Measurement and optional classifiers in Taiwan Mandarin

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Introduction: It is well-known that classifiers (henceforth CL) in Chinese are syntactically obligatory in the presence of numerals (Li 1998, Cheng and Sybesma 1999, among others), as shown in (1).

(1) Liubei mai-le san-*(ke)-pinguo.
Liubei buy-ASP three-CL-apple
'Liubei bought three apples.'

There have been two major views on the obligatory presence of Chinese classifiers in the literature. One proposes that CL is obligatory because Chinese nouns are "registered" as kind-terms and require classifiers to obtain their predicative meanings (Chierchia 1998, 2010). The other proposes that CL is obligatory because CL semantically encode a measure function, which are required to compose with Chinese numerals (Krifka 1995). However, this paper argues that neither claim is completely correct and offers two observations. First, Chinese classifiers are systematically optional in certain degree constructions (cf. Cheng et al. 2012), as in the positive (2), the comparative (3) and the superlative (4).

(2) Liubei mai-le **hen-duo** (ke) pinguo.
Liubei buy-ASP POS-many/much CL apple
'Liubei bought a lot of apple(s).'

(3) Liubei bi Caocao mai-le **geng-duo** (ke) pinguo.
Liubei than Caocao buy-ASP COMP-many/much CL apple
'Liubei bought more apple(s) than Caocao.'

(4) Zhe-xie-ren zhizhong, Liubei mai-le **zui-duo** (ke) pinguo.
These-CL-people among Liubei buy-ASP SUP-many/much CL apple
'Among these people, Liubei bought more apple(s) than anyone else did.'

Second, the optionality of Chinese classifiers is not a free variation. We observe that the presence/ absence of classifiers lead to a variation in the dimension of measurement. Without CL, the relevant dimension of measurement can be either cardinality or others obeying monotonicity such as weight or volume. In contrast, with CL, the dimension has to be cardinality and other dimensions such as weight or volume are impossible. Other nouns participating in the pattern include: conceptually count nouns like *yingtao* 'cherry' and *shu* 'book', flexible nouns like *shitou* 'stone' and *qiaokeli* 'chocolate', and conceptually mass nouns like *rou* 'meat' and *mi* 'rice'. Below, (5) illustrates the case of *mi* 'rice'.

(5) Liubei bi Caocao zhua-le **geng-duo** (li) mi.
Liubei than Caocao grab-ASP COMP-many/much CL rice
With CL: 'Liubei grabbed more grains of rice than Caocao.' √cardinality;#weight/ #volume
Without CL: 'Liubei grabbed more rice than Caocao.' √cardinality; √weight/ √volume

Similar variation in the dimension of measurement are also attested in English (Bale and Barner 2009, Wellwood 2014, 2015), though not exactly the same. Crucially, cardinality is ruled out in (6a).

(6) a. John has more rock than Mary. #cardinality; weight
b. John has more rocks than Mary. cardinality; #weight

The linguistics facts above raise several important questions concerning the relation between measurement and classifiers: **(i)** what is the role of classifiers in the measurement constructions? **(ii)** How is measurement connected with classifiers? **(iii)** How and why does the variation in the dimension of measurement show up? The central proposal of this paper is two-fold: **(i)** individual classifiers do not encode a measure function; they impose restrictions on the denotation of nouns. **(ii)** A covert measurement operator M-OP exists in Chinese, responsible for the measurement.

Measurement with the presence of classifiers: For purposes of illustration, I assume that **(i)** the semantics of Chinese bare nouns denote kind terms and can be shifted to a set of instances instantiating the kind via the $^{\cup}$ operator (Chierchia 1998). **(ii)** The semantics of an individual classifier induces partitions over the instances and checks the atomicity of the cells (cf. Chierchia 1998). **(iii)** a

covert measurement operator M-OP relates individuals to degrees along a contextually-valued dimension *c*, obeying monotonicity (Rett 2014, Solt 2015; cf. Wellwood 2015). **(iv)** the semantics of quantity adjectives such as *duo* 'many, much' induces a higher order measurement (Rett 2014, 2018). **(v)** *Duo* 'many, much' may also be an overt realization of M-OP. **(vi)** the semantics of a *pos*-morpheme requires the relevant degrees to exceed a certain contextually-given threshold d_s (Kennedy 1997). **(vii)** an existential closure ∃ closes the individual variable in the nominal domain. Below, (7) presents the semantics of M-OP; (8) provides the semantics of *duo* and that of *POS* (cf. Grano 2012).

