The Finnish partitive in counting and measuring constructions[1]

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Abstract. This paper proposes a compositional semantic analysis for the use of the partitive case in counting and measuring constructions in Finnish. Count nouns in counting constructions are partitive singular but partitive plural in measure constructions. Mass nouns are infelicitous in counting constructions but are partitive singular in measure constructions. We propose an analysis for this pattern by making the semantics of the partitive morpheme both (i) derived from the notion of mereological parthood and (ii) sensitive to quantization. Finally, we show how this analysis extends to account for why mass nouns and plural count nouns in partitive case are felicitous as partitive subjects, when singular count nouns in partitive case are not.

Keywords: Finnish, partitive case, mass/count, indefiniteness.

1. Introduction

In this paper we propose an analysis for the Finnish partitive case in counting and measuring constructions. In (1a), we see that count nouns like 'apple' are in the partitive case after numerals. Mass nouns such as 'rice' in (1b) are infelicitous with numerals. In the measure construction in (2), mass and count nouns are both in the partitive case, as in (2a) and (2c), but the count noun additionally has the plural marker. Without the plural morpheme, the count noun is infelicitous in the measuring construction (2b).[2]

(1) a. kaksi omena-**a**
two apple-**PART**
'two apples'

b. #kaksi riisi-**ä**
two rice-**PART**
Intended: 'two (portions/grains of) rice'

(2) a. kaksi kilo-a omeno-**i-ta**
two kilo-PART apple-**PL-PART**
'two kilos of apples'

b. #kaksi kilo-a omena-**a**
two kilo-PART apple-**PART**
Intended: 'two kilos of apples'

c. kaksi kilo-a riisi-**ä**
two kilo-PART rice-**PART**
'two kilos of rice'

[1]We would like to thank comments and discussion from audiences at Sinn und Bedeutung 24, SinFonIJA , TbiLLC 13 and the Potsdam University SynSem Colloquium. Thanks, also, to Eleni Gregoromichelaki and Malte Zimmermann for helpful discussions. Unless otherwise cited, data comes from consultation with *Finnish: An essential Grammar* (Karlsson, 2018) and native speakers, primarily from the Helsinki metropolitan area, particularly Markus Hippi, Silva Kirkkomäki and Sami Kumpula (*Kiitoksia!*). Funding for the first author was from the DFG CRC 991 project *The Structure of Representations in Language, Cognition, and Science*, project C09, *A frame-based analysis of countability*. Funding support for the second author is possible thanks to the Cognitive Science Program at Cornell University.

[2]Abbreviatons: 1 = first person; 3 = third person; ADESS = adessive; ALLAT = allative; GEN = genitive; ELAT = elative; INESS = inessive; N = noun; PART = partitive; PL = plural; PST.P = past participle suffix; SG = singular.

Proceedings of Sinn und Bedeutung 24, vol. 2, pp.336–353. Osnabrück University.

The pattern in Finnish is surprising given the typology across other number marking languages. Usually count nouns are either plural in both counting and measuring constructions, as in English in (3), or both singular as in Turkish in (4).

(3) English
  a. two apple**s** b. two kilos of apple**s**

(4) Turkish
  a. iki elma
   two apple
   'two apples'
  b. iki kilo elma
   two kilo apple
   'two kilos of apples'

Finnish, on the other hand, employs different strategies for counting and measuring constructions. While *omena-a* 'apple-PART' is in the partitive singular in (1a), in measuring constructions, the count noun takes the partitive plural (2a). Mass nouns are infelicitous in counting constructions (1b) but in the partitive singular in measuring constructions (2c).

This data presents a puzzle. On the assumption that nouns in counting constructions denote cumulative predicates, or single entities and sums thereof, *omena-a* ('apple.SG-PART') in (1) denotes a cumulative predicate, even though it is singular. Measure phrases, such as *kilo-a* 'kilo-PART' in (2), select for cumulative predicates. Therefore, singular nouns in partitive case in Finnish *should* be felicitous in measure constructions because they denote cumulative predicates—but they are not.

In this paper, we propose a compositional semantic analysis for the singular and plural partitive constructions in Finnish in (1-2). We argue that each morpheme contributes to the semantic interpretation, in contrast to Ionin and Matushansky (2004) and Ionin et al. (2006) who assume PL morphology is semantically vacuous. 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 (1989).

The goal of this paper is therefore to account for the distribution of the partitive singular and plural in counting and measuring constructions (1) and (2), namely: (i) count nouns in counting constructions are partitive singular but partitive plural in measure constructions; and (ii) mass nouns are infelicitous in counting constructions but are partitive singular in measure constructions. We do this by making the semantics of the partitive morpheme both (i) derived from the notion of mereological parthood; and at the same time (ii) sensitive to quantization. Bare singular count nouns denote quantized predicates, mass nouns and plural count nouns denote non-quantized predicates. We argue that the partitive morpheme is polysemous and is interpreted with a different sense depending on whether the predicate it applies to is quantized.

While previous accounts of the Finnish partitive include Kiparsky (1998), who focuses on the partitive and aspect, and Danon (2012), who takes a syntactic approach to counting constructions, these accounts do not obviously extend to measure constructions. To our knowledge, there is no compositional analysis of the partitive morpheme in Finnish that accounts for counting *and* measuring constructions.

This paper is structured as follows. We first give background on the partitive case and provide evidence that Finnish has a grammaticalized mass/count distinction (§2). We then provide background on counting and measuring constructions crosslinguistically (§3) and show why this makes the Finnish data all the more puzzling. §4 briefly reviews some previous accounts of the Finnish partitive. In §5, we propose an analysis for the partitive in counting and measuring constructions. In §6, we show how our account also predicts a key distributional fact about partitive subjects. §7 concludes the paper.

