

Sortal, Relational, and Functional Interpretations of Nouns and Russian Container Constructions

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Abstract

Among the semantic types that nouns can take on, functional types are the smallest class, and functional nouns are probably not a linguistically distinct subcategory, *pace* Löbner (1985). But there are some interesting constructions specific to functional nouns, of which we discuss three, devoting most attention to the third. The three are (i) parameter-headed NPs as modifiers in English, as in *a dress that length* (Partee 1986), (ii) a construction in Russian known as *Genitive with Obligatory Third Term* (Borschev & Knorina 1990), similar to English *person of medium height*, **person of height* and (iii) Russian *Genitive of Measure* construction(s), illustrated by *stakan moloka* ‘glass of milk’, involving a quantity of substance contained in a container. We describe a series of meaning-shifts that lead from the concrete container-noun to its use as a pure (functional) measure term. The main theoretical concerns here are these meaning shifts and the question of how many distinct senses need to be recognized. We close with some observations on the relation between linguistic and non-linguistic aspects of the natural-language metaphysics of containers.

1 INTRODUCTION. SORTAL, RELATIONAL, AND FUNCTIONAL NOUNS

Sebastian Löbner (1985, 1998) has drawn attention to some of the interesting properties of functional nouns. He divides nouns in natural language into four different basic semantic types, based on the two properties of inherent relationality and inherent uniqueness. His basic types are sortal nouns (*cow*)—neither relational nor unique; individual nouns (e.g. proper names)—non-relational but inherently unique; relational nouns (*part*)—relational but not unique; and functional nouns (*size*), both relational and unique.

The starting point for this paper is the claim that functional nouns are one of the basic types of nouns. On the one hand, we are inclined to dispute that claim; we would argue that the *basic* types of nouns are sortal nouns, proper names and relational nouns, and for the most part, functional nouns are simply an accidental subclass of the relational

nouns. On the other hand, there are some small classes of functional nouns that participate in distinctive language-specific constructions, and we will discuss three of these in this paper, two briefly and a third as our main topic: the semantics of the Russian *Genitive of Measure* construction with container nouns, as in *stakan moloka* ‘glass of milk’. Container nouns have a basic sortal meaning, but they shift productively to a relational reading when used in the Genitive of Measure construction and may shift to a functional reading over time to gain an abstract measure reading analogous to *litr* ‘liter’. The content and nature of these shifts and the semantics of the construction(s) involved are the central topic of this paper.

The distinction between sortal nouns and relational nouns is standardly taken as a distinction between one-place predicates and two- (or possibly more-) place predicates (Partee 1983/1997; De Bruin & Scha 1988; Barker 1995; Vikner & Jensen 2002; Asudeh 2005). Sortal nouns were so-named by Strawson (1959) because of their ontological role in classifying entities into *sorts*; he characterized them as ‘terms that provide a principle for distinguishing and counting individual particulars’. Adjectives, also often analyzed as one-place predicates, prototypically express qualitative properties that do not provide sortal classifications, though the distinction between sortal and non-sortal properties is hard to pin down.

Some relatively clear examples of sortal nouns are given in (1a).

- (1) a. Sortal nouns: cow, apple, house, number, proposition, sonata
b. Contexts: This is (a(n)) N. This/that N is ... (e.g. good).

(One could add non-relational mass nouns to the list, although these are usually not called ‘sortal’: e.g. *air, fire, fog, peace*.) Typical diagnostic contexts for a sortal noun N are in (1b).

Davies (1982) observed that when a demonstrative pronoun is used without a noun, as in (2), even with a gesture, there is generally an implicit sortal noun to help resolve the otherwise potentially incomplete deictic intention.

- (2) I don’t know why *that’s* in here.

Contrasting with sortal nouns are relational nouns, two-place predicates that often occur with a genitive phrase (Partee 1983/1997; De Bruin & Scha 1988; Barker 1995); some relatively clear examples of relational nouns are given in (3).

- (3) mother, grandmother, friend, description, portrait, part, edge, price, height

One pervasive fact about the distinction between sortal and relational nouns in many languages is the permeability of the boundary between them. The distinction is real: certain constructions clearly distinguish them. (Roughly: sortal nouns do not take arguments, relational and functional nouns do.) Nouns can often be coerced to cross the border, and some nouns like *teacher* have robust meanings both as sortal and as relational nouns. The distinction is formally sharp, but the classification of nouns is not.

For Löbner (1985, 1998), the further distinction between merely relational nouns and those relational nouns that are functional is important, since functional nouns play a foundational role in his theory of *definite associative anaphora*, also known as *bridging anaphora*, illustrated in (4), a phenomenon in which a definite NP is licensed by its (functional) connection to some earlier definite or indefinite antecedent.

- (4) a. Mary bought a used car, and soon realized that *the brakes* needed replacing.

Functional nouns are those which have a unique value for each argument, where the argument is typically expressible by a genitive NP: *mother* is functional, while *sister* is not, since *John's mother* is always defined (on a given domain, which we may think of as presuppositionally defined) and picks out a unique individual, whereas *John's sister* may be undefined or underspecified, since John may have no sisters or more than one. (As is often the case with relational nouns, the context may help to specify a unique referent for *John's sister* even if John has more than one sister.)

Some examples of merely relational (i.e. relational but not functional) and of functional nouns are given in (5), along with representative contexts in which they can occur.

- (5) a. Relational: grandmother, sister, daughter, friend, relative, description, portrait, property, attribute, part, edge
Contexts: John's friend, a/the friend of the President, John has a friend
- b. Functional: mother, apex, center, size, height, weight, address, duration, price, temperature, nationality
Contexts: John's height, #a/the height of the President, ?The door has a height, The door has a height of more than 2 meters.

In the semantic field of kinship terms, a few, like *mother* and *father*, are functional, while the great majority, like *grandmother*, *sister*, *daughter*, *aunt*, *niece* are not, although those are each functional on

certain subdomains. The same is true within other semantic fields: *center*, *apex*, *base* are functional where they are defined, whereas *edge*, *corner* are not. In such semantic fields, deciding whether a noun is functional or merely relational, or functional only on certain subdomains, tends to feel like a logic quiz, not like a natural classification. The main point is that most functional nouns occur in semantic fields that also include merely relational nouns; there are very few semantic classes that contain only functional nouns.

But in the semantic field that includes *size*, *height*, *duration*, etc., the terms all seem to be functional, and in this class, we find some special syntactic constructions that seem to be limited to functional terms; we will discuss one in section 2.1.

We do not want to take issue with Löbner's use of functional concepts in defining definite associative anaphora, especially since he is careful to emphasize that it is not always the lexicon alone that is responsible for a certain expression being interpreted as functional; and he builds in an important place for a situation argument, which makes more nouns express functional concepts than otherwise might be thought to. His generalizations about the relationship between the use of the definite article and the functional interpretation of the noun it applies to are really about the interpretation of nouns in context, as he emphasizes, and his examples involve equal numbers of what we are calling functional nouns and non-functional relational nouns. We merely want to argue that among *lexical* noun meanings, the line between relational and functional nouns is even less sharp than that between sortal and relational nouns, and we see relatively little evidence of the robustness of a lexical category of functional nouns as distinct from the broader lexical category of relational nouns.

Our working hypothesis is that sortal and relational nouns are of different syntactic categories and different semantic types. Functional nouns are a subclass of relational nouns but not a separate category or type. If categories are clusters of features, functional and relational nouns share most of their features.

But having claimed that the distinction between relational and functional nouns is not in general robust, we acknowledge that there are some small classes of functional nouns and some particular limited constructions specific to functional nouns. Before turning in section 3 to the construction that is our main concern, the Russian Genitive of Measure construction involving container words, we will briefly discuss two other language-particular constructions in section 2. All three constructions show interesting semantic properties and differ from the default function-argument application characteristic of prototypical

relational nouns with their arguments illustrated in (5a) above and (8) below.

The most difficult question we have encountered in working on the Russian Genitive of Measure construction is how many distinct readings to assign to it—two, three or four—and correspondingly how many distinct readings to assign to the container words and by what kinds of semantic shifts the distinct readings are obtained. The line between metonymy ‘on the fly’ and lexical shifts is not always sharp; both involve meaning shifts, but they differ in the degree to which they involve the stored lexicon. Distinguishing at least two different readings for this construction is uncontroversial; we will present arguments for distinguishing two more readings, as well as arguments against doing so. The four readings we offer as distinct can be shown to arise by a sequence of shifts from the basic sortal meaning of container nouns, whether or not those four readings should all be lexicalized as distinct. At the end, we also discuss an interesting asymmetry in the ontological constraints on the container words v. the ‘contents’ expressions in the container constructions.

2 SOME LANGUAGE-PARTICULAR FUNCTIONAL-NOUN CONSTRUCTIONS

In this section, we briefly discuss two constructions that apply to certain classes of functional nouns in certain languages. One is an unusual English-specific construction that applies to a class of functional nouns such as *height*, *weight*, *age*. The other is a Russian construction, *Genitive with Obligatory Third Term*, that involves a similar small class of functional nouns.

2.1 *An English-specific functional-noun construction: a dress that length*

It was observed in Partee (1986) that English has a language-specific construction involving the use of bare NPs as modifiers, as in (6a–c).

- (6) a. a dress that size, length, color, price, *that material, *design, *origin
- b. (i) That house has been every color.
- (ii) *?That boy is every student in my class; *?The pork chop on this plate is every piece of meat that we have in the house.

- c. (i) That shirt is blue.
- (ii) Blue is a nice color.
- (iii) ∴ That shirt is a nice color.

These are all well-formed in English. In most languages, an NP like *that color* or *a nice color* can only be used to refer to a color and cannot be used in these adjectival positions to express the property of having that color or having a nice color. Most languages instead require something like *is of a nice color* or *has a nice color* in (6c-iii). English allows NPs headed by certain nouns like *color*, *length* to function very similarly to adjectival phrases.

The analysis of this construction in English offered in Partee (1986), including an explanation of why quantification is possible in (6b-i) but not (6b-ii), draws on the work of Chierchia (1982). Informally, (6b-i) amounts to ‘For every color x , that house has been ${}^u x$ ’, where x is of type e and ${}^u x$ is of type $\langle e, t \rangle$; u is Chierchia’s ‘up’ operator that maps a *kind* onto its corresponding unsaturated *property*. Its inverse ‘down’ operator n maps the predicative meaning of adjectival *blue* in (6c-i) onto the meaning of the nominalized *blue* in (6c-ii).

Many languages have the two kinds of *blue* illustrated in (6c-i,ii), but apparently very few have the predicative use of *that color* as in (6a) or of *a nice color* as in (6c-iii), where it is applied to things that *have* colors rather than things that *are* colors (as in (6c-ii), which would be normal in most languages).

