Semantics for numerals in Lalo Yi

Numerals in English are found in a wide range of contexts, including being a determiner (1a), a predicate (1b) or a predicate modifier (1c). Accordingly, three different semantic analyses are proposed, including the GQ view (Barwise and Cooper 1981; Hofweber 2005), the adjectival view (Moltmann 2013; Landman 2004), and the modifier view (Ionin and Matushansky 2006).

(1) a. *Eight*$_{GQ}$ planets are discovered. b. eight (planets, {x: x are discovered})
(2) a. The planets are *eight*$_{PREDICATE}$. b. ∃x [planets (x) ∧ eight(x)]
(3) a. There are *eight*$_{PRED\ MODIFIER}$ planets. b. ∃x [eight(planets) (x)]

The controversy of the semantics for numerals is manifested at least in the following two respects. First, among the three uses of numerals illustrated from (1a) to (1c), it is debatable which reaing should be treated as a default reading, from which the other readings are derived. Second, how can the first-order properties denoted by numerals be related to their nominalized counterparts, such as being 'singular terms' (Frege 1884, Rothstein 2013)?

In this study, by looking into the numerals in Lalo Yi, a Loloish language spoken in Yunan province, China, we endorse the argumentation that numerals do not have a unified semantics both across and intra linguistically. Lalo Yi features two sets of numerals, including numerals borrowed from Chinese and numerals native to Lalo Yi (Table 1). We propose that the borrowed numerals from Chinese denote singular terms, and native numerals are mapped onto GQs in Lalo Yi.

	0	1	2	3	4	5	6	7	8	9	10	…
Lalo Yi		tʂhi^{31}	nɯ^{31}	sa^{33}	ʔlɯ^{33}	ŋa^{31}	k^{h}o^{31}	xɯ^{31}	hĩ^{31}	ku^{33}	tɕ^{h}i^{55}	…
Chinese	lin^{31}	ʑi^{13}	ʔɛ^{55}	san^{33}	si^{55}	u^{31}	lu^{13}	tɕ^{h}i^{13}	pa^{13}	tɕiəu^{31}	ʂi^{13}	

Table 1. The two sets of numerals in Lalo Yi

Before proceeding, we show that the two sets of numerals in Lalo Yi can be distinguished in the two contexts provided in (4) and (5). The counting context construed in (4) requires an argumental expression, where only borrowed numerals from Chinese can be used, and its native numerals cannot be used, unless they are accompanied by classifiers. This indicates that Chinese numerals in (4b) denote numeric objects, and native Yi numerals are not. In contrast, the 'specificational' sentence in (5) provides a predicative position for numeric expressions, where Num-Cl is licensed but neither the native Yi numeral *sa*^{33} nor the borrowed Chinese *san*^{33} becomes possible in their bare forms.

(4) a. ŋa^{55} *tʂ^{h}i^{31}*(ma^{55})* dʑi^{55}a^{31}ta^{31}hɛ^{33} *tɕ^{h}i^{55}*(ma^{55})* gu^{55} tɕhi^{55} ʔɛ^{55} a^{31}. [Native numerals]
I one-CL LOC-STATE-PAR ten-CL count to can SFP
b. ŋa^{55} *ʑi^{13}* dʑi^{55}a^{31}ta^{31}hɛ^{33} *ʂi^{13}* gu^{55} tɕ^{h}i^{55} ʔɛ^{55} a^{31}. [Chinese numerals]
I one LOC-STATE-RES-PRT ten count to can SFP
Both: 'I can count from one to ten.'

(5) a. ŋa^{55} fan^{31}tuəi^{55} a^{55} li^{31}ʑə^{55} *sa^{33} *(ma^{55}) / san^{33} *(kə^{55}).*
I object NMLZ reason three$_{native}$ CL/ three$_{Chinese}$ CL
'The reasons that I did not agree are three.'

Concerning the first question, it is theoretically possible for English numerals to shift from one reading to the others via the general type-shifting principles (Partee 1987; Landman 2004). Nevertheless, the GQ analysis of numerals is refuted by Krifka (1999), on the basis of modified numerals like *more than three* and *exactly three*, in which the numerals are predicative. In contrast with numerals in English, we claim that the two sets of numerals in Lalo Yi are not mapped onto predicates, but they are argumental expressions: those borrowed from Mandarin are singular terms in the sense of Frege (1884), and the native numerals are neither predicates nor singular terms but they are generalized quantifiers.

The GQ status of Yi numerals is corroborated by the following two facts independently. First, degree modifier like *more than, less than, exactly* are not available in Lalo Yi, which implies the constituent Num-Cl is not susceptible to the modification of degree modifiers. Instead, the Yi language may use the verb *ma^{31}ts^{h}i^{55}* 'exceed' to express the 'comparative' meaning 'more than'.

(6) ɕo^{13}sen^{33} tʂhi^{31}hã^{55}ma^{55} ma^{31}ts^{h}i^{55} dʐu^{55} mu^{31}.
student one-hundred-CL exceed have VIS
'(The number of) students exceed 100.'