2. Background on the partitive case and mass/count distinction in Finnish

2.1. The partitive case

The partitive is a nominal case marker that roughly conveys a meaning related to parthood, nonspecificity, or something without result, and is common across Finnic languages. The partitive singular has three endings: *-a/-ä*, *-ta/-tä*, or *-tta/-ttä*, where the vowel of the partitive suffix assimilates to vowels in the root. The partitive plural is built by adding *-i/ -j* to the stem and then the partitive ending (Table 1). While there are other uses of the partitive, here we focus on counting and measuring constructions.

Table 1: Finnish partitive singular and plural endings

N Concept	N.NOMINATIVE	N-PARTITIVE	N-PL-PARTITIVE
apple	omena	omena-**a**	omeno-**i-ta**
language	kieli	kiel-**tä**	kiel-**i-ä**
room	huone	huone-**tta**	huone-**i-ta**
ball	pallo	pallo-**a**	pallo-**j-a**

2.2. Evidence for a mass/count distinction in Finnish

Finnish has a lexicalized count/mass distinction, exhibited by the following contrasts with the quantifiers *monta* (5) and *paljon* (6) and the distributive determiner *jokainen* (7). For instance, the count noun *pallo* 'ball' is felicitous with the quantifier *monta* (5a), but the mass noun *riisi* 'rice' is not (5b). Similarly, the quantifier *paljon* is felicitous with count nouns like *ihminen* 'person' in the partitive plural but not singular (6a). Mass nouns are felicitous with *paljon* in the partitive singular but not plural (6b).

(5) a. Kuinka **monta** pallo-**a** on laatiko-ssa?
how **many** ball-**PART** be.3 box-INESS
'How many balls are in the box?'

b. #Kuinka **monta** riisi-**ä** on pakkaukse-ssa?
how **many** rice-**PART** be.3 package-INESS
'#How many rice(s) is/are in the package?'

(6) a. Tuo-lla on **paljon** #ihmis-**tä** / ihmis-**i-ä**.
that-ADESS be.3 **a.lot.of** person-**PART** / person-**PL-PART**
'There is/are a lot of #person/people over there.'

b. Pakkaukse-ssa on **paljon** riisi-**ä** / #riise-**j-ä**
package-INESS be.3 **a.lot.of** rice-**PART** / rice-PL-**PART**
'There is/are a lot of rice/#rices in the package.'

(7) a. **Jokainen** kultainen **sormus** maksa-a yli 200 euro-a.
each golden **ring** cost-3 over 200 euro-PART
'Each gold ring costs over 200 euros.'
b. #**Jokainen kulta** maksa-a yli 200 euro-a.
each **gold** cost-3 over 200 euro-PART
'#Each gold costs over 200 euros.'

We take the data in (5-7) as evidence for a mass/count distinction in Finnish.

3. The puzzle of Finnish counting and measuring constructions

Given that one of the contrasts in the Finnish data that we are focussing on are counting constructions such as (1a) and measuring constructions such as (2a,2c), one possible hypothesis to explain the distributional patterns of the Finnish partitive case and number morphology in such examples would be that they can be derived from syntactic and semantic differences between counting and measuring constructions that are witnessed cross-linguistically. Although we do not dispute that there are such differences, we argue that this hypothesis does not account for the Finnish data. Indeed, the Finnish data presents a puzzle regarding the meanings of nouns in counting and measuring constructions.

3.1. The counting/measuring distinction does not underpin the Finnish data

Rothstein (2011, 2016, 2017), based upon data from English, Hebrew, and Mandarin, proposes that the syntax of counting constructions (8,9), is distinct from the syntax of measure constructions (10)[3]. Furthermore, this structural difference underpins a semantic distinction, for example, whether the numeral is adjectival (counting constructions), or a type *n* argument to a measure function (measure constructions).

(8) $[_{DP}$ $[_{D}$ three$_i]$ $[_{NumP}$ $[_{Num}$ $t_i]$ $[_{NP}$ apples]]] Count (direct)

(9) $[_{DP}$ $[_{D}$ three$_i]$ $[_{NumP}$ $[_{Num}$ $t_i]$ $[_{NP}$ $[_{N}$ boxes] (of) $[_{NP}$ apples]]]] Count (container)

(10) $[_{NP}$ $[_{MeasP}$ $[_{Num}$ three] $[_{Nmeas}$ kilos] (of)] $[_{N}$ apples]] Measure

However, the syntactic/semantic distinction between counting and measuring constructions does not underlie the pattern we see in Finnish with respect to nouns such as *omena* 'apple'. We repeat (1a) and (2a) below as (11) and (13), respectively. The count container construction is given in (12). If the pattern we find in the Finnish data were to be explained on the basis of a distinction between counting and measuring, we would expect (11) and (12) to pattern together, and (13) to pattern differently. However, what we actually find is that (12) and (13) pattern together in Finnish, with (11) showing the distinct pattern of requiring the noun to be singular and in the partitive case. Therefore, it cannot be that the counting/measuring distinction explains why *omena* ('apple') must be plural in (12) and (13) but cannot be plural in (11).

(11) kaksi omena-**a**
two apple-**PART**
'two apples'

[3]Constructions such as those in (9) do also have a measure interpretation, albeit with a different syntactic structure (Rothstein, 2011). On this interpretation (9) means, approximately, *apples to the measure of three boxes-worth* as opposed to the count (container) interpretations which is *three boxes, each containing apples*.

