̀hʊ́] 'a

[6] For a recent discussion of the issue of the order of inflection and derivation, see Körtvélyessy & Štekauer (2018).

doubling' which is derived from the nominalising prefix *m-*, and the VP *bɔ ho* 'to double' (cf. Christaller 1875:53). They are exemplified in (21).

(21)	a.	*mbɔho*	*ebien*	b.	*mbɔho*	*eduonu*
		doubling	two		doubling	twenty
		'two-fold'			'twenty-fold'	
	c.	*mbɔho*	*a-ha-ebien*			
		doubling	PL-two-hundred			
		'two-hundred fold'				

It appears that the form *mbɔho* does not have its literal meaning of 'doubling' in these numerical expressions. Rather it seems to have a construction-specific meaning, which is 'increase by', with the specification of the rate of increase left to the cardinal numeral that occurs with it. We find this kind of multiplicative construction used in the Holy Bible in Matthew chapter 19, verse 29, as shown in (22).

(22)	*o-be-nya*	***mbɔho***	*ɔ-**ha***
	3SG-FUT-get	multiple	SG-hundred
	'[S/he] shall receive a **hundredfold**' (Matthew 19:29, NKJV)		

In terms of the CxM representation, we assume that the definite multiplicative numeral expressions in (21) and (22) instantiate a constructional idiom in which the nominal *mbɔho* is prespecified. What varies is the cardinal numeral which specifies the rate of increase, as shown in (23).

(23)
$$\langle\ [\textit{mbɔho}\ [\mathrm{x}]_i]_j \leftrightarrow [\mathrm{NUM}_i\text{-}\textit{fold}]_j \rangle$$
$$|$$
$$\langle\ [\textit{mbɔho}\ [\mathrm{ebien}]_i]_j \leftrightarrow [\mathrm{two\text{-}fold}]_j \rangle$$

We notice that for certain higher values, it may be possible to have the form *mbɔho* doubled in addition to the numeral which will signal the rate of increase, as shown in (24) and captured by the schema in (25).

(24) a.	*mbɔho~mbɔho*	*eduonu*	b.	*mbɔho~mbɔho*	*a-ha-ebien*
	RED~doubling	twenty		RED~doubling	PL-two-hundred
	'twenty-fold'			'two-hundred fold'	

(25) ⟨ [*mbɔho~mbɔho* $[x]_i]_j$ ↔ $[NUM_i$-*fold*$]_j$⟩
|
⟨ [*mbɔho~mbɔho* $[$*eduonu*$]_i]_j$ ↔ $[$two-fold$]_j$⟩

Here, we may suggest that the rate of increase seems to be marked redundantly by both the reduplication and the cardinal numeral. It is unclear to us which of them should be regarded as the primary marker of the rate of increase and which one the secondary marker. This is because both the reduplication and the cardinal numeral may independently mark the rate of increase. The only difference is that when reduplication alone marks multiplication, the rate of increase is indefinite, as will be discussed below in relation to (27).

Finally, definite multiplicatives can be formed by means of the lexical item *ahorow* '(different) kinds'. In this type of construction, the word *ahorow* is flanked by two numerals, as shown in (26). The numeral that occurs before the word *ahorow* is the *multiplicand* while the one that comes after it is the *multiplier*, and it seems there is no restriction on the value of the numeral that may occur on either side of the word *ahorow*. The properties of definite multiplicatives that are built around *ahorow* are captured in the constructional idiom in (26), in which the word *ahorow* is prespecified and is flanked by cardinal numerals of unspecified values.

(26) ⟨ $[[x]_i$ *ahorow* $[y]_j]_k$ ↔ $[NUM_i \text{ x } NUM_j]_k$ ⟩
|
⟨ $[[$eduonu$]_i$ *ahorow* $[$anan$]_j]_k$ ↔ $[$*twenty*$_i$ x *four*$_j]_k$ ⟩ (80)

3.3.2 Indefinite multiplicatives

In the indefinite multiplicative numeral, there is no cardinal numeral in the construction. Consequently, there is no specification of how many times the multiplication takes place, hence the name indefinite multiplicative numeral expressions. There are two types. The first is built around the nominal *mbɔho*, which is simply reduplicated to form the multiplicative construction. The absence of a cardinal numeral also means that, unlike the constructions in (24) above, there is no definite end to the multiplication operation. This is what precipitates the indefinite reading of the resultant construction. See the example in (27), whose properties are captured in the schema in (28).