The nouns that participate in this construction are a small class; Partee (1986) calls them ‘attribute nouns’, since they denote second-order properties. They are all functional nouns. But as seen in (6a), not all functional nouns belong to this class: such nouns as *material*, *design*, *origin* do not participate in this construction, even though *the material of this dress*, *the design of this dress*, *the origin of this dress* pick out a unique value just as well as *the length of this dress*, etc. do. The boundaries of the class are slightly fuzzy and speakers draw them slightly differently, but what is clear is that this is a marked minor construction of English that applies to a subclass of functional nouns not to functional nouns in general.

2.2 A Russian-specific function-noun construction: Genitive with obligatory third term

There is a well-known construction in Russian, called ‘Genitive with Obligatory Third Term’ (Borschev & Knorina 1990) or ‘Genitive of Quality’ (Zolotova 2001), illustrated in (7a). It was observed by Borschev & Knorina (1990) that the head of the genitive phrase in this construction, *rost* ‘height’ in (7a), always denotes a function or

attribute, and the ‘obligatory third term’, here *srednyj* ‘medium’, constrains or specifies a value of that function. The argument of the function is not specified: it is abstracted on, so that the whole genitive phrase constitutes a predicate which serves as a modifier of the noun, itself a sortal; the phrase as a whole is then interpreted as a predicate; (7a) is interpreted as a predicate true of an entity *x* if *x* is a person and the height of *x* is medium.

- (7) a. *čelovek srednego rosta*
 person medium-GEN height-GEN
 ‘person of medium height’
 b. **čelovek rosta*
 person height-GEN
 ‘#person of height’

With certain explainable exceptions, trying to use the construction without its ‘third term’ results in anomaly that feels like extreme redundancy, as in (7b), since every person has *some* height. Cf. the similarly ill-formed ‘#He solved it in a manner’ vs. ‘He solved it in an unusual manner’. It may be possible to argue in both cases that the anomaly of the expression without the additional modifier is merely pragmatic, but we will not take a stand on that issue here.

Nikolaeva (2007) studied this construction in the context of other kinds of Russian genitive constructions such as (8) and (9).

- (8) *brat Peti*
 brother Petja-GEN
 ‘brother of Petja’
 (9) *stakan moloka*
 glass milk-GEN
 ‘glass of milk’

What is interesting is that these various Genitive constructions are strikingly different compositionally as to which part is the function and which is its argument: in the normal genitive construction (8), the relational head noun *brat* ‘brother’ takes the dependent genitive NP *Peti* ‘Petja’ as its argument. In the Genitive of Quality in (7a), on the other hand, the complex Genitive NP forms a modifier that is applied to the sortal (non-relational) head noun and is not an argument of it. Nikolaeva investigated interactions of different classes of head nouns—strongly relational, weakly relational (shiftable) and non-relational—with different classes of Genitive dependents—strongly modifier-like, weakly modifier-like and strongly non-modifier-like.

What she found is that when the head noun is strongly relational and the Genitive NP is non-modifier like, as in (8), the Genitive NP is unambiguously interpreted as an argument, and in the reverse case, (7a), unambiguously as a modifier.¹ Other cases may involve alternations or shifts in the interpretation of the head noun and/or the Genitive NP.

Nikolaeva's work is relevant to open questions in formal semantics about type-shifting: is it the 'function' that causes a shift in its argument or does the argument coerce an adjustment in the function? Her work provides evidence that it can be either. Examples of function-expressions coercing a shift in their argument are familiar: *finish the book*, where *the book* is shifted to mean something like 'the reading of the book' or 'the writing of the book' (Pustejovsky 1993) or Chierchia's Derived Kind Predication, which applies when a predicate that requires an entity-argument is given a kind-denoting argument and leads to a shift whereby the predicate is taken to apply to an instance of the kind (Chierchia 1998). Nikolaeva focuses attention on the role of the argument or potential argument (the syntactic non-head constituent) and shows that it can coerce adjustment in the function or expected function-expression, as in (9), discussed below, and similarly in (10b). And as example (11) below will show, it may even be negotiable which term will be function and which argument. And is it only lexical items that shift their types or can whole phrases, such as NPs, shift? Here too, her work adds evidence that in fact it can be either: a lexical item in (9), a phrase in (7a) and (10a).

In (9), the head noun is potentially relational (section 3 below), and the Genitive noun *moloka* 'milk' cannot be interpreted as a modifier (there is a derived adjective *moločnyj* 'milky, of milk' which pre-empts that possibility), so *stakan* 'glass' has to take its relational sense and *moloka* must be interpreted as an argument.²

Most examples of the form N + NP-GEN are unambiguous with respect to the two possible structures, even when they have a third term as required by the Genitive of Quality.

¹ Susan Rothstein (p.c.) notes that Borer (2009) makes a similar distinction between two kinds of Hebrew *smikhut* (construct state) constructions, an argument construction and a modifier construction.

² Actually, we will see in section 3 that things are more complicated; on a 'measure reading', the genitive *moloka* 'milk-GEN' may end up interpreted indirectly as the head, and *stakan* 'glass' may end up contributing a modifier. In section 3, we will distinguish a number of different interpretations of (9).

- (10) a. stol krasnogo dereva
 table red-GEN wood-GEN
 ‘table (made) of mahogany wood’: Genitive NP a modifier
 (Genitive of Quality)
- b. kružka češkogo piva
 mug Czech-GEN beer-GEN
 ‘mug of Czech beer’: Genitive NP an argument, as in (9).
- c. vaza češkogo stekla
 vase Czech-GEN glass-GEN
 ‘vase (made) of Czech glass’: Genitive NP a modifier (Genitive
 of Quality)

But one can find ambiguous examples like (11), in which the head is weakly (shiftably) relational, the Genitive NP is weakly (shiftably) modifier-like, and mugs can be made of red clay. As an example of Genitive with Obligatory Third Term, ‘red’ specifies a value for the ‘clay’-attribute, and the Genitive NP functions as a modifier. On the function-argument structure, *kružka* ‘mug’ has a relational ‘container-of’ sense, and its argument ‘red clay’ is construed as a substance (soft, in a state in which it could fill a container.)

- (11) kružka krasnoj gliny
 mug red-GEN clay-GEN
 ‘mug of red clay’
 (i) mug made of red clay; (ii) mug containing red clay, mugful of
 red clay

All the nouns in (10a-c) and (11) are basically sortal; their different shifting potentials, plus non-linguistic compatibility restrictions, account for the possible interpretations. Beer can fill a mug but cannot be a material, and the reverse for glass; clay can do both. *Kružka* ‘mug’ can shift to a relational container sense, but Russian *vaza* ‘vase’ cannot (section 3). The double shiftability seen in (11) is rare, so few examples are ambiguous in this way.

Example (12) is unambiguously Genitive of Quality even though its head is a strongly relational noun *syn* ‘son’. The argument of relational son must be animate and must denote a possible parent. ‘Of draftable age’ is unambiguously a modifier; ‘draftable age’ certainly cannot be a parent. The valency of *syn* son is discharged by *u menja est* ‘I have’.

- (12) (U menja est) syn prizyvnoĝo vozrasta.
 at me is son-NOM draftable-GEN age-GEN
 ‘(I have a) son of draft age.’

‘The main point about the Genitive of Quality for the present discussion is that it, too, is a language-specific construction, possible only with a class of functional nouns denoting ‘attributes’ for which the obligatory third term specifies a ‘value’.

The two constructions discussed in these two subsections both show that functional nouns may have special properties, but in each case it is a selected subset that has special properties, and the phenomena in both cases are narrowly language-specific constructions.³ Thus we would argue that such constructions do not offer support for drawing a major lexical distinction between functional nouns and other relational nouns.

In the next section, we go into more detail on a further family of specialized nouns that can have functional readings, the Russian ‘container-nouns’, which occur both as sortal nouns and in several constructions in which they have shifted to functional readings. In some of those constructions, their semantic role is different both from that of canonical relational noun constructions as in (8) and from that of either of the specialized constructions just discussed.

3 CONTAINER NOUNS AND THE RUSSIAN GENITIVE OF MEASURE

The main topic of the rest of the paper is the use of container-nouns in Russian Genitive of Measure constructions, studied in Borschev and Partee (1999, 2001, 2004, 2011). These are a family of closely related constructions all of which can be instantiated by a simple phrase like *stakan moloka* glass of milk, with a container noun like *stakan* ‘glass’ followed by a genitive NP like *moloka* milk. The basic meaning of a container noun like *stakan* glass is sortal, but in these constructions, it is sometimes sortal, sometimes relational and sometimes functional.

And when we compare canonical genitive constructions containing relational nouns, like (8), the Genitive with Obligatory Third Term construction in (7a), and the constructions to be studied in this section, we will end up with three compositionally different organizations of the semantic parts that make up the constructions. In (8), the relational noun is the head and the genitive phrase is an argument of the relation. In (7a), the Genitive with Obligatory Third Term construction, the head noun is interpreted as a sortal noun, and the complex genitive NP forms a modifier. And in the constructions with container nouns, we will see that a container noun may be a sortal head, it may be

³ The two constructions are syntactically very different, but both involve ‘attribute’ nouns in a special construction that ends up acting as a modifier of a sortal noun. Whether that is significant is an open question.

a relational head, and sometimes it shifts to a functional reading which forms the core of a measure-phrase modifier of the NP in the genitive phrase. We will see how these readings arise as the container noun goes through a progression of semantic shifts from a concrete sortal noun through several steps until it becomes an *ad hoc* unit of measure, and for some nouns, like Russian *stakan* glass and English *cup*, it may undergo a further shift to become a lexicalized standard unit of measure.

We will begin the section with a range of examples of the construction (section 3.1). In section 3.2, we discuss and give analyses for a two-way split in interpretations of the construction, one of which denotes the container with its contents, and the other of which is a measure reading: that much is relatively uncontroversial, although analyses differ. There we also discuss two neighboring constructions in Russian whose existence blocks certain potential readings of the container constructions. Then in section 3.3, we address the question of whether two readings are enough, discuss reasons for the difficulty of deciding and offer arguments for distinguishing four readings in all, as well as arguments against, concluding in favor of four readings. In section 3.4, we show how the four readings we suggest can be seen as arising from a sequence of natural meaning-shifts in the container words, and we include a historical note on the derivation of measure terms from concrete container nouns that is consistent with the proposed sequence of meaning-shifts. Section 3.5 discusses ontological constraints on the two parts of the constructions, showing that the constraints on the container nouns are basically linguistic and lexical, while the constraints on the genitive NP are sortal constraints on the denotation of the whole NP, not lexical constraints on its head noun.

3.1 *Examples of the construction*

Prototypical examples of the construction we are concerned with are given in (13). The construction resembles the English pseudopartitive construction studied by Selkirk (1977) and many others since.