(12) kaksi laatikko-a omeno-**i-ta**
two box-PART apple-**PL-PART**
'two boxes of apples'

(13) kaksi kilo-a omeno-**i-ta**
two kilo-PART apple-**PL-PART**
'two kilos of apples'

Crosslinguistically, the Finnish pattern is distinctive in this way. As shown in Table 2, in Germanic languages such as English and German, counting constructions (formed with numerals greater than one) require plural marked nouns and so do measure constructions. In Turkish (Turkic) and Hungarian, singular count nouns are licensed in counting constructions with any numeral and likewise with measure constructions. Only Finnish (and other Finnic languages) display a pattern where direct counting licenses singular nouns (in partitive case), where container constructions and measure constructions require count nouns to be plural (and in partitive case).

Table 2: Distribution of PL and SG marking in counting and measuring constructions

Phrase type:	Count: direct	Count: container		Measure	
N concept:	*apple*	*box*	*apple*	*kilo*	*apple*
English	PL	PL	PL	PL	PL
German	PL	PL	PL	SG	PL
Turkish, Hungarian	SG	SG	SG	SG	SG
Finnish	SG.PART	SG.PART	PL.PART	SG.PART	PL.PART

3.2. The puzzle

The three distinct patterns just discussed give rise to the puzzle that is the central focus of this paper. On the assumption that, at least for English/German-type number marking languages, plural morphology is not semantically vacuous, we have a situation where counting with numerals greater than one requires count nouns to be in the plural, since singular count nouns do not denote sums of entities. Given that measure phrases such as *two kilos (of)* select for nouns denoting cumulative predicates (nouns which denote entities and all possible sums thereof), it is also not surprising that count nouns in measure constructions must also be in the plural. Turkish and Hungarian show a different pattern. In these languages, singular count nouns seem capable of denoting not only atoms, but also sums as we see in the Turkish example in (14) (Alexiadou, 2019: p. 128).[4]

(14) Kitap al-di-m
book buy-PAST-1SG
'I bought a book/books'

[4]See Farkas and de Swart 2010 for a defence of this view for Hungarian

This explains why singular count nouns are felicitous in counting constructions and in measure constructions as complements to measure phrases. Finnish, puzzlingly, displays neither pattern. Were it the case that singular count nouns in partitive case denoted entities and sums thereof, we would expect singular count nouns in Finnish to be felicitous as complements to measure phrases such as *kaksi kilo-a* (two kilo-PART), but they are not. The puzzle, then, in simple terms, is ***why are singular count nouns in partitive case felicitous in counting constructions but not measure constructions?***

4. Previous analyses of the Finnish partitive

There is not a large amount of work done on counting and measuring constructions in Finnish in the formal semantics literature. Most work has focussed on the relation between the partitive case and aspect (Krifka, 1992; Kiparsky, 1998; Filip, 1999; Kratzer, 2004).[5] Here, we briefly review the relevant claims that have been made and also highlight the ways in which our proposal differs from them.

4.1. Kiparsky (1998)

The key semantic notion for Kiparsky is unboundedness. A predicate P is unbounded (approximately) iff non-atoms of P have P-parts, non-maximal (suprema) of Ps are parts of some P, and at least some P are proper parts of other Ps (P is not quantized in the sense of Krifka (1989)). Unboundedness is combined with the following claims:

(15) A VP predicate is unbounded if it has either an unbounded head or an unbounded argument. (Kiparsky, 1998: §5)

(16) The object of an unbounded VP is obligatorily partitive.

Kiparsky (1998) does not specifically address counting and measuring constructions in the kinds of contexts we have considered. Instead, counting constructions are only considered as objects to verbs that licence genitive/nominative-partitive alternation insofar as NPs such as *kaksi karhu-a* ('two bear-PART') are bounded (for example, no sum of two bears is a proper part of a sum of two bears). Other examples of unbounded NPs are plural count noun NPs and mass noun NPs.

Partitive subjects, for Kiparsky, are VP internal subjects: "In its NP-related function, partitive case is assigned to quantitatively indeterminate NPs (including indefinite bare plurals and mass nouns)" (Kiparsky, 1998: §1). "On subjects, partitive case marks the unboundedness of the NP itself" (Kiparsky, 1998: §7). In other words, for intransitive verbs, unboundedness of the VP is determined by the NP. This means that only mass noun NPs and plural count noun NPs can be partitive subjects.

While a combined analysis of NP and VP uses of the partitive explains why SG count nouns do not take partitive case when in subjects and why partitive subjects are only found with

[5]There is more work done on the syntax of counting constructions. Much of this work argues that partitive case is structural (e.g. Vainikka 1989; Vainikka and Maling 1996; Nelson 1998), not inherent, or that numerals assign partitive case to nouns (e.g. Danon 2012). Belletti (1988) argues that the partitive case in Finnish is an inherent case. Here, we explore the extent to which partitive case can be viewed as making a systematic contribution to the meaning of counting and measuring constructions.

intransitive verbs, it does not obviously explain why we should find partitive case used in counting constructions (unless it is assumed that it is assigned by the numeral). It also does not explain why partitive subject NPs have an indefiniteness effect, as we will see below.

On our analysis, in contrast to Kiparsky, we will treat the partitive case, not as structural and merely conveying some semantic property of an NP or VP in which the case is used. Instead, we assign the partitive morpheme with a semantics that interacts with the semantic properties of nouns on which case is marked in interaction with independently motivated semantic properties of numerals and measure expressions.

4.2. Danon (2012)

Although Finnish is not the main focus, Danon (2012) analyses the partitive case in counting constructions as being assigned to the noun by the numeral. This is based on his analysis for numerals, number marking, and the structures of numeral-noun-complexes found across languages. He remarks on the puzzle of why the partitive plural may not appear on nouns in counting constructions. To account for this, he proposes a possible explanation where partitive plural is ruled out due to structural competition of number marking (NumP), making (17) ungrammatical: "[h]aving an embedded NumP which is both plural and partitive might then be blocked either for semantic reasons or due to a structural competition for the Num[ber marking] position, making the following recursive structure ungrammatical" (Danon, 2012: p.1305).

