Object Mass Nouns as Arbiter for the Mass/Count Category

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1 Introduction

Chierchia (2010) argues that object mass nouns constitute a good testing ground for theories of the mass/count distinction, given that these nouns constitute a non-canonical type of mass noun that seems to be restricted to number marking languages (excluding outliers like Greek which admit plural morphology on mass nouns). Taking this idea as a springboard, in this paper we pose the questions: Are there object mass nouns in classifier languages such as Japanese? What does the answer to this question mean for semantic accounts of the mass/count distinction in classifier languages?

Object mass nouns (e.g. *furniture, jewelry, mail*) are genuine mass nouns insofar as they do not freely admit pluralization, are infelicitous with determiners that select for count predicates (e.g. *many, each* and *every*), and are felicitous with determiners that select for mass predicates (e.g. *much*). Object mass nouns are non-canonical insofar as they, refer to collections of discrete entities (e.g. *jewelry* refers to sets of earrings, necklaces, bracelets, etc.) that are identifiable via semantic tests like the availability of cardinality comparisons in *more than* constructions (Barner and Snedeker, 2005), and they are felicitous with stubbornly distributive predicates (Rothstein, 2010). In contrast, canonical mass nouns like *water* refer to undifferentiated stuff and behave differently with respect to these semantic tests. Given these characteristics, object mass nouns have been used at least as early as Chierchia (1998a) and Gillon (1999) to exemplify the lack of direct alignment between the mass/count distinction and the pre-linguistic substance/object distinction of Soja et al. (1991); Spelke (1985). In exemplifying this misalignment, object mass nouns stand as counterexamples to early analyses of the mass/count distinction that assume count nouns denote individuals and mass nouns do not (e.g. Link, 1983).

Analyses of the mass/count distinction in number marking languages like English account for object mass nouns in various ways, though they often assume, based on existing evidence, that a parallel, non-canonical class of mass nouns does not exist in classifier languages like Japanese and Mandarin. Chierchia (2010), for example, argues that classifier languages should have no object mass nouns, which he aligns with their lack of obligatory number marking. Chierchia

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(2010) and others (e.g. Muromatsu, 2003; Nemoto, 2005), follow Cheng and Sybesma (1998) in assuming that the mass/count distinction is encoded in classifier languages through the syntax and semantics of classifiers, because shape-based classifiers do not combine with substance denoting mass nouns, at least not without coercing a countable interpretation. In other words, shape based classifiers only straightforwardly compose with object denoting nouns, and in this sense, classifier languages have mass/count syntax that is sensitive to whether nouns denote substances or objects. These assumptions lead to a picture of classifier languages in which the mass/count distinction aligns with the substance/object distinction.

Some recent studies have proposed that nouns in classifier languages, e.g. Japanese, encode individuation (Inagaki and Barner, 2009) and that Japanese has several morphosyntactic reflexes that indicate that determiners are sensitive to the countability of nouns (Sudo, 2015). Inagaki and Barner (2009) conclude from quantity comparison tasks that Japanese nouns like *isu* ('chair') individuate on account of the fact that quantities of chairs can be compared in terms of cardinality in the absense of grammatical markers like classifiers that are argued to encode individuation. Sudo (2015) argues that Japanese nouns encode countability on account of the fact that Japanese determiners like *nan-byaku to iu* ('hundreds of') are felictous with for count nouns like *komento* ('comment') but not mass nouns like *ase* ('sweat'). Given that Inagaki and Barner (2009) show that nouns encode individuation and Sudo (2015) shows that determiners are sensitive to countability of nouns in Japanese, Inagaki and Barner (2009) and Sudo (2015) have collectively demonstrated that Japanese contains the necessary characteristics for identifying object mass nouns, which are known to encode individuation and pattern with mass nouns (Barner and Snedeker, 2005, i.a.). That said, certain analyses have argued that classifier languages should have no such class of nouns (Chierchia, 2010, 2015). This prompts the following question: if nouns in classifier languages encode individuation and the lack of it, and if determiners in classifier languages are sensitive to the countability of nouns, then why should classifier languages like Japanese lack object mass nouns?

