The Finnish partitive in counting and measuring constructions

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We propose a compositional semantic analysis for singular and plural partitive constructions in Finnish to account for why count nouns in counting constructions are partitive singular, but partitive plural in measure constructions. We argue that each morpheme contributes to the semantic interpretation of the NP, cf. [5, 6] who assume plural morphology is semantically vacuous. To conclude, we extend this analysis to capture the distribution of partitive nouns as grammatical subjects.

1 Data and puzzle. Finnish has a lexical mass/count distinction that can be shown in counting constructions, which require all nouns (Ns) to be in partitive singular when directly modified by a nominative numeral greater than one as shown in (1), and in measure constructions, in which, for the N denoting that which is measured, mass Ns must be in partitive singular and count nouns must be in partitive plural, as per (2).

(1) kaksi omena-a / #riisi-ä
two apple-PART / rice-PART
two apples/#rices

(2) kaksi kilo-a riisi-ä / omeno-i-ta / #omena-a
two kilo-PART rice-PART / apple-PL-PART / apple-PART
two kilos of rice/apples/#apple

Such data are puzzling when it comes to giving a semantics for Ns with partitive case. Ns in felicitous counting constructions are commonly assumed to denote pluralities and so *omena-a* ('apple-PART') should denote pluralities of apples. Furthermore, measure phrases are commonly assumed to select for cumulative predicates as evidenced in English by contrasts such as *Two kilos of apples/#apple* (see [8] a.m.o). Crucially, given these two assumptions, *omena-a* ('apple-PART') should also denote a cumulative predicate and so be felicitous in measure phrases, contrary to fact. We propose a solution to this puzzle that analyses the Finnish partitive as semantically sensitive to both the semantic type of the nominal predicate it applies to and to whether or not type $\langle e, t\rangle$ predicates are quantized (QUA) in the sense of Krifka [8].

Additionally, partitive subjects (felicitous with a subclass of intransitive verbs [7]) may be post-verbal and give rise to existential interpretations as in (3). Singular/plural nominative subjects, when preverbal, normally give rise to definite interpretations (4). The use of the partitive with Ns in the subject position is also sensitive to the mass/count distinction. Count Ns cannot appear as partitive singular subjects, only as partitive plural or as singular or plural nominative as in (3-4). Mass Ns can be nominative or partitive subjects, but are always singular.

(3) Pöydä-llä on kirjo-j-a / #kirja-a.
table-ADESS be.3 book-PL-PART / book-PART
There are books / # is book on the table.

(4) Kirja / Kirja-t on/ovat pöydä-llä.
book / book-PL be.3/.3.PL table-ADESS
The/a book / (The) books is/are on the table.

2 Previous work. Although Finnish partitive subjects and to a lesser extent counting and measuring constructions have received much attention in the syntax literature, relatively little has been done in compositional semantics. Some claims have been made, however. Kiparsky [7] holds that the NP function of the partitive is associated with indefiniteness and Danon [2] offers a syntactic solution to why Finnish counting constructions prohibit the partitive plural, but does not address measuring constructions. Danon loosely hypothesises that the pattern might be semantic. One potential solution to the above puzzle would be to follow Ionin et al.'s [5, 6] proposal for English (based on data from Finnish, Hungarian and Turkish) in which plural morphology in counting constructions is semantically vacuous and the numeral is defined to operate on semantically singular predicates. However, such a proposal would face two problems for Finnish. First, it would ignore the role of the partitive entirely. Second, it would have to explain why, although partitive plural count nouns and partitive singular mass Ns can be subjects, partitive singular count nouns cannot. Furthermore, it has been argued that, in Turkish [1] and Hungarian [3], singular nouns are *not* semantically singular and can have semantically plural reference.

3 Proposed analysis. First, we adopt the notion that the property that distinguishes count Ns from mass, plural count and non-count collective Ns is the property of being a *quantized* (QUA) predicate (relative to a context, c) [8, 4]. A predicate P is quantized if and only if whenever it holds of something it does not hold of any of its proper parts. It is formalized as follows:

(5) $$QUA(P) \leftrightarrow \forall x, y[(P(x) \wedge P(y)) \rightarrow \neg x \sqsubset y]$$

We propose two semantic entries for the partitive to capture its distribution with mass and count nouns, both of which are derived from a basic meaning of partitivity defined in (6) in terms of mereological part-hood:

(6) $$[\![\text{PART}_{\text{basic}}]\!] = \lambda x.\lambda y.x \sqsubseteq y$$

Central to our analysis is that the interpretation of partitive morphology is determined by semantic properties of the noun that takes partitive case. In particular, we suggest that the meaning of partitive morphology is sensitive to whether the noun denotes a quantized type $\langle e, t\rangle$ predicate or not. The partitive, when applied to singular count nouns (quantized $\langle e, t\rangle$ predicates) is a type shifting function that introduces a cardinality function ($\mu_{\#}$) and so allows composition of numerals of type n and count predicates of type $\langle e, t\rangle$. The cardinality function, which is relativised to a predicate P is defined only for quantized predicates in terms of $[\![\text{PART}_{\text{basic}}]\!]$ (i.e. $\sqsubseteq$) in (7).