(17) $*[_{\text{DP}} [_{\text{D}}\ ]\ [_{\text{NumP}} [_{\text{Num}}\ ]\ [_{\text{CardP}} [_{\text{Card}}\ ]\ [_{\text{NumP}} [_{\text{Num}}\ [\text{PL.PART}]\ ]\ [_{\text{NP}} [_{\text{N}}\ \text{book}]\ ]\ ]\ ]\ ]\ ]$

While Danon proposes a possible syntactic explanation for the occurrence of SG.PART Ns in counting constructions, he does not extend it to measure constructions. So far, to our knowledge, no formal semantic account of the distribution of plural and partitive morphology in counting *and* measuring constructions has been given.

4.3. Krifka (1992)

One of the few accounts that treats the Finnish partitive as meaning-conveying is presented in Krifka (1992) (but see also Belletti, 1988; Filip, 1999). Here, as in Kirparsky's work, the focus is on nominative/genitive-partitive case alternations and their impact on aspect, however, part of Krifka's proposal will be incorporated into our approach below.

Krifka (1992) draws a parallel between the meaning of progressive verbal morphology in languages such as English and the meaning of partitive morphology in Finnish:

(18) $$PROG_{Krifka} = \lambda P_{:\langle v,t\rangle}\lambda e'\exists e[P(e) \wedge e' \sqsubseteq e]$$

(19) $$PART_{Krifka} = \lambda P_{:\langle e,t\rangle}\lambda x'\exists x[P(x) \wedge x' \sqsubseteq x]$$

In words, both PROG and PART are functions that apply to predicates and return a set of parts of some entity/eventuality in that predicate's denotation.

For aspect-related uses of the Finnish partitive, Krifka derives *PROG* applying at the VP level from *PART* applying at the DO DP level. We do not give the full details here, but the intuitive idea is as follows: For VPs such as *söi omen-a* ('ate apple-PART), $[\![\text{söi}]\!](PART([\![\text{omena}]\!]))$ means that part of an apple is eaten. From this, we can infer that the event in which the part of the apple was eaten is a part of some presumed eating-a-whole-apple eventuality. In other words, someone was eating an apple (a progressive, atelic reading).

While we do not comment here on the connection between aspect and partitive morphology, part of our analysis for *PART* will adopt much of the spirit of Krifka's notion of a set of parts of some *P*. On our analysis, however, partitive morphology will encode the notion of proper *P*-parts of some *P*.

5. Analysis: Counting and measuring constructions in Finnish

To briefly recapitulate, the goal of this paper is to account for the distribution of partitive case morphology in interaction with singular/plural plural morphology in counting and measuring constructions, repeated in (18) and (19), namely to explain why count nouns in counting constructions are partitive singular but partitive plural in measure constructions, and why mass nouns are infelicitous in counting constructions but are partitive singular in measure constructions. From this explanation, and from some relatively standard assumptions about the semantics of DPs, we will also then derive an important restriction on the distribution of partitive subjects.

(18) a. kaksi omena-**a**
two apple-**PART**
'two apples'
b. #kaksi riisi-**ä**
two rice-**PART**
Intended: 'two (grains of) rice'

(19) a. kaksi kilo-a riisi-**ä**
two kilo-PART rice-**PART**
'two kilos of rice'
b. kaksi kilo-a omeno-**i-ta**
two kilo-PART apple-**PL-PART**
'two kilos of apples
c. #kaksi kilo-a omena-**a**
two kilo-PART apple-**PART**
Intended: 'two kilos of apples'

5.1. Formal preliminaries

Throughout, we assume a classical extensional mereological semantics (CEM) in which the domain of type *e* forms a Boolean semilattice (contains both individual entities and sums thereof) minus the 0 element. (See Link (1983); Krifka (1989); Champollion and Krifka (2016) among many others.) In CEM, we have a complete, commutative, idempotent, and associative mereological sum operation $\sqcup$ (see Krifka, 1989), where for any two entities of type *e*, $a \sqcup b$, the sum of a and b is also of type e. Other standard definitions are given below:

(20) $a \sqsubseteq b \leftrightarrow a \sqcup b = b$ part

(21) $a \sqsubset b \leftrightarrow a \sqsubseteq b \wedge x \neq y$ proper-part

(22) $AT(P) := \{x : P(x), \forall y.P(y) \rightarrow \neg y \sqsubset x\}$ P-atoms

(23) ${}^{*}P := \{x : Y \subseteq P, x = \sqcup Y\}$ upward closure of P under $\sqcup$

5.2. The partitive morpheme in counting and measuring constructions

Building on Krifka (1992), we propose that the one common thread that underpins many uses of the partitive morpheme in Finnish is that of P-parts of entities:

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

In words, $PartSet(x,P)$ is the set of entities that are parts of x and are Ps.

In the rest of this section, we show how the notion of *PartSet* plays a role in counting and measuring constructions.

5.2.1. *PartSet* and counting constructions

For languages such as English, counting constructions such as *two apples* are typically analysed as sets of entities, where each member of this set is a sum of two apples. More formally, the set of entities that has a cardinality of 2 with respect to the set of single apples ($\lambda x.\mu_{\#}(x, apple) = 2$), such that each member of this set is a single apple or a sum thereof (${}^{*}apple$).

(25) $$[\![\text{two apples}]\!] = \lambda x\,[\mu_{\#}(x, apple) = 2 \wedge {}^{*}apple(x)]$$

Compositionally, the numeral is treated as adjectival (either type *et* or type $\langle\langle e,t\rangle,\langle e,t\rangle\rangle$) and as encoding a cardinality function $\mu_{\#}$. Depending on one's theory, the cardinality function is restricted in some way such that it is only defined for count nouns. Here, we take Krifka's notion of a quantized predicate. A predicate, P is quantized ($QUA(P)$) iff no two things in the extension of P are proper parts of each other.