It is not the case that all analyses of classifier languages assume that these languages have no object mass nouns. Rothstein (2010, 2017), for example, follows the tendency that is attested since at least Krifka (1995) of analyzing nouns in classifier languages as kind denoting. However, unlike Krifka (1995) who assumes that classifiers first combine with numericals, and unlike Chierchia (2010) who assumes that classifiers combine directly with kind-denoting nouns, Rothstein (2010, 2017) assumes that nouns in classifier languages shift from denoting kinds to denoting semi-lattices and therefore have mass denotations, which requires a classifier to specify a counting context before it can combine with a numerical. For Rothstein (2017), the mass denotations of object denoting nouns are object mass, and it is therefore the case that all object denoting nouns are object mass nouns in classifier languages, at least when they are counted. Despite the fact that Chierchia (2010, 2015) and Rothstein (2010, 2017) make opposite claims about the number of object mass nouns in classifier languages, what these analyses have in common is that they focus on the nature of counting constructions and the occurrence of bare nouns in classifier languages when making claims about countability. Setting aside counting constructions and the free occurrence of bare nouns, we follow Sudo (2015) in using determiners as our test for countability in Japanese, and we follow Inagaki and Barner (2009) in using cardinality based quantity comparison cardinality as our test for individuation.

Using the evidence for individuation from Inagaki and Barner (2009) and countability from Sudo (2015), we present a means of putting claims like those of Chierchia (2010) and Rothstein (2010, 2017) to the test: we constructed a felicity judgment task to test the felicity of 44 nouns from three different conceptual classes (discrete individuals, collections of discrete entities, and undifferentiated stuff) when composed with the determiner *nan-byaku to iu* ('hundreds

of'), which selects for count nouns. The results of this study provide some evidence to suggest that at least four Japanese nouns have one of the hallmark properties of object mass nouns, namely exhibiting grammatically mass behavior. We also tested the second hallmark property of object mass nouns, namely that they encode individuation, as argued by Inagaki and Barner (2009); Barner and Snedeker (2005). Our consultants indicated that they can compare quantities of entities in the extension of these nouns in terms of cardinality. The results of these two tests give us some reason to think that that at least four Japanese nouns demonstrate the mass noun behavior of being infelicitous with determiners that select for count nouns, and the object denoting property of being comparable in terms of cardinality. In other words, we have some evidence for the claim that Japanese has a small set of nouns that demonstrate the behavior of object mass nouns.

However, further studies are needed to explore the existence and robustness of a class of object mass nouns in Japanese, not least the testing of the same nouns in further grammatical environments that are diagnostic of the mass/count distinction in Japanese. If Japanese were to have a class of such nouns (admittedly a rather limited one), then the following question arises: What would an analysis of the mass/count distinction in Japanese be like? We outline one proposal that builds upon Sutton and Filip (2016a; 2016b; 2018; 2019). This proposal is based on the idea that the key property that grounds the grammatical property of countability is quantization relative to a contextually specified *schema of individuation* (details given in §4).

2 Background

Since at least Krifka (1995), bare nouns in classifier languages have been analyzed as kind denoting.[1] Chierchia (1998a,b) observes that several characteristics of classifier languages naturally follow from the assumption that nouns in classifier languages are kind denoting arguments, namely that bare arguments freely occur, that there is no obligatory number marking, that there are no definite or indefinite articles, and that there is a generalized classifier system. The generalized classifier system follows from this analysis on the assumption that they provide the necessary semantic criteria to specify a set of individuals to be counted. Without a classifier providing individuation criteria, many analyses assume that all nominal predicates are mass in classifier languages (Chierchia, 1998a,b; Nemoto, 2005; Rothstein, 2010, 2017; Li, 2011, among others).

In these analyses, it is sometimes assumed that the grammars of classifier languages reflect the pre-linguistic distinction between nouns that refer to objects and those that refer to substances in the sense of Soja et al. (1991), and in this sense, all nouns in classifier languages that refer to objects can be considered object mass nouns (e.g. Rothstein, 2017). Other analyses of classifier languages do not commit to nominal predicates being mass, though they do assume that nouns denote kinds (Chierchia, 2010, 2015) or are otherwise uniform in their internal structure (Muromatsu, 2003).