(7) $$\mu_{\#}(x, P) = |\{y : y \sqsubseteq x, y \in P\}| \text{ if } QUA(P).\ \perp\text{, otherwise.}$$

When applied to plural count or mass nouns (non-quantized $\langle e, t\rangle$ predicates), the partitive has a part-hood and an indefiniteness effect. The result is that, in counting constructions, only the partitive singular is felicitous, since plural partitive nouns do not come out with the requisite $\langle n, \langle e, t\rangle\rangle$ type. In measure constructions, partitive singular count Ns are ruled out via the standard assumption that measure expressions select for type $\langle e, t\rangle$ predicates (and also for non-quantized, predicates [8]).

Both of our lexical entries for $[\![\text{PART}]\!]$ in (8a) and (8b) are type shifting functions defined in terms of a noun predicate variable, P, a context c and $[\![\text{PART}_{\text{basic}}]\!]$. For a singular count predicate P, the partitive encodes a type shift yielding an expression that can compose with a numeral (8a). For a mass and plural count predicates P (i.e. non-quantized predicates), the meaning of $[\![\text{PART}]\!]$ in (8a) is not defined due to the selectional restrictions of $\mu_{\#}$. In such a case, we posit that the partitive returns the set of all proper P-parts of some P assumed to exist in the context, c, (which captures both the indefiniteness and part-hood aspects of the partitive) (8b). Notice however, that this does not necessitate that (8a) is a more basic meaning than (8b), since, if P_c is quantized, then (8a)$(P)(c) = \varnothing$. In other words, (8a) is only defined for quantized predicates and (8b) is only a sieve on entities relative to non-quantized predicates.

(8) $$[\![\text{PART}]\!] = \begin{cases} \text{(a)} & \lambda P.\lambda c.\lambda n.\lambda x.[\mu_{\#}(x, P_c) = n] \\ \text{(b)} & \lambda P.\lambda c.\lambda x.\exists y.[P_c(x) \wedge P_c(y) \wedge x \sqsubseteq y \wedge x \neq y] \quad \text{if } [\![\text{PART}]\!](P_c) = \perp \end{cases}$$

If the noun is a measure expression (e.g. *kilo*), which we assume to be of type $\langle n, \langle e, t\rangle\rangle$, partitive morphology is semantically vacuous since singular nouns such as *kilo*, *litra* ('kilo', 'litre') are already of the type that singular common nouns are shifted into by partitive morphology. Finally, we assume that plural morphology simply encodes the mereological sum closure operation: $[\![\text{PL}]\!] = \lambda P.\lambda x.^{*}P(x)$.

With these ingredients in place, we can derive the compositionality facts. As we see in (9-11), *kaksi omenaa* ('two apples') is felicitous, but *kaksi riisiä* (int: 'two rices') is not, since, as a mass noun (see (8)), the partitive form of *riisi* ('rice') is the wrong type to compose with *kaksi* ('two').

(9) (a) $[\![\text{kaksi}]\!] = 2$ (b) $[\![\text{omena}]\!]^c = \lambda x.[apple_c(x)]$ (c) $[\![\text{riisi}]\!]^c = \lambda x.[rice_c(x)]$

(10) $[\![\text{kaksi omena-a}]\!]^c = ([\![\text{PART}]\!]([\![\text{omena}]\!]^c))([\![\text{kaksi}]\!])$
$= \lambda n.\lambda x.[\mu_{\#}(x, apple_c) = n](2) = \lambda x.[\mu_{\#}(x, apple_c) = 2]$

(11) $[\![\#\text{ kaksi riisi-ä}]\!]^c = \lambda x.\exists y.[rice_c(x) \wedge rice_c(y) \wedge x \sqsubset y]\ (2)$ $\Leftarrow$ TYPE CLASH!