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

The property *QUA* then is used to define the felicity conditions on what can be a restriction on the cardinality function:

(27) $$\mu_{\#}(x,P) = \begin{cases} |\{y : y \sqsubseteq x, y \in P\}| & \text{if } QUA(P) \\ \bot & \text{otherwise.} \end{cases}$$

The reason we need some restriction is to avoid unintuitive results derived from double counting. Suppose that $P = \{a, b, a \sqcup b\}$, a non-quantized predicate. Without the restriction that P is quantized, we get an unintuitive counting result: $\mu_{\#}(a \sqcup b, P)$ would equal 3, not the more intuitive 2 or 1 (we would be counting a, b and $a \sqcup b$ each as individual Ps).

Interestingly, the definition for $\mu_{\#}(x,P)$ in (eq:cardfunc2) is actually based on *PartSet*:

(28) $$\mu_{\#}(x,P) = \begin{cases} |PartSet(x,P)| & \text{if } QUA(P) \\ \perp & \text{otherwise.} \end{cases}$$

In English, the derivation for a counting construction such as *two apples* would then be roughly as follows (although details vary depending on the details of one's analysis).[6]

(29) $$[\![\text{two}]\!] = \lambda P.\lambda x.\mu_{\#}(x, AT(P)) = 2$$

(30) $$[\![\text{apple}]\!] = \lambda x.apple(x)$$

(31) $$[\![\text{PL}]\!] = \lambda P.{}^{*}P$$

(32) $$[\![\text{apples}]\!] = [\![\text{PL}]\!]([\![\text{apple}]\!]) \; = \; \lambda x.{}^{*}apple(x)$$

(33) $$[\![\text{two apples}]\!] = \lambda x\,[\mu_{\#}(x, apple) = 2 \wedge {}^{*}apple(x)]$$

For a language in which singular count nouns have number neutral denotations (denoting single entities and sums thereof), the derivation would be more or less the same, save the application of $[\![\text{PL}]\!]$.

Such an analysis cannot work for Finnish, however, since grammatical Finnish counting constructions contain singular count nouns in partitive case not plural count nouns. As a first pass, then, we could assume that the sense in which the basic meaning of partitive morphology (*PartSet*) contributes to counting constructions is build a frame for a counting construction that combines the meaning of the argument noun with a numeral.

(34) $$[\![\text{PART}_{1st pass}]\!] = \lambda P.\lambda n.\lambda x.\ [\mu_{\#}(x,P) = n \wedge x = \sqcup(PartSet(x,P))]$$

In words, a function that is supplied with a predicate and a numeral of type *n* yields the set of entities that have a cardinality of *n* each of which is identical to the sum of its *P*-parts. Notice, in particular that the notion of *PartSet* is used both to determine cardinality of *x* (see (28)) and to further restrict the extension of the set.

Now, as it happens, when the 0-element is not part of the domain, (34), the following equivalence holds:

(35) $$[\![\text{PART}_{1st pass}]\!] = \lambda P.\lambda n.\lambda x.\ [\mu_{\#}(x,P) = n \wedge {}^{*}P(x)]$$

In other words, *PartSet* can play a central role in both defining a cardinality function and restricting membership of a set to *P*s and sums thereof. Put another way, the partitive morpheme, based on *PartSet*, can yield a means of compositionally deriving counting constructions in Finnish that take only singular count nouns as arguments.[7] In other words, we have a derivation for counting constructions in Finnish that selects for singular nouns in partitive case such as in *kaksi omena-a* (two apple-PART, 'two apples):

(36) (a) $[\![\text{kaksi}]\!] = 2$ (b) $[\![\text{omena}]\!] = \lambda x\,[apple(x)]$ (c) $[\![\text{riisi}]\!] = \lambda x\,[rice(x)]$

[6] In particular, the way in which the restrictor set for $\mu_{\#}$ is determined is disputed. Here, since our aim is not to analyse English, we use AT(P) just by way of demonstration.

[7] There are similarities between this and the proposal in Ionin and Matushansky (2004); Ionin et al. (2006) for numerals in English and Finnish. The distinction between our proposals is that we do not assume that plural morphology is semantically vacuous in either English or Finnish. We also think there is evidence that Finnish numerals in nominative counting constructions are not of an adjectival type, since, if they were, we would expect the numeral and the noun to have the same case.

(37) $[\![\text{omena-a}]\!] = [\![\textsc{part}]\!]([\![\text{omena}]\!])$
$= \lambda n.\lambda x\,[\mu_{\#}(x, apple) \wedge \sqcup(PartSet(x, apple)) = x]$

(38) $[\![\text{kaksi omena-a}]\!] = ([\![\textsc{part}]\!]([\![\text{omena}]\!]))([\![\text{kaksi}]\!])$
$= \lambda n.\lambda x\,[\mu_{\#}(x, apple) = n \wedge \sqcup(PartSet(x, apple)) = x]$ (2)
$= \lambda x\,[\mu_{\#}(x, apple) = 2 \wedge \sqcup(PartSet(x, apple)) = x]$

Count nouns in nominative case (singular or plural) and mass nouns in nominative case are ruled out from counting constructions, since they are of type $\langle e, t\rangle$, and so cannot compose with the numeral of type *n*. Mass nouns in partitive case such as *riisi-ä* (‘rice-PART’) are ruled out since $[\![\text{riisi}]\!]$ is not quantized and so $\mu_{\#}(x, [\![\text{riisi}]\!])$ is not defined