In addition to this widespread view of classifier languages, recent work on the mass/count distinction has advanced alternative claims. Chierchia (2010, 2015), for example, maintains that all nouns in classifier languages denote kinds, though he also argues that classifier languages should not be expected to have object mass nouns on account of the fact that they lack the prerequisite criteria for the formation of object mass nouns, namely an obligatory number marking system. Inagaki and Barner (2009); Doetjes (2012); Bale and Coon (2014) and Sudo

[1] This is a slight simplification. Krifka (1995) assumes that bare nouns in classifier languages denote *concepts*, which are a proper super set of kinds (concepts can, for example, be the product of combining different kinds).

(2016, 2015), on the other hand, take altogether different approaches to classifier languages and assume that a large number of nouns are encoded with individuation criteria or countability. In these analyses, the nominal semantics of classifier languages are much closer to that of number marking languages than is generally assumed.

2.1 Languages without object mass nouns

Chierchia (2010) follows his (1998a; 1998b) analysis in several respects, such as in assuming all nouns in classifier languages are kind denoting and therefore that no noun can combine with a numerical without first combining with a classifier, which shifts the noun into a countable predicate. He also demonstrates his assumption that a mass/count distinction is apparent in classifier languages in the distribution of classifiers. For example, the general classifier in Mandarin *ge* ($\text{CL}_{general}$) is typically only used with count nouns like *ji* ('chicken'); the general classifier is infelicitous with mass nouns like *xue* ('blood').

(1) a. san ge ji — Mandarin
three $\text{CL}_{general}$ chicken
'three chickens'

b. #san ge xue
three $\text{CL}_{general}$ blood
'three portions of blood' — (Chierchia, 2010, pp. 106-107)

The assumption that classifiers exhibit mass/count sensitivity, stems from the work of Cheng and Sybesma (1998), who show that shape-based classifiers typically only occur with nouns that refer to discrete objects, and if they occur with nouns that refer to substances, they enforce a portion interpretation.

Along with having a mass/count distinction apparent in the distribution of classifiers, Chierchia (2010, 2015) argues that classifier languages cannot have object mass nouns, given they lack the prerequisite properties that drive the existence of object mass nouns, namely a number marking system defined in terms of (stable) atomicity. As defined in (Chierchia, 2015), a predicate is *stably atomic* if and only if there is a set of entities in that are atoms in that predicate's denotation at all worlds in the common ground. Chierchia (2010, 2015) assumes that number marking in languages like English is defined in terms of (stable) atomicity, and from this analysis several characteristics of these languages follow. By assuming that morphologically singular and plural nouns must refer to atoms, Chierchia's (2010; 2015) analysis explains why it should be the case that mass nouns are singular despite the fact that they can refer to sums of entities. Mass nouns are atomic and able to refer to sums of entities, because they are assumed to denote a singleton property, that is, a property which, relative to all worlds for which the property is non-empty, denotes a set with only one member, namely, the sum of all entities in the denotation of the noun at that world. Crucially, the entities in the denotation of mass nouns like *mud* are assumed to be unstable unlike those in the denotation of count nouns like *chair*, which are stably atomic. Singular count nouns denote individual atoms and plural count nouns denote these atoms and all of the possible sums thereof. Mass nouns cannot pluralize because their pluralization would be semantically vacuous (given that they denote singleton properties). Furthermore, nouns that refer to stable atoms can be encoded as singleton properties as a matter of lexical choice, giving rise to object mass nouns like *furniture*. Because classifier languages lack obligatory number marking, they lack the semantic requirement that singular nouns must be (stably) atomic. Nouns that refer to unstable individuals are not expected to be encoded as singleton properties, so the encoding of stably atomic predicates as singleton properties via lexical choice is not expected to occur.

The picture of the mass/count distinction in classifier languages that emerges from the work of Cheng and Sybesma (1998) and Chierchia (2010, 2015) is one in which the mass/count distinction falls neatly in line with the substance/object distinction, and in this way they mirrorearly analyses of the mass/count distinction in English (e.g. Link, 1983). More recent research on the mass/count distinction has focused on the ways in which the mass/count distinction deviates from the substance/object distinction (e.g. Barner and Snedeker, 2005; Rothstein, 2010; Landman, 2011, among others), though, outside of some work done by Inagaki and Barner (2009), little work of this kind has been conducted on classifier languages.