- (13) a. *stakan* *moloka*
 glass-NOM.SG milk-GEN.SG
 ‘glass of milk’
 b. *jaščik* *jablok*
 box-NOM.SG apple-GEN.PL
 ‘box of apples’
 c. *mašina* *drov*
 truck-NOM.SG firewood-GEN.PL
 ‘truck(ful) of firewood’

- d. korzina gribov
 basket-NOM.SG mushroom-GEN.PL
 ‘basket of mushrooms’

The Genitive of Measure examples in (13) are a distinguishable subclass of a broader class of measure-related genitive constructions which also includes examples such as those in (14).

- (14) litr moloka ‘liter of milk’,
 kilogramm jablok ‘kilogram of apples’
 motok provoloki ‘roll of wire’
 oxapka drov ‘armful of firewood’
 stado ovec ‘herd of sheep’

The interpretation common to the larger class is, roughly, a quantity of some substance or a collection of objects, where the substance or the objects are named by the Genitive NP. The English analogue of the broader class is studied in Dodge & Wright (2002). Formal semantic analyses of measure constructions like *liter of milk*, *two liters of milk* in English and other languages can be found in Krifka (1989a, 1989b), Landman (2004), Rothstein (2009), Schwarzschild (2002, 2006). We will draw particularly on Landman’s and Rothstein’s work in what follows.

3.2 A basic two-way split: ‘Container plus Contents’ v. Measure

Rothstein (2009) has discussed examples like *three glasses of water* in English and Hebrew; she concentrates on a two-way ambiguity in English which she characterizes as an *individuating reading*, ‘in which the DP denotes plural objects consisting of three individual glasses of water’ (Rothstein 2009: p.1), and a *measure reading*, ‘in which the DP denotes quantities of water which equal the quantity contained in three glasses’ (Rothstein 2009: p.1). She shows that Hebrew, which has two constructions for expressing *three glasses of water*, one of them unambiguously individuating and the other ambiguous, provides support for an analysis of the ambiguity offered by Landman (2004). The distinctions argued for by Rothstein are similar to the semantic distinctions argued for in the case of Russian container-noun constructions in some of our earlier work (Borshev & Partee 1999, 2001, 2004, 2011). In Borshev & Partee (1999, 2001, 2004), we distinguished a *concrete quantity* reading from a *measure* reading, describing the *concrete quantity* reading as a predicate true of a portion of matter (quantity of substance) filling a container of the given sort; we noted examples referring simultaneously to the container and the substance in it, mentioning but not analyzing their similarity to Pustejovsky’s ‘dotted type’ readings.

More recently, in Borschev & Partee (2011), we explicitly distinguished and partially formalized additional readings, distinguishing four distinct readings for which we now use the terminology *Container + Contents*, *Concrete Portion*, *Ad Hoc Measure* and *Standard Measure*. The last two, possibly even the last three, can be considered subtypes of Rothstein's *measure* reading, although we do not consider the *Concrete Portion* reading to actually involve measure. Her *individuating* reading is close to our *Container + Contents* reading.

Rather than try to explain and argue for the differences among the four readings all at once, we will start by describing and analyzing two readings for the Russian construction which differ only a little from Rothstein's analysis of English and of Hebrew; the analyses are similar to those given for the two readings distinguished in Borschev & Partee (1999, 2001, 2004), but improved in part by drawing on the Landman–Rothstein analysis. In section 3.3, we address the more controversial question of whether additional readings are needed, settling on the four listed above, focusing as much on the arguments and difficulties as on defending our own answers.

We will refer to the two-way distinction for examples like (13a) that we begin with as (i) the *Container + Contents* reading (Rothstein's *individuating*) and (ii) the *Measure* reading (also Rothstein's *measure*). The *Container + Contents* reading is closest to the basic sortal meaning of the container-noun, and the *Measure* reading is similar to measure constructions with measure nouns like *liter*, whose analysis we will provide for comparison. In section 3.3, we will keep the *Container + Contents* reading unchanged and will argue for splitting the *Measure* reading into three distinct readings: this *Measure* reading will become the *Ad Hoc Measure* reading and will be distinguished from a *Standard Measure* reading, plus a *Concrete Portion* reading, which we argue does not really involve measure.

3.2.1 *The Container + Contents reading* The *Container + Contents* reading combines reference to the container and reference to the concrete portion of the substance in this container.

(15) **Container + Contents reading: a predicate true of a container** together with a substance that fills it.

There are many sentences that potentially allow for both the *Container + Contents* reading and the *Measure* reading, like (16); but there are various factors that make some examples, like (17), unambiguous.

- (16) On prines butylku vodki.
 he brought bottle-ACC.SG vodka-GEN.SG
 'He brought a bottle of vodka.'
- (17) Postav' ètot jaščik jablok v ugol.
 put-IMPER this box-ACC.SG apple-GEN.PL in corner.
 'Put this box of apples in the corner.'

Example (16) is ambiguous. What he brought was most likely a bottle with vodka in it, and it's natural to assume that the phrase refers to both together; but it could refer just to the vodka or the amount of vodka he brought. Example (17) is an unambiguous example of the *Container + Contents* reading, since the verb *postavit'*, 'put' or 'stand', is restricted to things that are considered to stand where they are put; that holds of bottles and boxes but not of apples.⁴ An instruction like English *Put this box of apples into the cider press* could very well refer only to the apples but in Russian 'putting' the apples in would require a different verb-plus-preposition collocation (e.g. *vysypat' v* 'to pour (little solid things) from out of something into') from putting the box in (e.g. *postavit' v* 'to set (something that stands) into').

This construction is similar to the English one discussed by Selkirk (1977) under the label 'pseudopartitive construction'. Pustejovsky (1993) introduced the notion dotted type, suggesting a 'Cartesian product of sorts', to represent the sort of an expression that simultaneously incorporates two distinct sorts: in a case like this, one might argue that we can refer simultaneously to the container and the substance contained in it.

Dodge & Wright (2002) discuss factors that favor reference to the container v. reference to the contents without observing that one can sometimes refer to both simultaneously. Accompanying verbs may select for one or the other, as in (18): (18a), with 'drink', is most likely understood as referring to the contents, and this is confirmed by the well-formedness of (18b). Example (18c), with 'break', favors reference to the container, as confirmed by the oddness of (18d).

- (18) a. My vypili butylku šampanskogo.
 we drank bottle-ACC.SG champagne-GEN.SG
 'We drank a bottle of champagne.'

⁴ One normally cannot say *Jabloki stojat v uglu* 'The apples are standing in the corner', but such a sentence is in fact possible, by a kind of metonymy, when the apples are in a box. The possibility of such metonymic shifts is one of the sources of difficulty in discriminating among linguistically distinct readings. In this case, Russian speakers have rather sharp intuitions about whether a given sort of object 'stands' or 'lies' (objects rarely 'sit' in Russian), and correspondingly have intuitions about literal v. metonymic uses of such verbs.

- b. My vypili pol-butylki šampanskogo.
we drank half-bottle-ACC.SG champagne-GEN.SG
'We drank half a bottle of champagne.'
- c. My razbili butylku šampanskogo.
we broke bottle-ACC.SG champagne-GEN.SG
'We broke a bottle of champagne.'
- d. #My razbili pol-butylki šampanskogo.
we broke half-bottle-ACC.SG champagne-GEN.SG
'(#)We broke half a bottle of champagne.'

As Pustejovsky (1993) emphasized, 'copredication' is possible for dotted-type objects, showing that both sorts are simultaneously accessible. The examples in (19) are from Asher & Pustejovsky (2005)⁵; (20) is a comparable example for our construction.

- (19) a. Mary picked up and mastered three books on mathematics.
b. Lunch was delicious but took forever.
- (20) On vypil stakan moloka, kotoryj stojal na stole.
he drank glass-ACC milk-GEN which stood on table
'He drank the glass of milk that was standing on the table.'

Note that if (20) is an example of the *Container + Contents* reading, then each of its constituent clauses must be as well. So although (18a), as discussed, is most likely to be understood as referring to the contents only, that is evidently a possibility also for dotted-type objects, and therefore (18a) may in principle also be analyzed as having the *Container + Contents* reading. But (18b) still normally cannot be, since a half-bottle is not normally a container, as shown by the oddness of (18d). We return to the difficulties in individuating distinct readings raised by such examples in section 3.3; the 'contents-only' possibility for (18a) and (16) may be an example of a *Concrete Portion* reading distinct from a measure reading (section 3.3.2).

When Rothstein (2009) discusses the reading which refers to the container together with its contents as the *individuating* reading, she does not attempt to give it a dotted type but takes it to refer to the complex entity consisting of the glass together with its contents. When she formalizes it (for English and for Hebrew), it turns out to actually refer just to the container, which is characterized as containing contents of a given kind.

For Russian, it would be slightly too weak to just say in an example like (20) that the glass *contains* milk; we must rather say that the glass

⁵ A referee notes that Russian analogs of (19a-b) are quite degraded. So the possibilities of 'dotted-type' semantic behavior need more typological study to determine what is universal and what is not.

is filled with milk.⁶ There is a different construction, illustrated in (21), which clearly denotes the container and describes it as containing (and not necessarily filled by) contents of a certain sort. Likewise there is a separate construction, illustrated in (22), that picks out just the contents, described as being in a container of a certain sort.

- (21) stakan s molokom
 glass with milk-INSTR
 ‘glass with (containing) milk’
- (22) moloko v stakane
 milk in glass-PREP
 ‘milk in a glass’

The two constructions in (21) and (22) unambiguously denote the container and the contents respectively, and neither is a measure phrase. The construction in (20), on the other hand, seems to denote both the container and the contents together. Formalizing such a reading requires a theory of the semantics of dotted types. Recent work by Nicholas Asher on dotted types (Asher 2008) looks like it could in principle solve our problem; we discuss it briefly in section 3.3. But because the formalism goes considerably beyond simple type theory, we will not try to implement it in this paper; the analysis we offer below should be considered a placeholder for a more adequate (dotted-type) formalization. Below, we approximately follow Rothstein’s analysis, amending it to specify that the container is filled by, and does not merely contain, contents of a given sort. This leaves some of the puzzles concerning dotted types unresolved.

In any case, the biggest difference between the *Container + Contents* reading and all the other readings described in this paper is that on the *Container + Contents* reading, *a glass of milk* is (primarily) *a glass*, while on the other readings, *a glass of milk* is *milk*. The same distinction holds for Rothstein’s two readings; it is in that sense that the measure reading in section 3.2.2 and the two additional readings discussed in section 3.3 are all variants of Rothstein’s measure reading.