5.2.2. *PartSet* and measure constructions

The reason why $\textsc{part}_{1st pass}$ is not sufficient is that it makes the wrong predictions for measure constructions. Recall that grammatical measure constructions contain (singular) mass nouns in partitive case and plural count nouns in partitive case, but, as it stands, $\textsc{part}_{1st pass}$ is not defined for either plural count or mass noun predicates. We therefore propose a polysemous interpretation for PART that ‘fills the gap’ by defining PART for predicates that $\textsc{part}_{1st pass}$ in (34) and (35) is not defined for. One polyseme for PART is as in $\textsc{part}_{1st pass}$, the second polyseme for PART will, like $\textsc{part}_{1st pass}$, be based on *PartSet*. Our inspiration for this is Krifka’s (1992) proposal (see section 4.3).

$$[\![\textsc{part}]\!] = \begin{cases} \text{(39a)} & \lambda P.\lambda n.\lambda x.[\mu_{\#}(x, P) = n \wedge \sqcup(PartSet(x, P)) = x] \\ \text{(39b)} & \lambda P.\lambda x.\exists y.[P(y) \wedge x \in PartSet(y, P) \wedge x \neq y] \end{cases}$$

When supplied with a predicate, *P*, the polyseme for PART in (39b) yields the set of entities that are *P*s or sums of *P*s but are not maximal in the context, i.e., not $\sqcup P$. In other words, (39b) applies to some set of entities or stuff and returns a proper subset of these entities, namely, everything other than the sums of entities or stuff which are not proper parts of anything else in the set.

Now, it is worth emphasising that these two senses of PART are in a pseudo-complementary distribution in the following sense. As we have shown, (39a) is only defined for predicates denoted by singular count nouns i.e., quantized predicates. However, (39b) returns the empty set if applied to predicates denoted by singular count nouns. It returns a non-empty set if applied to predicates denoted by plural count nouns and mass nouns, i.e. non-quantized predicates. This is because (39b) requires that there is at least one *P* that has a *P*-part not identical with itself, i.e., that there are at least two *P*s such that one is a proper part of the other.

By adopting this semantics for PART, we are almost able to derive the right results for measure constructions. There is, however, a wrinkle that we will only briefly address here. Measure constructions in Finnish also contain partitive case on the measure expression (e.g. *kilo-a* (‘kilo-PART’)). On standard assumptions, measure expressions such as *kilo* would be of type

$\langle n, \langle e,t \rangle \rangle$ (Rothstein, 2011) or of type $\langle n, \langle \langle e,t \rangle, \langle e,t \rangle \rangle \rangle$, but if *kilo-a* ('kilo-PART') were also of this type, partitive morphology on measure expressions would be semantically vacuous. Although not an optimal outcome, given that we are providing a semantic analysis of partitive morphology, this could be explicable in the following way. Since, for example, $[\![\text{kilo}]\!]([\![\text{kaksi}]\!])$ would be of an adjectival type, and since adjectives in Finnish display case agreement with the nouns they modify, partitive morphology on *kilo* is a matter of case agreement.

An alternative, more semantically driven approach would be to assume that, just as partitive morphology introduces a cardinality function on nouns, it introduces a measure function on a scalar concept such as **kg** such that $[\![\text{part}]\!](\mathbf{kg}) = \lambda n.\lambda P.\lambda x.\ [\mu_{\mathbf{kg}}(x) = n \wedge P(x)]$.

For our current purposes, we do not have to decide between these alternatives since both are compatible with the following semantics for the measure phrase *kaksi kilo-a* ('two kilo-PART'):

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

With this interpretation of measure phrases, our account makes the right predictions, namely that singular count nouns in partitive case such as *omena-a* ('apple-PART') are not grammatical as arguments to measure phrases. If sense (39a) of PART is selected to apply to $[\![\text{omena}]\!]$, then this leads to a type clash as shown in (41). However, if sense (39b) of PART is selected to apply to $[\![\text{omena}]\!]$, then this returns the empty set, and so the denotation *kaksi kilo-a omena-a* ('two kilo-PART apple-PART') would also be empty thus this sense of PART would be ruled out on pragmatic (quality and quantity) based grounds.

(41) $$[\![\#\ \text{kaksi kilo-a omena-a}]\!] = [\lambda P.\lambda x.[\![\text{kaksi kilo-a}]\!](x) \wedge P(x)]\ ([\![\text{omena-a}]\!])$$
$$[\![\text{kaksi kilo-a}]\!] : \langle \langle e,t \rangle, \langle e,t \rangle \rangle, [\![\text{omena-a}]\!] : \langle n, \langle e,t \rangle \rangle \Leftarrow \text{TYPE CLASH!}$$

Plural count nouns and mass nouns, however, are felicitous in measure constructions:

(42) $$[\![\text{omeno-i-ta}]\!] = [\![\text{PART}]\!]([\![\text{PL}]\!]([\![\text{omena}]\!])) = \\ = \lambda x.\exists y.[^*apple(y) \wedge x \in PartSet(y, ^*apple) \wedge x \neq y]$$

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

In words, (43) is the set of apples or sums thereof that measure 2 kilos in weight (with the implication that these are not all of the apples).[8]

In summary, we have argued that partitive morphology is polysemous in a way that effectively results in a sensitivity to whether the noun the partitive applies to denotes a quantized predicate

[8]There is a problem with this analysis, however. As it stands, measure phrases such as *kaksi kilo-a* ('two kilo-PART') select for non-quantized predicates, however, this could be supplied by a plural marked noun in the nominative case. We suspect that the reason why the nominative plural form is excluded from these contexts is due to interactions with indefiniteness. For example, to communicate 'two kilos of the berries' would require a different case on 'berry', namely the elative case, as in (i).