2.2 Individuation without classifiers: Inagaki and Barner (2009)

Inagaki and Barner (2009) use quantity comparison tasks to investigate if Japanese nouns encode individuation or if individuation is imposed via the semantics of classifiers as many analyses assume (e.g. Chierchia, 1998a; Rothstein, 2010, 2017). Inagaki and Barner (2009) compared judgments pertaining to quantities in three languages, English, French, and Japanese, by showing natives speakers of the respective languages two sets of items at a time and asking for an evaluation of relative quantity. For example, the participant would be directed to look at two portions of spinach, one with a larger cardinality and one with larger volume as depicted in Figure 1. Japanese participants were then asked to compare the quantities of spinach via the

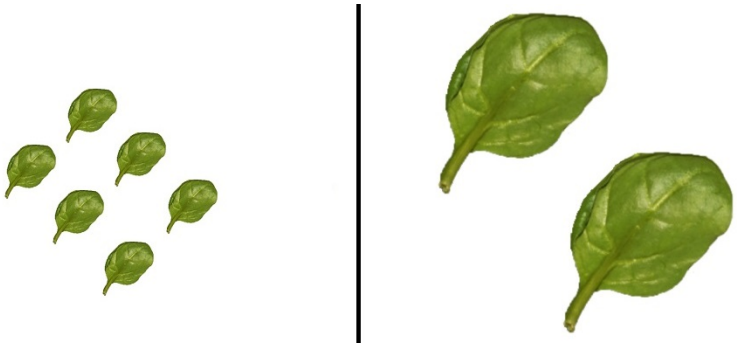

Fig. 1: Quantity Comparison in the Style of Inagaki and Barner (2009)

question in (2), which contains no classifier or other grammatical means of specifying that there might be individuals to be counted and compared in terms of cardinality.

(2) Dotira-no hito-ga yori-ookuno hoorensoo-o motte-iru desyoo
which-GEN person-NOM more.than-more spinach-ACC have-PROG COP.QCOP.Q
'Who has more spinach?' (Inagaki and Barner, 2009, p. 125)

Japanese participants, like their English counterparts, favored volume based comparison for nouns that refer to undifferentiated stuff like *karasi* ('mustard'). Both sets of participants favored cardinality comparisons for nouns like *kutu* ('shoe') that refer to discrete individuals and are count nouns in English. The ability to compare according to cardinality extends to nouns that refer to collections of discrete entities, such as *kagu* ('furniture'), as was also shown to be the case for English nouns in this category by Barner and Snedeker (2005). These results suggest that not all nouns in classifier languages are uniform in the way they are encoded. Inagaki and Barner (2009) assume that Japanese nouns that refer to discrete individuals can individuate just as they can in English, while those that refer to undifferentiated stuff cannot.

2.3 Arguments for nominal individuation: Doetjes (2012)

Doetjes (2012) reviews a number of characteristics of classifier languages that she argues indicate that classifier languages have grammaticized lexical mass/count distinctions. The first characteristic is that classifier languages do not always require classifiers in counting constructions. Sudo (2015) also shows this to be the case in Japanese: large round numbers like 1000 can combine directly with nouns that refer to discrete individuals:

(3) sen-(choo)-no bairorin
1000-CL-GEN violin
'a thousand violins' (Sudo, 2015, p. 4)

The second characteristic is the fact that general classifiers can be used in the place of sortal classifiers. Doetjes (2012) argues that this indicates that the nouns themselves must be individuated because the general classifier would otherwise have to contribute the individuation criteria for every noun that it can combine with. The last characteristic is that some classifier languages have determiners that are sensitive to the countability of nouns. The Mandarin determiner *yī diǎnr* ('a little') has been shown by Iljic (1994) to never occur with a classifier, and to typically occur with substance denoting nouns and abstract nouns. Doetjes (2012) argues that these three characteristics of classifier languages indicate that nouns in classifier language provide criterion for counting.