As a corollary of this basic distinction, the use of numbers like *half* or *two and a half* is more restricted for the *Container + Contents* reading than for the measure readings. It is not absolutely impossible to use

⁶ Susan Rothstein (p.c.) counters that when we speak, for instance, of a glass of wine on this reading, the glass is rarely full; it is only when using a glass or cup as a measure that we normally require it to be full. But at the same time Russian speakers we have consulted have clear intuitions of a difference between *kastrjulja vody* ‘pot of water’ and *kastrjulja s vodoj* ‘pot with water’: the first must be relatively full, while the second just has to have some water in it. We believe, as Rothstein herself suggests (p.c.), that the answer lies in the vagueness and context-dependence of the notions of ‘fill’ and ‘full’: a glass of wine on the *container + quantity* reading counts as full when it contains a normal serving of wine, while on a measure reading it should be full to the brim.

fractional numbers with the *Container + Contents* reading, but it not usual, and it may entail implausible real-world states of affairs. The *Container + Contents* reading, like Rothstein's *individuating* reading, is a count-noun reading, hence modifiable by cardinal numbers. Normally cardinalities are expressed by whole numbers, and many set-theory based formalisms make that obligatory; but there are approaches such as those of Hackl (2001), Krifka (1989a), discussed by (Kennedy & Stanley 2009), which treat the counting of count nouns as analogous to the measuring of mass nouns, so as to account for the possibility of fractional numbers used with count nouns as in (23).

- (23) a. John ate two and a half sandwiches for lunch.
 b. We burned two and a half logs in the fireplace last night.

If one uses fractional numbers with the *Container + Contents* reading, it would seem that there must be 'fractional containers' involved; there is no such restriction when fractional numbers are used with measure readings. So while (24) is normal in any of the measure readings discussed below but not in the *Container + Contents* reading, (25) is anomalous because the verb focuses on the container, so we would need the *Container + Contents* reading, but that would require the existence of some salient container that counts as a 'half glass'—perhaps a cut-off glass or a half-filled glass being referred to metonymically as a half glass.⁷

- (24) On vypil dva s polovinoj stakana moloka.
 He drank two-ACC with half-INSTR glass-GEN milk-GEN
 'He drank two and a half glasses of milk.'

⁷ It seems to be easier to interpret a phrase like *polkorziny gribov* 'half a basket of mushrooms' or *polbutylki vina* 'half a bottle of wine' as referring to a half-full basket or a half-full bottle than to do similarly when a complex number like *dva s polovinoj* 'two and a half' is involved. The second author and one of our anonymous referees have partly differing intuitions on 'half a basket' examples. For the second author, the sentence *On prines polkorziny gribov* 'He brought half a basket of mushrooms' can refer to a half-full basket together with the mushrooms in it, but the referee disagrees. For the referee, but not for the second author, pronominal reference to the basket is impossible in (ia), as is the use of the verb *postavil* 'put/stand' used in example (17) and in (ib).

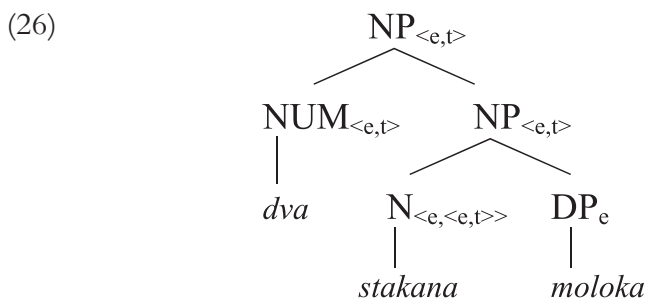
(i) a. On prines polkorziny gribov (*i postavil ee na stol). 'He brought half a basket of mushrooms (and stood it on the table.). b* On postavil na stol polkorziny gribov. (*He placed/stood on the table half a basket of mushrooms.)

More generally, that referee finds that only on the container (or *Container + Contents*) reading can one use a gendered pronoun (referring to the container); on measure readings pronominal reference either to the container or to the contents seems to be degraded. Examples (ii) (with our slight modification) and (iii) are from the referee. The second author agrees about (ii) but in (iii) finds the plural pronoun OK. (ii) My prodegustirovali etu butylku vina i ostavili ee v ugol. 'We tasted that bottle (f.) of wine (n.) and left (stood) it (f.) in the corner. (A 'dotted-type' example: we tasted the wine and 'stood' the bottle.) (iii) Voz'mite dva stakana muki i dobav'te ??ix/??ee k smesi. 'Take two glasses (m.) of flour (f.) and add ??them (m pl.) / ??it (f.) to the mixture.

- (25) ??On uronil s podnosa dva s polovinoj
 He dropped from tray two-ACC with half-INSTR
 stakana vina.
 glass-GEN wine-GEN
 'He dropped two and a half glasses of wine from the tray.'

Thus, while difficult issues remain both in capturing the dotted-types reading and in controlling for the effects of metonymy, what is clear is that the *Container + Contents* reading is different from all the measure and measure-like readings in that it most clearly refers to the container (as well as the contents). And as the formalization below shows, on that reading the container-word has shifted from its sortal meaning to a relational noun meaning which takes the substance NP as its argument. On that reading, as the tree in (26) represents, the container-word is the head noun, and any number preceding it is counting entities, just as with a sortal. Hence that construction most clearly resists fractional numbers and most straightforwardly combines with verbs that apply to concrete objects. This is Rothstein's *individuating* reading.

A syntactic tree for *dva stakana moloka* on this reading is shown in (26), annotated with semantic types. We draw the tree only up to NP, although this could be a non-branching DP as well.



On the *Container + Contents* reading, the types and meanings of the basic constituents and the compositional derivation are shown in (27). We call this derived meaning of *stakan* 'glass' *stakan+*, mnemonic for *Container + Contents*.

- (27) (i) *stakan+*: Type $\langle e, \langle e, t \rangle \rangle$. $\lambda y. \lambda x [\text{glass}(\text{es})(x) \ \& \ \exists z [z \sqsubseteq y \ \& \ z \text{ fills } x]]$
 (ii) *moloka*: Type e . MILK_e (a kind-denoting term)
 (iii) *stakan+ moloka*: Type $\langle e, t \rangle$. $\lambda x [\text{glass}(\text{es})(x) \ \& \ \exists z [z \sqsubseteq \text{MILK}_e \ \& \ z \text{ fills } x]]$
 (iv) *dva*: Type $\langle e, t \rangle$. $\lambda x [|x| = 2]$

- (v) *dva stakana+ moloka*: Type $\langle e, t \rangle$. $\lambda x[\text{glass}(es)(x) \ \& \ \exists z[z \sqsubseteq \text{MILK}_e \ \& \ z \text{ fills } x] \ \& \ |x| = 2]$

The meaning for *stakan+* is a shift from the sortal meaning of the container word to a relational meaning expressing the relation between the container and its contents. But this clearly does not result in a dotted type reading. Like Rothstein's individuating reading, we have the literal interpretation of the expression apply to a plurality of glasses that are two in number. On the issue of the dotted types, we would try in further research to incorporate something like the analysis of Asher (2008), as mentioned above.

There are several important details which we do not discuss here, for lack of space and of immediate relevance, including (i) taking the type *e* kind-denoting MILK as argument; (ii) including a partitivity relation \sqsubseteq in the meaning (which we did not have in our earlier papers) and (iii) saying that the given portion of milk fills the glass(es), rather than just that the glasses contain the milk. See Partee & Borschev (2010) for discussion of these details and of an interesting maximality question: for which of the various relevant constructions do expressions like *a box of the manuscripts of Dickens's novels* carry an implication that all of the manuscripts of Dickens's novels are in the box, a difficult question to test in a language like Russian that lacks definite articles.

Even without including a formalization of dotted types, we do have at least some account for the perceived difference in meaning between *dva stakana moloka* 'two glasses of milk' and *dva stakana s molokom*, (two glasses with milk): the former requires glasses filled with milk, while the latter requires only that the glasses contain some milk.

3.2.2 The measure reading In section 3.3, we will debate the pros and cons of splitting the measure reading into three distinct readings. What we present here as the most basic measure reading is the one we will later call the *Ad Hoc Measure* reading, one in which some arbitrary container is treated as a unit of measure, and *dva stakana moloka* 'two glasses of milk' is a predicate that holds of a quantity of milk that fills, or would fill, some glass two times. In our earlier papers, we represented the idea of 'filling some glass' by means of an existential quantifier over glasses. But we have realized that including an existential quantifier in the characterization of this sense of *stakan* would be a mistake, and that 'some glass' should instead be characterized as some context-dependent particular glass or some contextually understood prototypical-sized glass. We point out examples below which show this context-dependence particularly clearly.

The measure reading of a container-word like *stakan* 'glass' involves a shift from the relational *stakan+* — a relation between a glass and

a quantity of milk (or anything else) that fills it— to a unit of measure corresponding to the volume of milk that glass can hold.

On this basic measure reading, when we refer to some milk as *dva stakana moloka*, the milk need not be in a glass, but its quantity is described using some glass as a measure. Sentence (28)⁸ shows that the substance need not be in the ‘measuring’ container.

- (28) (Is there more soup?) Da, v kastrjule ešče tri tarelki supa
 Yes in pot still three bowls soup
 ostalos’.
 remained
 ‘Yes, there are still three bowls of soup left in the pot.’ (No *bowls*
 need be in the pot.)

In syntactic and semantic structure, on this reading the *substance* phrase in the genitive is the head, perhaps surprisingly, and the *measure expression* phrase in the nominative (or in whatever case the position of the whole NP in the sentence requires) is a modifier. While it may seem surprising that what is intuitively the semantic head of the phrase is in the genitive, that is not so surprising for Russian, where many numerals demand genitive case on the noun, and where genitive may be used to express partitivity even without any overt quantifier or measure expression.^{9,10}

- (29) **Measure reading: a *measure* predicate true of a quantity**
 of the substance, corresponding to some container of the given
 sort.

With the glass construed as a measure, it is perfectly natural to speak of fractional glassfuls (as with the English word *glassful*, in fact), as in the example in (24) above and those in (30a). And in the case of (30b), it is

⁸ This example is a slight variant of a Hebrew example from Rothstein (2009). Also thanks to an anonymous referee for a similar example in Russian involving half a basket of mushrooms in a plastic bag.

⁹ Some Russian nouns have two distinct genitive forms, a standard genitive which can be used in any genitive construction, and an unambiguously partitive genitive which may be used only with partitive interpretation. The noun *čaj* ‘tea’ has standard genitive form *čaja* and partitive genitive form *čaju*. A Google search on the two variants in the construction *dva stakana čaja/čaju* ‘two glasses of tea’ shows that both forms are widely used (87100 for *čaja*, 39400 for *čaju*), which confirms that the substance noun in container constructions is indeed construed as a partitive.

¹⁰ Both referees wished for a more explicit statement of how case is assigned in the structure proposed for measure readings. One referee suggests that the measure noun assigns case to the complement (presumably on all readings), as for instance in Ionin and Matushansky (2006) and wonders how we can achieve this result given the two syntactic structures we propose. We are not syntacticians and must leave this issue open, appealing to the plausibility of informal remarks such as those given in the text, and to Rothstein (2009).

particularly clear that the ‘tank’ in question is context-dependent; any driver might use such a sentence referring to his own vehicle, whether a small car, a large truck, an airplane, etc. The authors could use (30a) to describe their berry-gathering around their Russian dacha even though we do not use a berrying-bucket, appealing to the typical berrying-buckets used by many berry-pickers, which are usually 5-liter or 7-liter buckets. (The *measure* reading in ordinary language can be vague. The first author cannot distinguish a 5-liter bucket from a 7-liter bucket by sight.)