(i) kaksi kilo-a marjo-i-sta
two kilo-PART berry-PL-ELAT
'two kilos of the berries'

(e.g. is singular count on the one hand, or is plural count or mass on the other). This polysemy not only explains why counting constructions require singular count nouns, but also why measure phrases (such as *kaksi kilo-a*, 'two kilo-PART) cannot combine with singular count nouns (in partitive case).

6. Extending the analysis to derive restrictions on partitive subjects

Based on the analysis of PART given in section 5.2, with only few extra assumptions about definite and indefinite DPs, we can also derive a restriction on partitive subjects in Finnish.

6.1. Partitive and Nominative subjects in Finnish

The subjects of some intransitive verbs in Finnish display case alternation (see Kiparsky 1998; Karlsson 2018; amongst others). Unsurprisingly, subjects can be in nominative case, but they can also be in partitive case. However, partitive subjects cannot be singular count nouns (44). Partitive subjects formed with mass nouns or plural count nouns are interpreted as indefinite (45). Nominative subjects are interpreted as definite for plural count nouns (46) and mass nouns (47) but as underspecified for definiteness for nominative singular count nouns (48).[9]

(44) #Omena-a on pöydä-llä.
apple-PART be.3 table-ADESS
'Apple is on the table.'

(45) Omeno-i-ta / Riisi-ä on pöydä-llä.
apple-PL-PART / rice-PART be.3 table-ADESS
'There are apples/There is rice on the table.'
Not: The apples are / the rice is on the table.

(46) Omena-t ovat pöydä-llä.
apple-PL be.3.PL table-ADESS
'The apples are on the table'

(47) Riisi on pöydä-llä.
rice be.3 table-ADESS
'The rice is on the table'

(48) Omena on pöydä-llä.
apple be.3 table-ADESS
'An apple / the apple is on the table'

6.2. Extending the analysis to partitive and nominative subjects

To extend our analysis to the data in (44)-(48), we need a couple of extra assumptions. Our first additional assumption is that nominative case is semantically vacuous ($[\![\text{NOM}]\!] = \lambda P.P$). Our second additional assumption is that, since (written) Finnish lacks articles, we have two

[9] For sentences such as (48), the indefinite reading can be made more salient if the subject is sentence final *Pöydällä on omena*.

type-shifting functions (i.e., the interpretations of a null D head):

(49) $INDEF : \langle et, \langle\langle e, vt\rangle, vt\rangle\rangle \quad = \lambda P_{:\langle e,t\rangle}.\lambda \mathscr{E}_{:\langle e,\langle v,t\rangle\rangle}.\lambda e.\exists x.\mathscr{E}(x)(e) \wedge P(x)$

(50) $DEF : \langle et, e\rangle \quad = \lambda P.\iota P$

INDEF introduces an indefinite GQ and so enables a subject NP to compose with a VP. The definition of *DEF* we use is based on that proposed by Chierchia (1998: p. 346):

(51) a. ιX = the largest member of X if there is one (else, undefined)
b. the dogs = $\iota DOGS$ = the largest plurality of dogs
c. the dog= ιDOG = the only dog (if there is one)

The last ingredient we need is a representation of an intransitive VP, which we assume to be of type $\langle e, \langle v,t\rangle\rangle$. For the purposes of explication only, our working example will be based on the following representation of *on pöydä-llä* (is table-ADESS, 'is on a/the table'), an intransitive VP containing a PP:

(52) $[\![\text{on pöydä-llä}]\!] = \lambda x.\lambda e.[location(e, on\_table) \wedge theme(e,x)]$

6.2.1. Intransitive VPs and singular count nouns as nominative subjects

In our analysis, singular and plural nouns in nominative case and partitive case marked mass nouns and plural count nouns are of type $\langle e,t\rangle$. Given that intransitive VPs are of type $\langle e, \langle v,t\rangle\rangle$, we must assume the presence of a null D that is realised as either *DEF* or *INDEF*. This leaves two possible derivations for the sentence in (48), one using *DEF* and the other using *INDEF*.

The derivation using DEF:

(53) $DEF([\![\text{omena}]\!]) = \iota(apple)$

I.e. the single apple that is in the context

(54) $(52)(DEF([\![\text{omena}]\!])) = \quad \lambda e.[location(e, on\_table) \wedge theme(e, \iota(apple))]$

The set of eventualities in which the single apple in the context is on a/the table

The derivation using INDEF:

(55) $INDEF([\![\text{omena}]\!]) = \lambda \mathscr{E}_{:\langle e,vt\rangle}.\lambda e.\exists x\ [\mathscr{E}(x)(e) \wedge apple(x)]$

I.e., a function from verbal predicates to the set of eventualities in which there is an apple on a/the table.

(56) $(52)(INDEF([\![\text{omena}]\!])) = \lambda e.\exists x.[location(e, on\_table) \wedge theme(e,x) \wedge apple(x)]$

The set of eventualities in which there is an apple on the table.

In summary, singular count noun subjects in nominative case are entirely compatible with the application of *DEF* or *INDEF*, hence the different available readings in (48).

6.2.2. Intransitive VPs and partitive subjects

Singular count nouns in nominative case or mass or plural count nouns in partitive case, in our analysis, are of type $\langle e,t\rangle$. In contrast, singular count nouns in partitive case are of type $\langle n,et\rangle$. This straightforwardly accounts for the infelicity of partitive subjects for singular count nouns since singular count nouns in partitive case are the wrong type to compose with an intransitive VP. This explains the data in (44), repeated here as (57):

(57) #Omena-a on pöydä-llä.
apple-PART be.3 table-ADESS
'Apple is on the table.'