2.4 Mass/count characteristics in Japanese: Sudo (2016, 2015)

Sudo (2016, 2015) shows that Japanese has several morphosyntactic reflexes that resemble those that we find in languages that have a grammaticized lexical mass/count distinction. As mentioned in the previous section, large round numbers like 100 and 1000 can directly combine with nouns that refer to discrete entities. Japanese also has five determiners that, as Sudo (2015) argues, seem to distinguish count nouns and mass nouns, and that can be used without classifiers: *tasuu* ('many'), *shoosuu* ('few'), *nan-byaku-toiuu* ('what-100-say'), *dono* ('which'), and *hotondo* ('most'). As shown in (4), the determiner *nan-byaku to iu* ('hundreds of') is felicitous with *komento* ('comment') but not with *ase* ('sweat').

(4) a. sono tookoo-ni nan-byaku-toiuu komento-ga tsuita.
that post-TO what-100-say comment-NOM provided.
'That post got hundreds of comments.'
b. Taro-wa nan-byaku-toiuu ase-o kaita
Taro-TOP what-100-say sweat-ACC secreted
(intended) 'Taro sweated a lot.' (Sudo, 2015, p. 5)

Based on this evidence, Sudo (2015) argues some Japanese nouns have denotations that are compatible with morphosyntax that selects for countability while other Japanese nouns do not. In other words, it seems that Sudo (2015) is alluding to the presence of a grammaticized lexical mass/count distinction in Japanese.

3 Testing for Object Mass Nouns

Recent research on Japanese by Inagaki and Barner (2009) and Sudo (2016, 2015) has laid the groundwork for showing that Japanese distinguishes between different kinds of nouns, those that encode individuation versus those that do not (Inagaki and Barner, 2009) and those that

encode countability versus those that do not (Sudo, 2015). However neither study went as far as to investigate whether this distinction falls in line with the substance/object distinction or not. Despite the fact that the relevant tests for distinguishing object mass nouns are available in Japanese, it has not yet been shown that Japanese has object mass nouns and thereby a lexical distinction between nouns that does not align with the substance/object distinction.

We set out to test for object mass nouns in Japanese by mainly building upon Sudo's (2015). observations about Japanese determiners. Building on his evidence that the determiner *nan-byaku to iu* ('hundreds of') is felicitous with nouns that denote discrete entities, but not those that denote undifferentiated stuff, we formulated a set of test sentences, each containing this determiner and a noun from one of three different conceptual classes: discrete individuals, e.g. *onna no hito* 'woman' in (5); undifferentiated stuff, e.g. *yuki* 'snow' in (6); and collections of discrete entities, e.g. *chōrikigu* 'kitchenware' in (7). Having formulated suitable English sentences for each test item, we had them translated by our Japanese consultants into Japanese sentences that sounded as natural as possible.

(5) toranpu-shi ga daitoryō ni na-tta ato, nan-byaku-to-iu
Trump-president NOM president ACC become-PST after; what-hundred-to-say
onna.no.hito ga washinton de neriarui-ta
woman NOM Washington LOC march-PST
'After Trump became president, hundreds of women marched in Washington DC.'

(6) #nan-byaku-to-iu yuki wa mō toke-te shima-tta
what-hundred-to-say snow NOM already melt-TE finish-PST
'#Hundreds of snow melted already.'

(7) #Atarashī ryōri no gakkō wa nan-byaku-to-iu chōrikigu o ka-tta.
new cooking GEN school TOP what-hundred-to-say kitchenware ACC buy-PST
Dakara subete no seito ga benkyōsuru tame no potto to furaipan o
therefore all GEN student NOM study for GEN pot and pan ACC
mo-tta.
hold-PST
#'The new culinary school bought hundreds of kitchenware, so every student had pots and pans to work with.'

On the basis that nouns that refer to discrete individuals (e.g. *woman*) are generally count and nouns that refer to undifferentiated stuff (e.g. *mud*) are generally mass in languages with a mass/count distinction, we can immediately make several predictions about what we should expect to find when using these sentences in an acceptability judgment task. First, sentences containing nouns that refer to discrete individuals composed with *nan-byaku to iu* ('hundreds of') should be judged to be felicitous, because this determiner selects for count nouns and nouns that refer to discrete individuals are typically count. Second, sentences containing nouns that refer to undifferentiated stuff composed with *nan-byaku to iu* ('hundreds of') should be judged to be infelicitous, because this determiner selects for count nouns and nouns that refer to undifferentiated stuff are typically mass.