Second, it is impossible for Num-Cl to compose with quantifiers, like *every* or *many*, to derive determiner phrases. The plural phrase Num-Cl can function as a distributive quantifier when it is reduplicated , as shown in (7a).Or we can employ the nominalization strategy when the quantifier *ha* 'all' intends to take a singular phrase as its complement, as in (7b). (A more explicit syntax will be provided to show that the quantifier *ha^{55}* actually does not form a constituent with Num-Cl in the RC 7b.)

(7) a. a^{55}ni^{55}za^{31} sa^{33}ma^{55} sa^{33} ma^{55} p^{h}in^{31}ko^{31} tʂ^{h}i^{31}ma^{55} dza^{31}.
kid three CL three CL apple one CL eat
'Every three kids eat one apple.'
b. a^{55}ni^{55}za^{31} ha^{55} tʂ^{h}i^{31}ma^{55} ŋa^{55} a^{55} p^{h}in^{31}ko^{31} dza^{31}pɛ^{55} a^{55} mu^{55}.
kid all one CL be NLMZ apple eat PFV SFP VIS
'Kids, each of them, ate apples.' (Literal: 'Every kid eats apples.')

Our GQ analysis also provides a solution to the puzzle raised in Bu and Liu (2020), which shows that the constituent Num-Cl in Lalo Yi does not form a constituent with nouns, regardless of whether the noun is intended to be interpreted as subject (8a) or object (8b). We suggest that in Lalo Yi, it is the classifier but not the noun that comes to saturate the restrictor associated with GQs. To put it explicitly, when numerals in Lalo Yi are suggested to be of type <<e,t>, <<e,t>, t>>, the first argument is saturated by the subsequent classifier, and the constituent Num-Cl serves as argument of the verb by itself.

(8) a. a^{55}ni^{55}za^{31} ɣa^{31}hen^{55} ʔluɯ^{33}ma^{55}ŋu^{55} ki^{33} a^{31} mu^{31}.
child hard four CL cry PROG SFP VIS
'Four kids are crying sadly.'
b. mi^{55}-ku^{55} a^{55}nɯ^{31} ha^{55} nɯ^{31}k^{h}ɯ^{55} dza^{31} ki^{33} a^{31} mu^{31}.
field-Loc cow crops two CL eat PROG SPF VIS
'Two cows are eating the crops in the field.'

Regarding the second question, all these three approaches introduced from (1) to (3) share the same problem that they fail to derive the use of numerals as singular terms. According to Hofweber (2005), the bare use of numerals in (9a) is derived from nominal phrases (9b) by NP ellipsis. However, as Rothstein (2013) points out, the argumentation of NP ellipsis fails to account for why only the verb in its singular form *makes* is allowed for bare numerals in (9c).

(9) a. Two and two make four. b. Two things and two things make four things.
c. Two plus two makes/#make four.

A neo-Fregean semantics was proposed in Rothstein (2013) that cardinal numerals start out with a standard modifier interpretation at type <e,t>, with the cardinality function defined in (10a), and it can also denote the individual property correlate of the set, namely, being a singular term (10b).

(10) a. $\|four\|_{<e,t>} = \lambda x.\ |x|=4$ b. $\|four\|_{<n>} = \cap(\lambda x.\ |x|=4)$ (Rothstein 2013)

We suggest that the neo-Fregean semantics for numerals proposed in Rothstein (2013) is not applicable to numerals in Lalo Yi. Neither set of numerals in Lalo Yi is mapped onto predicates. We argue that borrowed Chinese numerals are born as singular terms, which are analogous to the kind denotation of bare nouns in Chinese as proposed in Chierchia (1998). They can be coerced with a predicative meaning by lexical device, e.g. the use of classifiers, which results in the counting predicate Num-Cl.

(11) a. $\|san^{33}\|_{n}=3$ b. $\|\ san^{33}\ kə^{55}\|=\lambda n\lambda x.[Atom(x)\&\ |x|=n](3) =\lambda x.[Atom(x)\&\ |x|=3]$

As far as its native numerals are concerned, they are of type <<e,t>, <<e,t>t>> and are applied to classifiers to derive GQ phrases. GQs can only be shifted to predicates by the *IDENT* function denoted by BE, but the lowering from GQs to e is blocked and it is compensated by the Chinese numeral system instead.

(12) a. $\|\ sa^{33}\|_{<<e,t>,\ <<e,t>t>>}=\lambda P\lambda Q.\exists x.P(x) \cap Q(x) = 3$
b. $\|\ sa^{33}\ ma^{55}\|=\lambda Q.\exists x.ATOM(x) \cap Q(x)= 3$ ➔ BE ($\|\ sa^{33}\ ma^{55}\|$)=IDENT ($\|\ sa^{33}\ ma^{55}\|$)

In a word, both cross-linguistically and intra-linguistically, numerals are not endowed with a unified semantics. In Lalo Yi, the two sets of numerals diverge from each other in either serving as a functor that takes classifiers as its argument, or as an argument (e.g. being a numeric object) to saturate the variable for numeral associated with the semantics of classifiers. In these two cases, classifiers are not analyzed with a unified semantics either.

Selected references:

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