(27) *mbɔho~mbɔho*
mbɔho~doubling
'indefinite-fold'

(28) ⟨ [*mbɔho~mbɔho*$_i]_j$ ↔ $[$Multiple-folds$]_j$ ⟩

The second subtype of indefinite multiplicatives in Akan is shown in (29). In this construction type, the quantifier *pii*/*bebree* 'many' occurs with the nominal *mbɔho*, instead of the reduplication in the previous example in (27). Here too, the absence of a cardinal numeral means that there is no terminal point for the multiplication operation, hence, the construction is an indefinite multiplicative with the meaning 'many-fold', as shown in (30). Indeed, the quantifier itself suggests the indefinite reading.

(29) *mbɔho* *pii*/*bebree*
doubling many
'many-fold'

(30) ⟨ [*mbɔho* $[x]_i]_j$ ↔ $[\text{NUM}_i$-*fold*$]_j$⟩
|
⟨ [*mbɔho* $[\text{pii/bebree}]_i]_j$ ↔ $[\text{many-fold}]_j$⟩

We find this type of indefinite multiplicative used in the Akan (Asante) translation of the Holy Bible. In Luke chapter 18, verses 28-30 is the story of Jesus' response to a disciple's question about the reward for renunciation. In verse 30, Jesus assures the disciples that whoever renounces anything for the sake of the kingdom of God will receive them back in multiples, as seen in (31).

(31)

na	*ne*	*nsa*	*n-ka*	*no*	***mmɔho***	***bebree***	*berɛ*	*yi*	*mu*
CONJ	3SGPOSS	hand	NEG-touch	3SG	doubling	many	time	this	in

'who shall not receive **many times more** in this present time' (Luke 18:30, NKJV)

In this section, we have identified different types of multiplicative numerals in Akan which may be grouped into two – definite and indefinite multiplicatives. In the former, there is a definite number of times that the multiplication happens which is indicated by a cardinal numeral. In the latter, there is no such indication of the number of times that the multiplication happened or was meant to happen.

3.4 Frequentatives

The final class of numerals to be discussed is the class of frequentative or iterative numerals, which hardly features in discussions of numerals. For example, frequentatives do not feature at all in the work of James Hurford, who has dedicated a lot of time and research energy to the study of numerals (cf., inter alia, Hurford 1987, 2001, 2007). Others treat them as part of multiplicative numerals (cf. Christaller 1875) and, as shown below, there appears to be evidence for this approach. In Lieber (2010), frequentatives are discussed as part of the properties of verbs. For instance, citing examples from the Austronesian language Samoan (Mosel & Hovdhaugen 1992) and other languages like Tagalog and Manchu, Lieber (2010), showed that frequentative forms of verbs may be formed through reduplication. See (32) for the Samoan examples from Mosel & Hovdhaugen (1992:227), as cited in Lieber (2010:76).

(32)	a'a	'kick'	a'aa'a	'kick repeatedly'
	'etu	'limp'	'etu'etu	'limp repeatedly'
	fo'i	'return'	fo'ifo'i	'keep going back'

In this paper, our interest is in frequentatives that may be regarded as numerals because they contain at least one numeral constituent. Such frequentative numerals express the number of times that some item or action occurs. Thus, they would occur in answer to the question: *mpɛm ahen*? 'How often'?/'How many times'?' In Akan, frequentative numerical constructions are composed of the morphemes *pɛn*, *prɛ* 'instance' and a cardinal numeral, as shown in (33).

(33)	***Asante***	***Fante***	***Meaning***	
	prɛ-ko	*pɛn-kor*	'once/one time'	
	m-pre-nu	*m-pɛn-ebien*	'twice/twofold'	
	m-prɛ-nsa	*m-pɛn-ebiasa*	'three times/threefold'	
	m-prɛ-nan	*m-pɛn-anan*	'four times/fourfold'	
	m-prɛ-num	*m-pɛn-anum*	'five times/fivefold'	
	m-prɛ-nsia	*m-pɛn-esia*	'six times/sixfold'	(Christaller 1875:53)

Where some occurrence happens more than once, a prefixal plural marker is added to signal this, as shown in (33), where the nasal prefix which occurs in all the numerals, except the first, marks plurality (cf. Balmer & Grant 1929:143).