What is less clear is how sentences containing nouns that refer to collections of discrete entities composed with *nan-byaku to iu* ('hundreds of') will be judged. Sutton and Filip (2016b) observe that this class of nouns is the site of mass/count variation both within and across languages. If sentences containing these nouns are judged to be felicitous, then we have some evidence that these nouns are count, and if sentences containing these nouns are judged to be

infelicitous, then we have some evidence that these nouns are mass on the assumption that the infelicity is due to the ungrammatical composition of a mass noun and a determiner that selects for count nouns. Any noun that refers to collections of discrete entities and is shown to be mass is a candidate for being an object mass noun if it can be shown to also encode individuation, for example in a quantity comparison task like that of Inagaki and Barner (2009).

In addition to these test sentences, we constructed an equal number of filler sentences. Our filler sentences consisted of adjective-noun combinations, a subset of which were infelicitous. The set of survey items had an approximately equal number of felicitous and infelicitous filler constructions and target constructions, as far as such judgments could be predicted based on the chosen data. We tested the felicity of these constructions in an online survey in which participants were asked to judge the naturalness of sentences on a five point Likert scale from 1, *zenzen yokunai* ('not at all good'), to 5, *totemo yoi* ('very good'). Each sentence was judged by 50 native Japanese speakers via the crowd-sourcing platform www.crowdworks.jp.

3.1 Results

As predicted by previous work on Japanese (Sudo, 2015), the results of our acceptability judgment task show that sentences with nouns that refer to discrete individuals (e.g. *onna no hito* 'woman') composed with the determiner *nan-byaku to iu* ('hundreds of') are felicitous while sentences with nouns that refer to undifferentiated stuff (e.g. *yuki* 'snow') composed with the same determiner are infelicitous (see Figure 2). More specifically, sentences with nouns referring to discrete

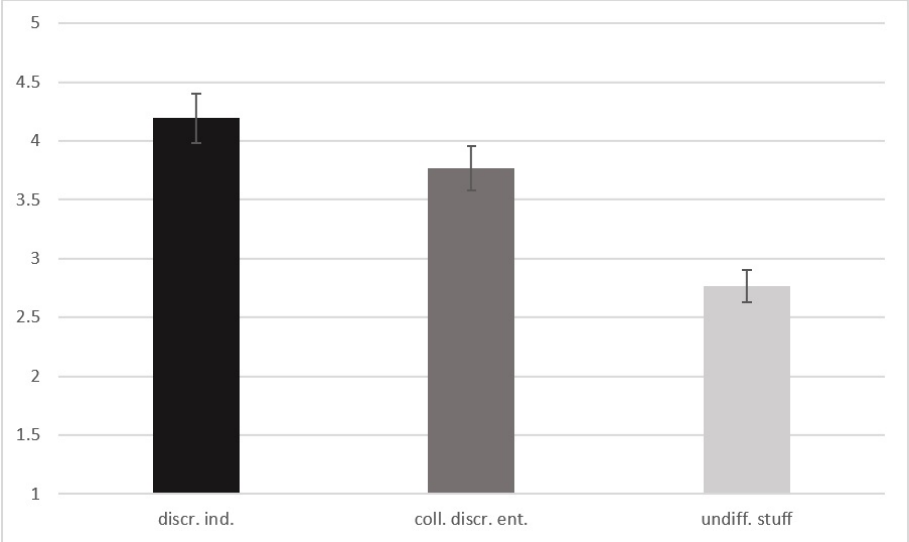

Fig. 2: Average judgment by conceptual class

individuals have a high average acceptability ($\bar{x} = 4.20$), while sentences with nouns referring to unindividuated stuff have a low average acceptability ($\bar{x} = 2.76$). As a single class, the sentences containing nouns that refer to collections of discrete entities (e.g. *chōrikigu* 'kitchenware') did not pattern as high as those with nouns referring to discrete individuals nor as low as sentences containing nouns that refer to undifferentiated stuff ($\bar{x} = 3.77$).