- (30) a. Za jagodnyj sezon my sobrali, naverno, dva
 Over berrying season we gathered, most-likely, two-ACC
 s polovinoj vedra černiki i
 with half-INSTR buckets-GEN blueberries-GEN and
 polvedra brusniki.
 half-bucket-ACC lingonberries-GEN
 ‘Over the course of the berrying season we probably gathered
 about two and a half buckets of blueberries and half a bucket of
 lingonberries.’
- b. Na ètu poezdku nam potrebuetsja dva baka
 For this trip us-DAT is-needed two-NOM tank-GEN
 benzina.
 gasoline-GEN
 ‘For this trip we will need two tankfuls of gasoline.’

To formalize the measure reading, we begin with the semantics of pure measure phrases like *two liters of milk*, which have been well-studied. The syntactic structure we give for *two liters of milk* also serves for the measure reading of *dva stakana moloka* two glasses of milk (and for all three measure-like readings that we will distinguish in section 3.3) and differs from the structure given above for the *Container + Contents* reading.

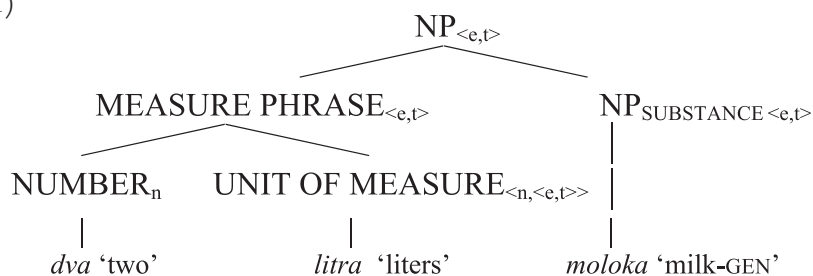
Measure phrases like *two liters of milk* involving standard measure words like *liter* are not ambiguous, since pure measure units like *liter* have no alternative interpretation as sortal nouns: they are unambiguously functional nouns of a special sort. There are several approaches to formalizing their syntax and semantics; see (Krifka 1989a, 1989b; Schwarzschild 2002, 2006; Landman 2004; Ionin *et al.* 2006; Brasoveanu 2008; Rothstein 2009; Champollion 2010). Here, we build on Landman (2004), Rothstein (2009), and our work in Borschev & Partee (2011), Partee & Borschev (2010).

3.2.2.1. Formalizing *litre* The tree in (31), from Borschev & Partee (2011), is a slight simplification of the structure proposed by Landman (2004) and used by Rothstein (2009). Like Rothstein, we ignore the

more complex ‘number phrases’ considered by Landman, which encompass ranges of numbers like *between 3 and 6*, *less than 10*, etc. In our examples, we will have only simple number expressions like *dva* ‘two’ or *dva s polovinoj* ‘two and a half’.

NP is to be understood as ‘common noun phrase’; the whole NP below can also be the sole constituent of a DP (which would be understood as indefinite) or can be made into a DP by the addition of a determiner such as *tvoi* ‘your-FAM.PL’ or *èti* ‘these’.

(31)



Numerals are given their own type *n* by Landman; they could also be treated as a nominalization of the NP-internal numerals, in type *e*, as in (Ionin & Matushansky 2006).¹¹ *Moloka* ‘milk’ is a sortal (mass) common noun, type $\langle e,t \rangle$, a predicate of portions of milk, which we represent as $MILK_{\langle e,t \rangle}$.

The measure unit *litr* ‘liter’ is assigned a basic lexical meaning as a measure function, a function of type $\langle e,n \rangle$ which applies to a measurable entity (some quantity of substance whose volume can be measured in liters), and whose value is the number of liters of the volume of that entity. We write this basic meaning as $LITER_1$. In order for the measure phrases that occur in NPs to be interpreted as modifiers, *litr* is shifted to a derived meaning, *litr*₂, of type $\langle n, \langle e,t \rangle \rangle$, which takes a number as argument and returns a predicate of portions of matter. (Schwarzschild (2005) discusses further shifts undergone by unit-of-measure terms as they occur in other constructions.)

¹¹ Ionin and Matushansky (2006) pay more attention to the semantics and morphology of complex cardinals than we do here; they argue that the ‘mathematical’ use of cardinals in type *e* is derived from an attributive use of type $\langle \langle e,t \rangle, \langle e,t \rangle \rangle$. We have followed Partee (1986) and others in giving attributive numerals type $\langle e,t \rangle$, but Ionin and Matushansky argue that one needs to put numerals into type $\langle \langle e,t \rangle, \langle e,t \rangle \rangle$ in order to correctly interpret numbers like *two hundred* compositionally. We offer no independent account of the relation between our two uses of numerals and would be prepared to appeal to Ionin and Matushansky for a promising account.

Because not everything can be measured in liters, there are presuppositions corresponding to definedness conditions for the function, but we will not try to represent those explicitly.¹²

The semantic derivation for *dva litra moloka* then proceeds as shown in (32).

- (32) (i) *litr*: *litr*₂: Type $\langle n, \langle e, t \rangle \rangle$. Meaning: $LITER_2$, defined as follows:

$$LITER_2 = \lambda n. \lambda x [LITER_1(x) = n]$$

 (ii) *dva*: Type n . Meaning: 2.
 (iii) *dva litra*: Type $\langle e, t \rangle$. Meaning: $\lambda x [LITER_1(x) = 2]$
 (iv) *moloka*: Type $\langle e, t \rangle$. Meaning: $MILK_{\langle e, t \rangle}$
 (v) *dva litra moloka*: Type $\langle e, t \rangle$. Meaning: $\lambda y [LITER_1(y) = 2 \ \& \ MILK_{\langle e, t \rangle}(y)]$

Note that measure functions like the $LITER_1$ function can return rational numbers, not just cardinal numbers. This is one of the formal distinctions between readings that involve a unit of measure and those that involve counting concrete containers.

Also note that although *moloka* is genitive, and *litr* is a functional noun, in the semantics we do not have *moloka* as an argument of *litr*. Rather *moloka* is a common noun (phrase) (NP), type $\langle e, t \rangle$, and *dva litra* is also of type $\langle e, t \rangle$, and they combine by the Predicate Modification rule of Heim and Kratzer (1998). As mentioned above, the fact that the noun occurs in the genitive case is evidently related to the use of genitive with numbers and for expressing partitivity, but we do not give explicit case assignment rules. The modifier phrase *dva litra* could alternatively be analyzed as being of type $\langle \langle e, t \rangle, \langle e, t \rangle \rangle$, combining with the head by function-argument application; that might be relevant to accounting for the assignment of genitive case to *moloka*.

3.2.2.2. *Formalizing the measure reading* The analysis of the measure reading of the container construction is quite similar to the analysis of pure measure constructions with *litr*.

We call the shifted *stakan* in the *measure reading* *stakan*_M. The semantic derivation is shown in (33). We discuss the type-shifts that give rise to the different meanings of container words in section 3.4, after we have discussed the additional meanings we posit.

¹² There is explicit discussion of the definedness conditions for various measure expressions in (Krifka 1989a, 1989b), and more recently Schwarzschild (2002; 2006) makes a case for including measure dimensions like *volume* and *length* more explicitly as well.

- (33) (i) *stakan_M*: Type $\langle n, \langle e, t \rangle \rangle$. Meaning: $\lambda n. \lambda x [\text{glass}(y_i) \ \& \ x \text{ would fill }^{13} y_i \ n \text{ times}]$, where y_i is a context-dependent variable.¹⁴
- (ii) *dva*: Type n . Meaning: 2.
- (iii) *dva stakana_M*: Type $\langle e, t \rangle$. Meaning: $\lambda x [\text{glass}(y_i) \ \& \ x \text{ would fill } y_i \ 2 \text{ times}]$
- (iv) *moloka*: Type $\langle e, t \rangle$. Meaning $\text{MILK}_{\langle e, t \rangle}$
- (v) *dva stakana_M moloka*: Type $\langle e, t \rangle$. Meaning: $\lambda x [\text{MILK}_{\langle e, t \rangle}(x) \ \& \ \text{glass}(y_i) \ \& \ x \text{ would fill } y_i \ 2 \text{ times}]$

This meaning is presumably the same meaning that is found with the productive English *-ful* suffix, as in *truckful*, *spoonful*, *bowful*, which is also not restricted to standard measures.

3.3 Are two readings enough? What is clear and what is not so clear

The claim that there are (at least) two distinct readings for pseudopartitives, including container constructions, is not controversial. But exactly what the distinct readings are is not so clear. Rothstein's *individuating* reading involves reference to the container; we believe that the *Container + Contents* reading should in principle be analyzed as a dotted type reading with reference to both container and contents. The *Measure* reading for *dva stakana moloka* presented above does not involve any 'standard size' for a glass but rather involves a context-dependent choice of a glass to measure with. Is that a dispute about *the* measure reading or a distinction between two readings? And is there a reading which involves reference to the milk and not to the container but is not a measure reading?

In this section, we discuss two further plausible splits among the meanings of the container construction that will result in three distinct measure or measure-like readings. In section 3.3.1, we argue for distinguishing between a *Standard Measure* reading and an *Ad Hoc Measure* reading, depending on whether some actual container is used to provide a measure or whether the language has lexicalized a standard measure unit (like English *cup*, *teaspoon*, *tablespoon*), in which case reference to *a cup of milk* need not involve any cup at all. In section 3.3.2, we argue the pros and cons of another split, between those two measure readings and a *Concrete Portion* reading in which *dva stakana moloka* refers to milk and in which *dva stakana* is a modifier but

¹³ Note that the measure reading has a modal component—"would fill" under suitable conditions. The same modal component is implicit in the "-FUL" operator that Rothstein (2009) appeals to.

¹⁴ As discussed at the beginning of section 3.2.2, in our earlier papers, we had an existential quantifier $\exists y$ over glasses, whereas we now have a context-dependent free variable y_i .

not really a measure modifier. For reasons that we will discuss, this one is harder to argue for as a separate reading; what is accounted for on this reading might be accountable by appealing to the dotted type *Container + Contents* reading plus the possibility of metonymy but probably not within current formal frameworks.

3.3.1 *Distinguishing between Standard Measure and Ad Hoc Measure*
In English, a *cup of milk* has a reading in which *cup* is a standard unit of measure (two cups make a pint, two pints make a quart): *cup* as a unit of measure has become lexicalized as a specific volume. In Russian, that has not happened with *časka* ‘cup’ or *kružka* mug, but it has happened¹⁵ with *stakan* glass.