PL count nouns in partitive case (and mass nouns in partitive case) are of the right type to be subjects. What remains to be explained is why they can only be interpreted as indefinite DPs, i.e, the pattern in (58):

(58) Omeno-i-ta on pöydä-llä.
apple-PL-PART be.3 table-ADESS
'There are apples on the table.'
Not: The apples are on the table.

The explanation for this follows directly from the interaction between our proposed analysis for PART and the definition of DEF. The relevant sense for $[\![\text{PART}]\!]$ is repeated is in (59), repeated from (39b). For a predicate P, this is the set of Ps (individual entities and sums thereof) excluding the supremum of P.

(59) $$\lambda P.\lambda x.\exists y.[P(y) \wedge x \in PartSet(y,P) \wedge x \neq y]$$

In contrast, the *DEF* shift entails that the supremum of P (locally in the context) is denoted. Therefore, for count nouns such as *omena* ('apple'), $DEF([\![\text{PART}]\!](PL)([\![\text{omena}]\!]))$ will be semantically anomalous since the meaning of the partitive morpheme and *DEF* are effectively at odds with one another.

Plural marked nouns in partitive case and mass nouns in partitive case, unlike singular marked nouns in partitive case, can be partitive subjects if we use *INDEF*. For example, for *omeno-i-ta* (apple-PL-PART), we have:

(60) $PL([\![\text{omena}]\!]) = \lambda x.{}^*apple(x)$

(61) $[\![\text{PART}]\!]((60)) = \lambda x.\exists y[{}^*apple(x) \wedge {}^*apple(y) \wedge x \sqsubseteq y]$

(62) $INDEF((61)) = \lambda \mathscr{E}.\lambda e.\exists x.\exists y[\mathscr{E}(x)(e) \wedge {}^*apple(y) \wedge x \in PartSet(y, {}^*apple) \wedge x \neq y]$

Which, when applied to (52) yields the set of eventualities in which there are apples on the table (but not all of the apples in the context), i.e., that there are some apples on the table. In other words, mass nouns and plural count nouns in partitive case have to have an indefinite interpretation whenever they are felicitously used in the subject position.

6.2.3. Intransitive VPs: count nouns as nominative plural subjects and mass nouns as nominative subjects

Finally, we need to explain why subjects are interpreted as definite if they are either plural count or mass and in nominative case (46)-(47). We suggest that the explanation for this is pragmatic, not semantic, and arises as the result of reasoning based on case alternatives. Given that the interpretation of singular nominative mass nouns such as $[\![\text{riisi}]\!]$ and plural count nouns in nominative case such as $[\![\text{omena-t}]\!]$ are of type $\langle e,t\rangle$, there is no semantic reason why they cannot be combined with *INDEF* or *DEF*. However, given that partitive mass and partitive plural count nouns are alternatives for the nominative forms, and given that, as we have shown, the partitive forms must be interpreted as indefinite, the definite interpretations of *omena-t* (apple-PL) and *riisi* ('rice') in (46)-(47) can be explained as an implicature. As evidence for this, we note that, where there is no partitive subject alternative available, mass and plural count subjects in nominative case can be interpreted as either definite or indefinite as the examples below from Karlsson (2018) show for the plural count noun subject *poja-t* (boy-PL) and the mass noun subject *kahvi* (coffee):

(63) Poja-t potkivat pallo-a.
boy-PL kick.3 ball-PART
'(The) boys kick a/the ball'

(64) Kahvi on hyvä-ä.
coffee be.3 good-PART
'(The) coffee is good'

7. Conclusions

We began with data on Finnish counting and measuring constructions which demonstrate that (i) count nouns in counting constructions are partitive singular but partitive plural in measure constructions and (ii) mass nouns are infelicitous in counting constructions but are partitive singular in measure constructions. We posited that to capture the data the partitive is derived from mereological parthood (the notion of *PartSet*) and sensitive to quantization (mass/count). The analysis proposed here supports theories that argue that PL nouns in counting constructions are semantically plural.

Making the partitive sensitive to quantization also correctly predicts a key distributional fact about partitive subjects. Under our analysis, partitive singular count nouns are of type $\langle n,\langle e,t\rangle\rangle$ and partitive plural count nouns and partitive singular mass nouns are $\langle e,t\rangle$. On the assumption that indefinite NPs can be derived via $\exists$-closing type e arguments of type $\langle e,t\rangle$ NPs and forming a GQ, this analysis predicts that partitive singular count nouns should not be allowed in subject position (they are of type $\langle n,\langle e,t\rangle\rangle$), but partitive plural count nouns and partitive singular mass nouns can be in subject position (since they are type $\langle e,t\rangle$).

Our proposed analysis is (to our knowledge) the first compositional analysis of the Finnish partitive morpheme that (i) accounts for counting and measuring constructions and (ii) also predicts a key distributional fact on partitive subjects. Our analysis accounts for this data with standard assumptions about the semantics of plural morphology while keeping parthood as the core meaning of the partitive morpheme.

As demonstrated above, count nouns are in the partitive singular in counting constructions. An interesting case for future investigation where a count noun is in the partitive plural in a counting construction is given in (65). In (65), the noun *kirjoja* 'books' is discontinuous from the numeral.

(65) Oman hyllyn **kirjo-j-a** luin **kaksi**.
own.GEN shelf.GEN **book-PL-PART** read.PAST.1 **two**
'Of the books on my shelf, I read two (of them).'/'I read two books on my shelf.'[10]

Further investigation of the syntactic and semantic structure of (65) is needed to determine why the count noun is in the partitive plural. For instance, is (65) an instance of subextraction of the NP *oman hyllyn kirjoja* from the object position? Is this a partitive structure, different than the counting constructions presented above? We leave these questions open for future work.

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