(7) $[\![\text{M-OP}]\!]^c = [\![duo_e]\!]^c = \lambda P_{\langle e,t\rangle}.\lambda d_{\langle d\rangle}.\lambda z_{\langle e\rangle}.[P(z) \wedge \mu_c(z) = d]$

(8) a. $[\![duo_d]\!] = \lambda d_{\langle d\rangle}.\lambda D_{\langle d,t\rangle}.\mu(D) = d$

b. $[\![POS]\!] = \lambda D'_{\langle d,t\rangle}.\exists d'[D'(d') \wedge d' > d_s]$

With these assumptions, (9) presents the LF and (10) shows some crucial pieces of the semantic computation, when (2) is interpreted with the presence of CL.

(9) LF: [**POS** [λ2 [d_2-**duo$_d$** [λ1 [Liubei bought [∃ [d_1-**CL** apple]]]]]]]

(10) a. $[\![\text{pingguo}]\!]^w = \lambda x_{\langle e\rangle}.{}^{\cup}\text{apple}_w(x)$

b. $[\![\text{ke}]\!]^w = \lambda P_{\langle e,t\rangle}.\lambda d_{\langle d\rangle}.\lambda x_{\langle e\rangle}.\exists S[\Pi(S)(x) \wedge |S| = d \wedge \forall s{\in}S \rightarrow P(s) \wedge \text{atom}(s)]$

c. $[\![(2)]\!]^{w,c,g} = 1$ iff $\exists d'[\mu\,(\lambda d.\ \exists z[$Liubei bought $z \wedge \underline{\exists S[\Pi(S)(z) \wedge |S| = d \wedge \forall s{\in}S \rightarrow {}^{\cup}\text{apple}(s) \wedge \text{atom}(s)]}]) = d' \wedge d' > d_s]$

In (10), given that the set of instances in the cover *S* is defined over atomicity (by the contribution of CL), cardinality is thus the only possible dimension of measurement for M-OP. This explains the variation in the dimension of measurement with the presence of CL.

Measurement with the absence of classifiers: With the same assumptions, (11) presents the LF and (12) shows the semantics, when (2) is interpreted with the absence of CL.

(11) LF: [**POS** [λ1 [Liubei bought [∃ [d_1- **duo$_e$** [apple]]]]]]

(12) $[\![(2)]\!]^{w,c,g} = 1$ iff $\exists d'[\mu(\lambda d.\ \exists z[$Liubei bought $z \wedge {}^{\cup}\text{apple}(z) \wedge \mu_c(z) = d]) = d' \wedge d' > d_s]$

In (12), when the set of instances in the cover *S* is not necessarily restricted to be atomic (i.e., (2) is computed without CL), there are two possibilities for the relevant dimension of measurement. One possibility is that M-OP induces a monotonic measurement on the set of instances relative to the level of the measuring unit; this is the case where the relevant dimension is weight or volume. The other possibility is that the set of instances in the cover *S* is defined over atomicity (as we have seen in the case with CL discussed above); in this case, the relevant dimension of measurement is cardinality.

Implications: Taking numerals as degree-denoting terms, the current analysis has three implications: **(i)** a covert measurement operator exist in a non-classifier language like English, leading to the apparent direct combination of numerals. In contrast, a non-classifier language like Chinese does not have such covert measurement operator, thus the use of CL is obligatory. **(ii)** Classifiers are not for nouns, but for numerals. The fact that Chinese CL can be syntactically optional challenges the view that Chinese nouns are 'registered" as kind-terms and require classifiers for their predicative meanings (i.e., unable to have a predicative meaning without the help of CL). In contrast, the current analysis is more sympathetic to the view that classifiers are obligatory because of the presence of numerals (Krifka 1995, Bale and Coon 2014). **(iii)** The point of variation between English and Chinese does not lie in the semantics of numerals (contra Krifka 1995), but the elements introducing measurement, as evidenced by the fact that the relevant measurement *remains active* in degree constructions, irrespective of whether Chinese classifiers are syntactically present or absent. Finally, two findings of this study are worth highlighting. First, the presence of plural morphology and that of CL play a similar role in restricting the dimension of measurement to cardinality. Second, the relevant dimension of measurement for Chinese nouns (analyzed as mass nouns in Chierchia 1998) can be either cardinality or other dimensions obeying monotonicity (see also Lin & Schaeffer 2018 for experimental evidence); but such interpretational flexibility does not seem to hold for English mass nouns (see (6)), even with cases of contextual coercions discussed in Chierchia (2010) and Rothstein (2010).

Selected Refs: **[1]** Bale, A. & D. Barner. 2009. The interpretation of functional heads: using comparatives to explore the mass/count distinction. **[2]** Chierchia, G. 2010. Mass nouns, vagueness and semantic variation.