We find a frequentative numeral in a story in the Holy Bible (Fante translation) in the second book of Kings, chapter 5 and verse 10, a portion of which is produced in (34). Here the prophet instructs a leprous man to go and wash in the river Jordan a certain number of times as part of a healing ritual.

(34)	*Kɔ*	*na*	*ko-guar*	*Jordan*	*mu*	***mpɛn***	***esuon***
	go	CONJ	go-bath	Jordan	in	instance	seven

'go and wash in the Jordan **seven times**' (2 Kings 5:10, NKJV)

For the CxM representation, we assume that frequentatives instantiate a constructional idiom in which the form *pɛn*/*prɛ* is pre-specified, as shown in (35). The nasal plural prefix is parenthesized because it occurs only when the numeral constituent is greater than or equal to two (≥ 2).

(35) ⟨ [(*m*)*pɛn*/*prɛ* [x]$_i$]$_j$ ↔ [NUM$_i$ times]$_j$⟩
|
⟨ [*mpɛn* [ebien]$_i$]$_j$ ↔ [two$_i$ times]$_j$ ⟩

As a final comment, we would like to observe that the discussions in this section and the previous one (section 3.3.2) show that definite multiplicative and frequentative numerical expressions have a lot in common. The former refers to the rate of occurrence of some quantity, and the latter, the number of occurrences of some action. Given this, we may posit one supertype construction called the *number of occurrences construction* from which the two numeral expressions inherit their properties, as shown in (36). Thus, by default inheritance, all instantiations of the two constructions inherit their non-unique properties from the supertype construction.

(36) ⟨ [*measure_word* [x]$_i$]$_j$ ↔ [NUM$_i$ TIME]$_j$ ⟩

⟨ [(*m*)*pɛn*/*prɛ* [x]$_i$]$_j$ ↔ [NUM$_i$ times]$_j$ ⟩ ⟨ [*mbɔho* [x]$_i$]$_j$ ↔ [NUM$_i$-*fold*]$_j$ ⟩

The possibility of positing this supertype construction probably justifies the treatment of multiplicatives and frequentatives together in the discussion of Akan numerals by Christaller (1875).

4. Conclusion

Most studies on numerals concentrate on the two principal types of cardinal and ordinal numerals, to the neglect of other numeral types which are very interesting their own right because they possess both regular compositional properties as well as equally interesting non-compositional properties. In this paper, we have discussed the structure of Akan numeral constructions other than cardinals and ordinals. The numerals discussed are fractions, distributives, multiplicatives and frequentatives. It has been shown that these numeral expressions have easily recognizable formal structures because they tend to instantiate very regular phrasal and morphological patterns in the language from which they inherit their non-unique properties. Thus, the structure of the numeral expressions in general do not differ radically from other constructions in the language. We have also shown that the interpretation of the numerals is mediated by specific arithmetic operations. For example, the interpretation of fractions is mediated by addition, when *fa* 'half' is involved and division in all other cases. Also, the interpretation of frequentatives and multiplicatives is mediated by multiplication.

In addition to the identified regular formal and semantic properties, the numeral expressions discussed in this paper also exhibit a fair amount of idiosyncratic formal and semantic properties which show that each of them can best be described as a pairing of a particular form and a particular meaning whose properties generally cannot be derived fully from the properties of their constituents. Therefore, the notion of construction as conceptualised in CxM offers an appropriate framework for the analysis of the classes of numeral expressions discussed in this paper. We analysed each numeral type as a construction and posited various constructional schemas to account for their properties, including constructional idioms, in which one or two formal properties are pre-specified. The foundational understanding that constructions can have holistic properties means that provision is made for possible form-meaning mismatches in constructions in CxM. Thus, where a meaning component does not emanate from the constituents, it is treated as a holistic constructional property.

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