We believe that there are several differences between such a *Standard Measure* reading and the plain measure reading of section 3.2.2, which we will now call the *Ad Hoc Measure* reading. Both measure readings are quite similar to the interpretation of *liter*. The *Ad Hoc Measure* reading is available for all sorts of containers¹⁶ whether they have any ‘standard’ versions used for measuring or not: an *ad hoc* unit of measure is created based on a concrete container, such as a particular glass, or a locally prototypical berry-bucket. On the *Standard Measure* reading, the container word has shifted to a unit of measure just like *liter*, and there is no requirement that any actual container be involved at all—*dva stakana moloka* ‘two glasses of milk’ on that reading is just milk in a certain amount. This is Rothstein’s *measure reading*, unless perhaps her *measure reading* is indeterminate between the two.

Both measure readings describe milk of a certain quantity and neither requires the milk to be in a container of the mentioned sort. Both allow fractional numbers, unlike the *Container + Contents* reading, a typical difference between measuring and counting. The difference is in whether some particular glass is being used as a measure—perhaps only on a single occasion—something that could in principle be done with any container any time; or whether a standard has become conventionalized, perhaps so far as to become lexicalized. These two

¹⁵ Russian *stakan* ‘glass’ is a standard unit of measure found in cookbooks, but it is not as precise as English ‘cup’; there is simply a cultural convention for what size glass is more or less standard. There is no Russian *stakan*-analog of American measuring cups with marks for fractions; when Russians want to measure volume precisely, they use containers marked for metric units like centiliters.

¹⁶ Louise McNally (p.c.) observed that in several languages, it is hard to get this reading for things that are not ‘normally’ used as containers. As she notes, one can equally speak of *two spoons of ice cream* or *two spoonfuls of ice cream*, and of *two forkfuls of spaghetti* but not *#two forks of spaghetti*. It is similarly difficult in Russian to use *vilka* ‘fork’ as an *Ad Hoc Measure* without somehow enriching the context so as to coerce a shift of *vilka* into the sort ‘container’. See discussion in Borschev and Partee (2004) of the possibility of coercing hats and rooms (in Russian) into containers by adding modifiers like ‘full’ and numerals.

measure readings have a vague boundary, since there is no sharp line between the *ad hoc* or occasional use of some container as a unit of measure and a conventionalized appeal to a container of a certain size as a standard unit of measure.

The *Ad Hoc Measure* reading, like the *Container + Contents* reading, involves a more or less ‘formal’ meaning-shift: we can define the semantics of the shifted uses of the container word in terms of its original sortal meaning. But it is not quite purely formal, because of the inclusion of the context-dependent variable that must be contextually resolved to some particular (or prototypical) container of the given kind. The shift from the *Ad Hoc Measure* reading to the *Standard Measure* reading is on the one hand another small step but on the other hand this one is a non-productive lexical shift that is only undergone by some nouns, those for which there is a notion of a standard volume associated with that kind of container. This is the case for Russian *stakan* glass and English *cup*.¹⁷ It is not the case for Russian *kastrjulja* ‘pot’ or for English *glass*. Of course standards may be context-relative and temporary, and some containers may be used as standard measures at a certain time and place even if not conventionally for the language as a whole. And conventional standards are a cultural as well as a linguistic matter: in the parts of the English-speaking world that use metric units, *cup* is presumably not a standard unit. So the line between the *Ad Hoc Measure* reading and the *Standard Measure* reading is not a hard-and-fast one.

On the *Standard Measure* reading, *cup of milk* in English or *stakan moloka* glass of milk in Russian has a meaning and use fully parallel to *liter of milk*.

- (34) **Standard Measure reading: a measure predicate true of a standard quantity** of the substance, corresponding to a conventional standard size of containers of the given kind.

Example (35) is a typical cookbook instruction.

- (35) Voz'mite dva stakana muki.
 Take-IMPER two-ACC glass-GEN flour-GEN
 ‘Take two glasses (cups) of flour.’

Landman and Rothstein, in their interpretation rules for their measure reading, which corresponds to our *Standard Measure* reading, use expressions like ‘GLASS-FUL’ without attempting to define them explicitly in terms of ‘GLASS’. We split the measure reading into two,

¹⁷ See section 3.4.2 for some notes on the history of *cup* and of the measure word *gallon*.

depending on whether one is appealing to the existence of some glass (the *Ad Hoc Measure* reading, definable from the sortal noun meaning plus a free variable) or to the existence of a standard (the *Standard Measure* reading, requiring a lexical shift).

We have already formalized the *Ad Hoc Measure* reading; that was the *Measure* reading in section 3.2.2. Now we formalize the *Standard Measure* reading, which is exactly parallel to the measure construction with *litr* ‘liter’. For this meaning of *stakan*, we write *stakan*_{SM}. The meaning of *stakan*_{SM} is not productively derivable from the meaning of sortal *stakan* but is a basic lexical measure of volume like *liter*. Like *liter*, its basic type is $\langle e, n \rangle$, a function from entities to numbers that gives the volume of that entity in number of glasses. We denote that function by ***stakan-units***. The type for *stakan*_{SM} as used in this construction is $\langle n, \langle e, t \rangle \rangle$, defined in terms of ***stakan-units***, combining with a number to make an amount modifier.

The derivation is in (36).

- (36) (i) *stakan*_{SM}: Type $\langle n, \langle e, t \rangle \rangle$. Meaning: $\lambda n. \lambda x[\mathbf{stakan-units}(x) = n]$
 (ii) *dva*: Type n . Meaning: 2.
 (iii) *dva stakana*_{SM}: Type $\langle e, t \rangle$. Meaning: $\lambda x[\mathbf{stakan-units}(x) = 2]$
 (iv) *moloka*: Type $\langle e, t \rangle$. Meaning $\text{MILK}_{\langle e, t \rangle}$
 (v) *dva stakana*_{SM} *moloka*: Type $\langle e, t \rangle$. Meaning: $\lambda x[\text{MILK}_{\langle e, t \rangle}(x) \ \& \ \mathbf{stakan-units}(x) = 2]$

One anonymous referee asks if there is any difference in constructional meaning between the *Standard Measure* reading and the *Ad Hoc Measure* reading or is it just a lexical difference? It is indeed at heart a lexical difference and not a sharp one at that. And one might try to treat the lexicalized *stakan-unit* or English standard *cup* as instances of the *Ad Hoc Measure* reading that happen to choose as value of the free variable an actual or imagined ‘standard glass’ or ‘standard cup’ analogous the historical standard meter-bar. But the *Ad Hoc Measure* reading (a) is derived by a productive meaning-shifting rule applicable to all container words, potentially on the fly, (b) is context-dependent and (c) appeals to the existence of some glass whose volume provides the measure; whereas the *Standard Measure* reading (a) is lexicalized, (b) is more or less context-independent and (c) has no requirement that any glass be involved or appealed to; hence there is no obvious way to unify them into a single reading.

3.3.2 *For and against a separate Concrete Portion reading* The lines between different interpretations of expressions like *dva stakana moloka*

‘two glasses of milk’ are admittedly not entirely easy to draw, and the further distinction we propose in this section, probably the hardest to defend, is influenced in part by issues that arose as we worked out how to formalize the different readings.

When we formalized a ‘QUANT’ reading for *stakan moloka* glass of milk in Borschev & Partee (1999, 2001), we did not think about how it would combine with numerals, and when we later tried to formalize that QUANT meaning¹⁸ in a way that made a place to add *dva* (two), we were faced with a decision as to whether we were counting the glasses in which the milk was contained (which normally could not be a fraction) or whether the number was indicating how many times a certain glass could be filled by the given portion of milk—a true measure reading, easily allowing fractional results.

We have already seen evidence for one or two measure readings, which do allow fractions and which do not require that the milk actually be in any glass. But we still believe there is another reading that refers only to the milk, which does require that it be in a container of the stated kind and which is different from either of the two measure readings. We now call this the *Concrete Portion* reading because the modifier has a semantics which refers to some actual concrete container(s) and characterizes the substance in terms of its occupying those containers. Because of the ‘concreteness’ of the containers, this reading allows for examples like (37), where *two pots* can involve one large pot and one small one. That can also happen with the *Container + Contents* reading but not with the either of the measure readings.

- (37) On svaril dve kastrjuli supa, bol’suju dlja nas i
 He cooked two pots-ACC soup-GEN big-ACC for us and
 malen’kuju dlja koški.
 small-ACC for cat
 ‘He cooked two pots of soup, a big one for us and a small one for the cat.’

And on this reading, as on the *Container + Contents* reading, we do not normally expect to be able to talk about fractional glasses of milk, unless the glasses themselves are somehow ‘fractional’.

Earlier names for this reading in our work were QUANT, *quantity*, *concrete quantity*; we have decided to avoid the word *quantity* because of its invitation to equivocation, since it is often used interchangeably

¹⁸ Our formula for *stakan moloka* ‘glass of milk’ on the QUANT (quantity) reading in Borschev and Partee (1999, 2001) was: $\lambda x[\text{substance}(\text{moloko}) \ \& \ \text{quantity}(\text{moloko})(x) \ \& \ \exists z(\text{stakan1}(z) \ \& \ \text{fills}(z)(x))]$; this formula uses *moloko* for the e-type name of the kind ‘milk’, and *stakan1* as a predicate true of individual glasses.

with something like *portion*, as in a *quantity of matter*, as a way of talking about bits of stuff, but it is also frequently used when discussing amounts and measures. We undoubtedly equivocated a certain amount in our own earlier work, in ways that left it unclear whether our *quantity* reading was a kind of measure reading or not. Since we are increasingly sure that this reading, if it deserves to be a separate reading at all, is not a measure reading, we want to avoid any measure-suggesting terms in its name.

An example like (38a) may best be interpreted as involving the *Concrete Portion* reading, since the definiteness suggests that the milk is in two particular glasses; we will return to the possibility that it might even be interpreted as involving the *Container + Contents* reading. Sentence (38b), on the other hand, would probably be more readily interpreted as the *Ad Hoc Measure* reading, although many examples are undoubtedly ambiguous or indeterminate between the two.

- (38) a. Vypej èti dva stakana moloka.
 Drink-IMPER these two-ACC glass- GEN milk-GEN
 ‘Drink these two glasses of milk’
 b. Vypej rjumku vodki.
 Drink-IMPER small-glass-ACC vodka-GEN
 ‘Drink a little glass of vodka.’

This *Concrete Portion* reading arises from the reference to the container by a form of metonymy which has become conventionalized for all container-words, from container to contents. The container-word, together with any preceding numeral phrase, is reinterpreted so as to contribute a modifier; the whole phrase denotes milk or soup contained in a glass or pots, not the glass or pots.

