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 (> 1) 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 (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. Measure phrases are commonly assumed to select for cumulative predicates as evidenced in English by contrasts such as *Two kilos of apples/#apple* ([8]). 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 counting and measuring constructions have received attention in the syntax literature, relatively little has been done in compositional semantics. Kiparsky [7] holds that the NP function of the partitive is associated with 'unboundedness'. Danon [2] offers a syntactic solution to why Finnish counting constructions prohibit the partitive plural, but does not address measuring constructions. 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. Such a proposal faces two problems for Finnish. First, it ignores the role of the partitive entirely. Second, it has 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. We assume that *quantization* (QUA) (relative to a context, c) distinguishes count Ns from mass and plural count Ns [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 in (3). An important notion in our analysis, that underpins the semantics of the partitive morpheme, is that of a *part-set* relative to a predicate. $PartSet(x, P)$ in (4) denotes the set of all P-parts of x.

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

(4) $PartSet(x, P) := \{y : y \sqsubseteq x, y \in P\}$

The cardinality function is also defined in terms of $PartSet$, but only for quantized predicates.

(5) $\mu_{\#}(x, P) = |\{PartSet(x, P)\}|$ if $QUA(P)$. $\perp$, otherwise.

Our main claim is that the meaning of partitive morphology is (at least) two-ways polysemous insofar as it is sensitive to whether the N denotes a quantized type $\langle e, t\rangle$ predicate or not. Both senses of $[\![\text{PART}]\!]$ in (6a,b) are defined in terms of a context-indexed predicate, P_c and $PartSet$. In (6a) the partitive, when applied to quantized $\langle e, t\rangle$ predicates (denoted by SG count Ns) is a type shifting function that introduces a cardinality function ($\mu_{\#}$). For a mass and plural count predicates P (i.e. non-quantized predicates), the meaning of $[\![\text{PART}]\!]$ in (6a) is not defined due to the selectional restrictions of $\mu_{\#}$. In such a case, as in (6b), 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). (This does not necessitate that (6a) is a more basic meaning than (6b), since, if P_c is quantized, then (6a)$(P)(c) = \varnothing$.) In other words, (6a) is only defined for quantized predicates and (6b) is only a sieve on entities relative to non-quantized predicates. The result is that, in counting constructions, only the partitive singular is felicitous, since plural partitive Ns and singular partitive mass Ns do not come out with the requisite $\langle n, \langle e, t\rangle\rangle$ type.

(6a) $[\![\text{PART}]\!] = \lambda P.\lambda c.\lambda n.\lambda x.[\mu_{\#}(x, P_c) = n \wedge \sqcup(PartSet(x, P_c)) = x]$ if $\mu(x, P_c) \neq \bot$

(6b) $\lambda P.\lambda c.\lambda x.\exists y.[P_c(y) \wedge x \in PartSet(y, P_c) \wedge x \neq y]$ otherwise

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 (7-9), *kaksi omenaa* ('two apples') is felicitous, but *kaksi riisiä* (int: 'two rices') is not, since, as a mass noun, the partitive form of *riisi* ('rice') is the wrong type to compose with *kaksi* ('two').

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

(8) $[\![\text{kaksi omena-a}]\!]^c = \lambda x.[\mu_{\#}(x, apple_c) = 2 \wedge \sqcup(PartSet(x, apple_c)) = x]$

(9) $[\![\text{\# kaksi riisi-ä}]\!]^c = \lambda x.\exists y.[rice_c(x) \wedge x \in PartSet(y, rice_c) \wedge x \neq y]$ (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 (10-11). 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 (10) and (12-13):

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

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

(12) $[\![\text{omeno-i-ta}]\!]^c = \lambda x.\exists y[^{*}apple_c(x) \wedge x \in PartSet(y, {}^{*}apple_c) \wedge x \neq y]$

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

Using familiar semantic properties and operations, we capture the distribution 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, a language that lacks articles, 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 SG and PL 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 (6b).

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 used as subjects by type shifting them into $\langle e, t\rangle$ via $\exists$-closure of the type n variable is due to the fact that $\exists$-closing the n variable is extensionally equivalent to the application of the *-operation to a type $\langle e, t\rangle$ predicate:

(14) $\forall x.[^{*}P(x) \leftrightarrow \exists n.[\mu_{\#}(x, P) = n]]$ for all $n \in \mathbb{N} \geq 1$

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 a non-morphologically realised operation of $\exists$-closure of n arguments is blocked.

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