These results were analyzed using the lme4 package in R and a Generalized linear mixed effects model. The fixed effect was notional class and the random effects were noun and participant. This analysis shows that the judgments of sentences containing nouns that refer to undifferentiated stuff were significantly lower than the judgments of sentences containing nouns that refer to discrete individuals ($p < 0.001$), as were judgments of sentences containing

nouns that refer to collections of discrete entities ($p < 0.01$). Interpreting these results relative to composition with the determiner *nan-byaku to iu* ('hundreds of'), we might say that nouns that refer to undifferentiated stuff are infelicitous with this determiner, as is predicted by Sudo (2015). Furthermore, the class of nouns that refer to collections of discrete entities does not pattern similarly to nouns that refer to discrete individuals. This result is not predicted by analyses that assume that all nouns that can compose with shape-based classifiers are uniform in their encoding. Instead, what seems to be the case is that the class of nouns that refer to collections of discrete entities shows mass/count variation in Japanese.

To tease apart differences in behavior among nouns that refer to collections of discrete entities, we conducted a post hoc analysis based on how closely the judgments of individual sentences containing these nouns resembled the judgments of sentences containing nouns referring to discrete individuals and how closely these judgments resembled the judgments of sentences containing nouns referring to undifferentiated stuff. In addition to using the Generalized linear mixed effects model to analyze the results of this post hoc analysis, these results were also analyzed with respect to effect size, namely the degree to which a phenomenon exists, which is determined by dividing the difference between two average judgments by the standard deviation of all judgments (Cohen, 1988). In acceptability judgment tasks, the measure of grammaticality is the size of the effect (Mahowald et al., 2016). Using the high felicity of sentences containing nouns that refer to discrete entities as our baseline, a trivial effect is an effect size less than 0.2, a small effect is an effect size between 0.2 and 0.5, a medium effect is between 0.5 and 0.8, and a large effect size is anything greater than 0.8.

The graph in Figure 3 contains the average number of judgments the sentences containing a noun referring to discrete entities had at each level of the Likert scale. The judgments of sentences containing nouns that refer to discrete individuals had a clear tendency towards the high (felicitous) end of the Likert scale. In this post hoc analyses, we interpret the average judgment of these sentences and this distribution pattern as our baseline of felicity.

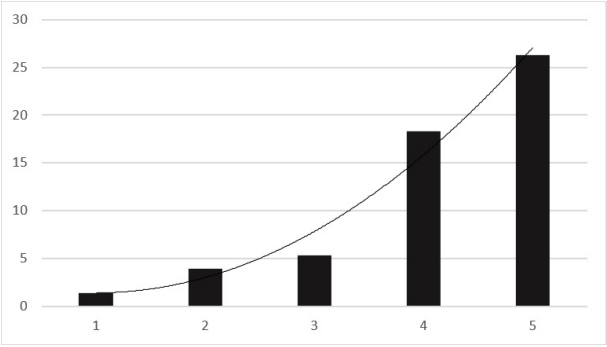

Fig. 3: Average judgments: Nouns referring to discrete individuals

The judgments of sentences with nouns that refer to undifferentiated stuff patterned towards the center and only slightly towards the low (infelicitous) end of the Likert scale (Figure 4).

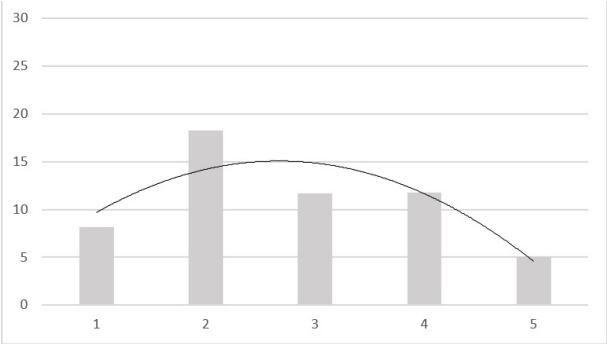

Fig. 4: Average judgments: Nouns referring to undifferentiated stuff

Notably, this pattern is not the inverse of the felicity pattern seen in judgments of sentences containing nouns that refer to discrete individuals. Despite this distribution of judgments, the difference between this group of sentences and the set of sentences that contain nouns that refer to discrete individuals is statistically significant ($p < 0.001$, effect size > 0.8). We interpret this measure of difference in statistical tests as the criteria for categorization as infelicitous.