The *Concrete Portion* reading is not easy to discriminate from all the others; it shares properties with the *Container + Contents* reading on the one hand and with the *Ad Hoc Measure* reading on the other, sitting between them on a ‘scale’ of readings, as we will discuss in section 3.4. Like the *Container + Contents* reading, it requires that the substance be in the container, but as on the *Ad Hoc Measure* reading, the whole phrase *dva stakana moloka* (two glasses of milk) is a predicate that applies to milk, not to glasses, a fact that is reflected in its syntax, which is like that of both of the measure readings and unlike that of the *Container + Contents* reading. Like the *Container + Contents* reading, it resists fractional numerals.

For now, we consider it worthwhile to call attention to the existence of such a reading as distinct from the others, but this situation may be a reflection of our inability to find an analysis which is both explicit about how these expressions combine with numerals and at the

same time neutral with respect to some of the distinctions we are making.

On our analysis, the *Concrete Portion* reading is close to the measure readings and involves the same syntax but does not express measure. We give the explicit analysis and then discuss reasons to think that it might be better to have an analysis in which the *Concrete Portion* reading could be subsumed under the *Container + Contents* reading.

3.3.3 Formalizing the Concrete Portion reading The syntactic tree and the semantic types for the *Concrete Portion* reading are the same as for the measure construction in (31), so we will not draw them here. We call the shifted *stakan* in this reading *stakan*_{CP}. The semantic derivation is shown in (39).

- (39) (i) *stakan*_{CP}: Type $\langle n, \langle e, t \rangle \rangle$. Meaning: $\lambda n. \lambda x. \exists y [\text{glasses}(y) \ \& \ x \text{ fills } y \ \& \ |y| = n]$
 (ii) *dva*: Type n . Meaning: 2.
 (iii) *dva stakana*_{CP}: Type $\langle e, t \rangle$. Meaning: $\lambda x [\exists y. \text{glasses}(y) \ \& \ x \text{ fills } y \ \& \ |y| = 2]$
 (iv) *moloka*: Type $\langle e, t \rangle$. Meaning $\text{MILK}_{\langle e, t \rangle}$
 (v) *dva stakana*_{CP} *moloka*: Type $\langle e, t \rangle$. Meaning: $\lambda x [\text{MILK}_{\langle e, t \rangle}(x) \ \& \ [\exists y. \text{glasses}(y) \ \& \ x \text{ fills } y \ \& \ |y| = 2]]$

So on the *Concrete Portion* reading, *dva stakana moloka* (two glasses of milk) is a predicate true of milk that fills two glasses; unlike the two measure readings, on this reading there could be a big glass and a small glass, as needed for examples like (37). Thus, this reading is not really a measure reading, and it is not accidental that this reading requires that the contents be in an actual container or containers.

One could make this subtler by allowing ‘glass-stages’, so that the milk could fill the same glass at different times OR different glasses. We will not try to incorporate such subtleties concerning counting and individuation; see classic discussion of stages in Carlson (1980) and of the problem of counting *passengers* in Gupta (1980). But we return to this possibility below in connection with the possibility of unifying the *Concrete Portion* reading with the *Ad Hoc Measure* reading.

3.3.4 Questioning the Concrete Portion reading Admittedly, the distinctions we have drawn are easier to perceive theoretically than in examples. Various colleagues, and three referees, have expressed some skepticism about the claim that there are really four distinct readings. In the previous section, we indicated our reasons for distinguishing between the *Ad Hoc Measure* reading and the *Standard Measure* reading,

as well as some possible reasons for wanting to collapse them if one can find a way to do it. In this section, we consider two different possible avenues of collapsing the *Concrete Portion* reading with one of the other readings, either the *Ad Hoc Measure* reading or, more plausibly, the *Container + Contents* reading.

3.3.5 Unify the *Concrete Portion* reading with the *Ad Hoc Measure* reading? What properties distinguish the *Concrete Portion* reading from the *Ad Hoc Measure* reading (and in fact from both measure readings)? The *Concrete Portion* reading requires that the substance be in a container or containers; it resists fractional numerals; and it allows for the situation in (37) with a big pot and a little pot. An example like (16), or the same example with *dve butylki vodki* ‘two bottles of vodka’, is potentially compatible with an *Ad Hoc Measure* reading, a *Concrete Portion* reading, as well as with a *Container + Contents* reading: the measure reading does not forbid the vodka being in an actual bottle or in two actual bottles if they are of the same size. And since the numeral is not fractional, the non-measure readings are also possible.

But to collapse the *Concrete Portion* reading with the *Ad Hoc Measure* reading, it would be necessary for the *Ad Hoc Measure* reading to permit examples like (37) with ‘a big pot and a little pot’. That does not seem consistent with using a pot as a measure and counting how many times it can be filled. But perhaps we are being too strict in our construal of the *Ad Hoc Measure*; a recipe may call for three eggs or three onions and not literally require that they all be of the same size. So let’s try to see what it would take to unify those two readings, which we repeat in (40) below.

- (40) (i) ***Concrete Portion reading***
dva stakana_{CP} moloka: Type $\langle e, t \rangle$: λx [MILK $_{\langle e, t \rangle}$ (x) & [$\exists y$. glasses(y) & x fills y & $|y| = 2$]]
 (ii) ***Ad Hoc Measure reading***
dva stakana_M moloka: Type $\langle e, t \rangle$: λx [MILK $_{\langle e, t \rangle}$ (x) & glass(y_i) & x would fill y_i 2 times]

There are three differences: The *Concrete Portion* reading requires that the numeral is counting the glasses, hence that there is a non-fractional number of distinct glasses (of possibly different sizes); and it also requires that the milk is in the glass. And the *Ad Hoc Measure* reading has no existential quantification over glasses but rather a context-dependent free variable picking out a glass to use as a measure. We could easily get rid of the requirement that the glasses be

distinct by counting glass-stages rather than glasses, and perhaps that is independently preferable. But the remaining differences are not easy to collapse: measuring involves picking a glass to use as a measure and counting how many times (possibly fractional) that glass would be filled by the given portion of milk, whereas the *Concrete Portion* reading counts the glasses actually filled by the milk. We see no way to unify these short of an ugly disjunction of the two subformulas following the ‘milk’ clause. The *Concrete Portion* reading is really not a *measure* reading.

3.3.6 Unify the *Concrete Portion* reading with the *Container + Contents* reading? As we have currently formalized the readings, it would be impossible to be neutral between the *Concrete Portion* reading and the *Container + Contents* reading, since the former refers to the milk and the latter to the glass. All the differences between these two readings hinge on that fact: different selectional restrictions, different anaphoric possibilities. In other respects, such as disallowing fractional numerals and allowing ‘a big one and a little one’, the *Concrete Portion* reading patterns with the *Container + Contents* reading. And we have mentioned the possible role of metonymy earlier; so let us look more closely at the family of issues concerning dotted types, selectional restrictions and metonymy.

We have emphasized that we believe a more adequate treatment of the *Container + Contents* reading would make use of some theory of dotted types, so that it would be possible to refer to a glass of milk as having properties some of which are properties of the milk and others of which are properties of the glass.

An ontology for dotted types is not straightforward. It is not clear how to make the *Container + Contents* meaning actually denote *both* the container and the contents. We cannot take the mereological sum of the glass(es) and the milk contained in them, because then counting would make no sense; and yet we very easily count glasses of milk in those uses, and we do it by counting the glasses. In the simplified semantics, we have given here, in order to be able to count the glasses, we have followed Rothstein in formalizing this reading as referring to glasses that contain milk, modifying it to specify that the milk fills the glasses.

Asher (2008) offers a theory of dotted types that appears to avoid the difficulties encountered by previous attempts at formalization. The core of the theory involves complicating the notion of predication, so that one predicates something not of an object as a ‘bare particular’, but of an object ‘under a certain conceptualization, or aspect’ (Asher 2008, p.165). Asher’s approach handles the ‘copredication’ evident in examples like (18), (19) and (20). We believe it would handle the cases discussed here but have not tried to implement it.

On that approach, a glass of milk may consist of both the glass and the milk and may have different properties under different ‘aspects’. If we really had such an analysis, we would not need a separate *Concrete Portion* reading to ‘refer to the milk’; the *Concrete Portion* reading has all the properties that we would expect for a dotted-type container-plus-contents object considered under its ‘contents’ aspect. Counting would naturally count the glasses, since milk by itself cannot be counted.

Even without considering dotted types, metonymy may play a role in blurring or shifting selectional restrictions. Some of the main tests for different readings that are frequently appealed to in the literature on pseudopartitives concern selectional restrictions: you cannot drink a container and you cannot break liquid. But actual usage seems to be rather flexible in such matters; even when there is only a word for a container or a word for a substance present, one often finds perfectly natural uses of *prima facie* violations of selectional restrictions, as in the English examples in (41).

- (41) a. Stir the pot every 10 minutes or so. [What is stirred is the soup, not the pot.]
 b. Please put a lid on the soup. [The lid goes on the pot, not the soup.]
 c. Set the juice on my desk, please. It shouldn’t be sitting on the windowsill. [Setting and sitting are applicable to solids, not liquids.]
 d. He drank the whole glass in one gulp. [Maybe, but more likely the contents.]
 e. Keep the wine on its side, not vertical. [Only makes sense for the bottle.]
 f. “Drink me” – from *Alice in Wonderland*, written on a bottle.¹⁹

These all seem to involve metonymy that can go in either direction between a container and its contents, meaning that even if we can clearly distinguish meanings for *stakan moloka* that pick out the glass or the milk, it won’t be easy to find simple tests for identifying which meaning we have in a given example because such metonymic shifts could reverse the results. It is not even completely clear where to localize the shifts in (41); are they all shifts in the noun phrase or might some of them be shifts in the verb or other predicate? These metonymy phenomena make it harder to give criteria for distinguishing among the different meanings we have claimed to distinguish, and they may also be

¹⁹ Thanks to one of our referees for adding this example to our list, showing that even pronouns can display ‘dotted type’ behavior or metonymy.

at the root of the phenomena underlying Pustejovsky's theory of dotted types, although that is only a conjecture. We believe that Asher's recent work (Asher 2008) supports the idea that on a dotted-type reading, one can apply predicates that hold of the given 'complex entity' under any of its aspects. But his work does not settle the question of how to tell when there is further metonymy at work in a given example.

3.3.7 Syntactic issues Thus, it seems most plausible that if the *Concrete Portion* reading can be unified with one of the other readings, it would be with the *Container + Contents* reading, via a dotted-types analysis that has quite a lot in common with metonymy. But then why did we give the *Concrete Portion* reading a syntactic analysis like that of the measure phrases rather than like that of the *Container + Contents* reading? Because only on the *Container + Contents* reading is a numeral treated as an ordinary cardinal modifier and only on that reading is the whole noun phrase obligatorily treated as plural.²⁰ The *Concrete Portion* reading is a mass NP and the *Container + Contents* reading is a count NP. On our analysis of the *Container + Contents* reading, the whole NP is a predicate of the glass(es), and the milk is existentially quantified; on the *Concrete Portion*, reading it is the reverse. Thus, a unification of these two readings would require not just a good semantics for dotted types, but also something like a 'dotted syntax', to make the mass/count syntactic behavior correlate with the semantic reading.