For measure constructions, since the interpretation of *omena-a* (apple-PART) is of type $\langle n, \langle e, t\rangle\rangle$, it cannot compose with *kaksi kilo-a* (two kilo-PART) intersectively (12-13). However, since the composition of the plural with partitive results in a cumulative (so non-quantized) predicate of type $\langle e, t\rangle$, *kaksi kilo-a omeno-i-ta* (two kilo-PART apple-PL-PART) is felicitous as shown in (12) and (14-15):

(12) $[\![\text{kaksi kilo-a}]\!]^c = \lambda P.\lambda x.[\mu_{\mathbf{kg}}(x) = 2 \wedge P_c(x)]$

(13) $[\![\#\text{ kaksi kilo-a omena-a}]\!]^c = \lambda x.[\![\text{kaksi kilo-a}]\!](x) \wedge [\![\text{omena-a}]\!](x)$
$\Leftarrow$ TYPE CLASH!

(14) $[\![\text{omeno-i-ta}]\!]^c = [\![\text{PART}]\!]([\![\text{PL}]\!]([\![\text{omena}]\!]^c)) =$
$= \lambda x.\exists y.[{}^*apple_c(x) \wedge {}^*apple_c(y) \wedge x \sqsubset y]$

(15) $[\![\text{kaksi kilo-a omeno-i-ta}]\!]^c = \lambda x.\exists y.[\mu_{\mathbf{kg}}(x) = 2 \wedge {}^*apple_c(x) \wedge {}^*apple_c(y) \wedge x \sqsubset y]$

Using familiar semantic properties and operations, we capture the distribution and interpretation of the partitive singular and plural in Finnish. Importantly, even though our analysis is motivated only by the data from Finnish counting and measuring constructions, we can also straightforwardly derive the correct predictions for partitive subjects. On our analysis, singular mass partitives, plural count partitives, singular nominatives and plural nominatives are all type $\langle e, t\rangle$. On the assumption that Finnish has a freely available $\exists$-closure operation on type e variables, then all of the above expressions can be used as indefinite subject NPs.

Further assuming an ι-closure type shifting operator which encodes a uniqueness condition or presupposition, then singular and plural nominatives can be used as definite subject NPs. The definite interpretation for singular mass partitives and plural count partitives would be semantically anomalous, since, on the standard assumption that ι-closure is modelled via the mereological supremum operator, a combination of mass/plural partitive nouns and a definiteness operator would be to denote the sum entity that is explicitly excluded via the $\sqsubset$-relation in the entry for the partitive morpheme (8b).

Partitive singular count Ns are not of type $\langle e, t\rangle$ on our analysis, but are, instead, of type $\langle n, \langle e, t\rangle\rangle$. We propose that the reason they cannot be type shifted into $\langle e, t\rangle$ via $\exists$-closure of the type n variable is because this operation is extensionally equivalent to the *-operation insofar as the following equivalence holds for $n \in \mathbb{N} \geq 1$:

(16) $\forall x.[{}^*P(x) \leftrightarrow \exists n.[\mu_{\#}(x, P) = n]]$

In other words, given that there is a morphologically realised means of encoding a mapping from the interpretation of a basic lexical predicate to its upward closure under mereological sum (i.e., via plural morphology), the achievement of the same result via partitive morphology and an non-morphologically realised operation of $\exists$-closure of n arguments is blocked.

References [1] A. Bale, M. Gagnon, and H. Khanjian. "Cross-linguistic representations of numerals and number marking". *Proceedings SALT 20*. Ed. by N. Li and D. Lutz. LSA, 2011, 582598. [2] G. Danon. "Two structures for numeral-noun constructions". *Lingua* 122 (2012), pp. 1282–1307. [3] D. F. Farkas and H. E. de Swart. "The semantics and pragmatics of plurals". *Semantics & Pragmatics* 3, Article 6 (2010), pp. 1–54. [4] H. Filip and P. R. Sutton. "Singular Count NPs in Measure Constructions". *Semantics and Linguistic Theory* 27 (2017). [5] T. Ionin and O. Matushansky. "A Singular Plural". *Proceedings of the WCCFL 23*. Ed. by B. Schmeiser et al. Cascadilla Press, 2004, pp. 101–114. [6] T. Ionin, O. Matushansky, and E. Ruys. "Parts of speech: Toward a unified semantics for partitives". *Proceedings of the NELS 36*. Ed. by C. Davis, A. Deal, and Y. Zabbal. GLSA, 2006, pp. 357–370. [7] P. Kiparsky. "Partitive Case and Aspect". *The Projection of Arguments*. Ed. by M. Butt and W. Geuder. CSLI, 1998. [8] M. Krifka. "Nominal Reference, Temporal Constitution and Quantification in Event Semantics". *Semantics and Contextual Expression*. Ed. by R. Bartsch, J. v. Benthem, and P. van Emde Boas. Foris, 1989, pp. 75–115.