Similar syntactic issues arise for classifier constructions, including container constructions, in Hebrew. Rothstein (2009) notes that according to the diagnostics of Borer (2009), in Hebrew *smikhut* constructions, the 'container' construct state forms have the same syntactic structure on both their measure and individuating readings. Rothstein (2009) follows Borer (2009) in this, giving the same syntax for both the measure reading and the individuating reading when they are expressed by the construct state form, but she posits 'syntactic reconstruction' for the measure reading before compositional semantic interpretation applies, ending up with differing syntactic forms for the different interpretations just as she does for English.

If it turns out to be a general fact that dotted types and metonymy may give rise to what appear to be 'double analyses' of single expressions, involving what seems to be different syntax as well as different semantics, it would seem that we may need a new sort of

²⁰ As discussed by Rothstein (2009), English speakers often vacillate between singular and plural agreement with *measure* readings and the *concrete portion* reading of phrases like *two cups of milk*. Other languages vary in the extent to which they show differences in morphosyntactic behavior among the different readings. See Brasoveanu (2008) and Rothstein (2009).

multi-dimensionality in syntactic–semantic analysis. But we have no proposals to offer.

So for now, we will keep all four readings, since we do not have an explicit dotted-type analysis for the semantics and because of the correlated syntactic issues.

3.4 Comparing the four shifted meanings of container-words

3.4.1 *A sequence of shifts from concrete container to abstract measure* If we compare the four different shifted meanings of *stakan* presented above, we can see that they form a derivational scale: the most concrete is the *Container + Contents* reading, *stakan+*, denoting a glass together with its contents; then that may be shifted to the *Concrete Portion* reading *stakan_{CP}*; then the *Ad Hoc Measure* reading *stakan_M*; and finally, the most abstract measure-like reading, *stakan_{SM}*, the *Standard Measure* reading (which does not exist for all container nouns).

We repeat the four definitions below in (42) for ease of comparison.

- (42) a. *stakan+*: Type $\langle e, \langle e, t \rangle \rangle$.
 Meaning: $\lambda y. \lambda x [\text{glass}(es)(x) \ \& \ \exists z [z \sqsubseteq y \ \& \ z \text{ fills } x]]$
- b. *stakan_{CP}*: Type $\langle n, \langle e, t \rangle \rangle$.
 Meaning: $\lambda n. \lambda x. \exists y [\text{glasses}(y) \ \& \ x \text{ fills } y \ \& \ |y| = n]$
- c. *stakan_M*: Type $\langle n, \langle e, t \rangle \rangle$.
 Meaning: $\lambda n. \lambda x. [\text{glass}(y_i) \ \& \ x \text{ would fill } y_i \text{ } n \text{ times}], \text{ where } y_i$
 is a free variable.
- d. *stakan_{SM}*: Type $\langle n, \langle e, t \rangle \rangle$.
 Meaning: $\lambda n. \lambda x [\textit{stakan-units}(x) = n]$

In this comparison, it is easy to see that numbers like the *dva* in *dva stakana moloka* ‘two glasses of milk’ play a very different role with *stakan+* than with the other three constructions. With *stakan+*, it is simply counting concrete glasses. In the *Ad Hoc Measure* construction and the *Standard Measure* construction, the number is related to a unit of measurement. In the *Concrete Portion* reading, it enters the construction in the same way as with the two measure readings, but there is quantification over glasses internal to the construction, and the milk is described by counting those glasses.

The meanings in (42) can be seen as the result of a sequence of meaning-shifts that can apply to containers quite productively, aside from the final step of lexicalization. The first shift, from the one-place sortal predicate *stakan* to the relational *stakan* used in the *Container + Contents* reading maps the sortal onto a relation between the container and the substance-kind of which some portion *x* fills it. The second

shift, from there to the *Concrete Portion* reading, takes the relation between the container and the substance-kind of which some portion fills it and transforms that into a relation between the portion of substance that fills it and the number of times it is filled, that is, a way of describing some milk in terms of the glasses it fills. Then the third shift, to a measure reading, introduces a free variable to pick out a glass and introduces modality so as to measure some milk in terms of how many times it could fill the given glass. And the last shift replaces the contextually selected glass and the spelling out of the filling relation by a lexicalized standard ‘glass-unit’ as a unit of volume.

As we realized when we tried to write out these shifts using meaning-shifting operators that might apply to these meanings to produce the consecutive meanings in the scale, only the very first shift can be so formalized, trivially. The other steps in the scale involve not a function applying to one meaning to give the next, but ‘tweaking’ the innards of the meanings in small incremental ways. We would maintain that these are all small and natural meaning-changing steps, but we do not have a formal theory that would predict them or generalize beyond them.

3.4.2 *A historical note* We have some confirmation of order of development of senses of container terms for the case of the word *cup* in English.²¹ The OED gives the following:

(43) **OED:**

- a. cup I: a drinking vessel, or something resembling it.
Citations for this sense date from c.1000
- b. cup II: transferred and figurative uses. Sense 8: a cup with the liquor it contains;
the drink taken in a cup; a cupful.
Citations for this sense date from 1382.
- c. cup III: Cookery (chiefly N. Amer.) A measure of capacity equal to the amount it takes to fill a cup; spec. a standard of measure of eight American fluid ounces.

Citations for this sense date from 1857.

We also note that *gallon*, now a pure measure unit in English, with citations from about 1300, derives from Old North French *gallon*, corresponding to Old French *jalon* ‘liquid measure’, which is related to

²¹ Thanks to Aynat Rubinstein for tracking this down.

the Middle Latin diminutive form *galleta*, ‘bucket, pail’, also ‘a measure of wine’, perhaps from Gaulish *galla* ‘vessel’.^{22,23}

3.5 *Ontological constraints on head noun and Genitive NP: linguistic and non-linguistic respectively*

Not every potential container + substance expression is well-formed, as illustrated in (44) below. Apparently not everything that might be used as a container is conceptualized as belonging to the sort *container*. One of the main goals of Borshev & Partee (2004) was to uncover the principles behind these anomalies, which we did in terms of constraints on the *sorts* corresponding to the container term and the contained substance.

- (44) #bassejn vody ‘swimming pool of water’
 #vaza vody/ cvetov ‘vase of water/flowers’
 #sejf/papka dokumentov ‘safe/folder of documents’.

We argued that the semantics of these container constructions and neighboring ones (*kuća peska* ‘pile of sand’, *motok provoloki* ‘roll of wire’, with vague boundaries separating them) is closely tied up with lexical specifications (and possible lexical shifts) of the ontological sort of the head noun. Here, we focus on the interesting difference between the sortal restrictions on the container noun and those on the substance NP.

A very rough approximation for meaning postulates for the sort *container*²⁴ in its relational sense is given in (45):

- (45) **Container (x) for substance (y)**
 1) sort – physical object **x**, substance **y**
 2) form – **x** has an inner part and when it is used to keep a substance **y**, **y** is inside of **x**
 3) usage – **x** can be used to hold *substances* of the sort **y**; can be filled by some substance to some degree (full, almost full, half-full, almost empty, etc.)
 4) volume of **x** – it is the volume of its inner part and so the volume of the substance that **x** can contain.
 5) status – **x** is used in order to make use of the *substance y* it contains (its *contents*).

²² From the Online Etymology Dictionary, <http://www.etymonline.com/index.php?term=gallon>. Retrieved April 2, 2010.

²³ As one of our referees reminded us, other kinds of measure nouns like English *foot* are derived from objects having a particular size on a given dimension. As the referee noted, and as was noted in Borshev and Partee (2004) and earlier by others, there are also metaphorical notions of containers as in *two minutes of silence* and *two paragraphs of nonsense*.

²⁴ These meaning postulates can be seen to distinguish the natural container *spoon* from the less plausible container *fork*; this helps to explain the differences between them discussed earlier.

The genitive complement must also be of a suitable ontological sort, but as illustrated in (46), that need not be lexically determined. The genitive complement may be a full NP, not necessarily just a noun, and it is evidently the referent of the complement phrase and not the meaning of its lexical head, that must meet the requirements imposed by the function. This contrasts interestingly with the Genitive of Quality construction in (7), where lexical properties of the function-noun (attribute) that heads the genitive NP are crucial.

- (46) a. ložka kakogo-to lekarstva
 spoon some.kind.of-GEN medicine.GEN
 ‘spoon of some kind of medicine’
 b. stakan kakoj-to gadosti
 glass some.kind.of-GEN filth-GEN
 ‘glass of some sort of nasty stuff’
 c. butylka Egermajstera
 bottle Jägermeister-GEN
 ‘bottle of Jägermeister’

4 CONCLUDING REFLECTIONS

When we compare the Genitive with Obligatory Third Term and the Genitive of Measure, we can see that lexical sortal properties of the functional nouns are crucial, although they are in different parts of the structure in the two constructions.

There are also constraints on the sortal properties of the other parts of the construction, but those are not lexical properties. The functional noun places conditions on its argument(s), and these must be satisfied by the denotation of the argument, not necessarily by the lexical items expressing it.

From the examples we have considered, we can see that the crucial properties of the functional noun in the container-headed Genitive of Measure construction reside not simply in the lexicon but in the properties associated with the sort *container* and presumably likewise with the properties associated with the respective *attribute-function* sorts (or however we should best characterize the words like *size*, *length*, *color*) in the English and Russian constructions examined in section 2. Nouns may be assigned to those sorts lexically or may be coerced into those sorts.

Probably our most interesting new proposal in this paper, in section 3, is the series of shifts in the meaning of container-words that lead to four different interpretations of a Genitive of Measure phrase like *dva stakana moloka* (two glasses of milk), starting from the *Container* +

Contents reading in which *stakan* still has a concrete container meaning but reference is to both the container and its contents via a dotted type interpretation, and ending with the *Standard Measure* reading in which *stakan* is a lexicalized measure term analogous to *litr* ‘liter’. Perhaps further research will show that we should have identified fewer distinct readings, or perhaps more, but at this point these four seem formally distinct. The *Container + Contents* reading has a syntax different from the other three; the other three have the same part-whole syntactic structure and the same semantic type for *stakan* but nevertheless differ significantly in their semantics: in one of them, one is still counting glasses that contain milk, while in the other two one is measuring milk with the help of an actual glass or a measure corresponding to a standard glass.

Open questions for further research include the issue of how best to formalize dotted types and how to best understand and capture the apparent ease with which intuitively clear selectional restrictions relating to containers and their contents seem to be violated. Progress on those difficult, and probably closely related, topics could have an impact on the question of how many readings of container constructions should be described as distinct. And progress on all of these matters may help clarify the mechanisms and constraints on type-shifting and other meaning-shifts, and with them the bigger question of the interplay of compositionality and context dependence.

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