The sentences that contain nouns referring to collections of discrete entities were separated in to one of three groups depending on whether the distribution of judgments of these sentences most closely resembled those of sentences containing nouns referring to discrete individuals, those containing nouns referring to undifferentiated stuff, or neither. While having three categories of felicity does not reflect the binary way in which morphosyntactic reflexes of the mass/count distinction are typically discussed, such gradients are common in acceptability judgment tasks, (e.g. Bresnan, 2007; Bresnan and Ford, 2010; Chomsky, 1964; Featherston, 2005; Keller, 2000; Newmeyer, 2007; Sorace and Keller, 2005; Sprouse, 2007), and more accurately reflects the judgments of the individual sentences in this study.

As depicted in Figure 5, one set of sentences containing nouns that refer to collections of discrete entities (group 1) was judged in a way that is nearly identical to the way that sentences containing nouns that refer to discrete individuals were judged. Furthermore, the

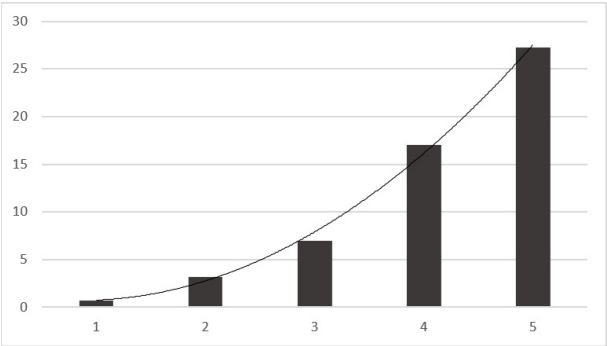

Fig. 5: Average judgments: Nouns referring to collections of discrete entities, Group 1

average judgment of sentences in this class strongly resembles the average judgment of sentences containing nouns that refer to discrete individuals ($n = 7$, $\bar{x} = 4.22$, $p = 0.567$, effect size < 0.2). On the assumption that sentences containing nouns that refer to discrete entities are felicitous, the statistical analysis of the judgments of sentences in Group 1, which contain nouns that refer to collections of discrete entities, are such that these sentences are also felicitous.

One set of sentences containing nouns referring to collections of discrete entities (Group 3) was judged in such a way that most closely resembles the judgment of sentences containing

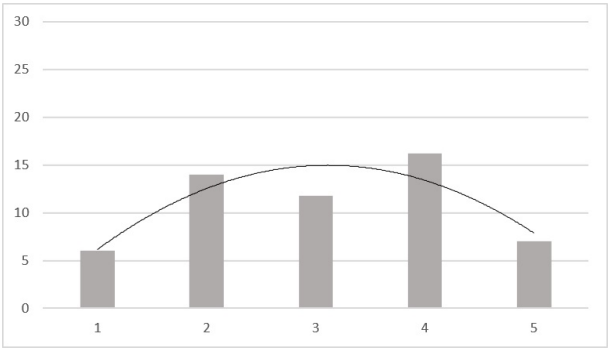

Fig. 6: Average judgments: Nouns referring to collections of discrete entities, Group 3

nouns that refer to undifferentiated stuff in the sense that the judgments of these nouns pattern towards the center of the Likert scale. While the distribution of judgments of sentences in Group 3 is not slightly towards the low end of the Likert scale as is the case for judgments of sentences containing nouns that refer to undifferentiated stuff, the average judgment of these sentences ($n = 4$, $\bar{x} = 3.21$, $p < 0.001$, effect size > 0.8) is similar to the average judgment of sentences containing nouns that refer to undifferentiated stuff in that both sets are as strongly unlike the average of judgments of sentences containing nouns that refer to discrete individuals as is possible. On the assumption that a p-value less than 0.001 and an effect size greater than 0.8 are indicators of infelicity, then the sentences in Group 3 are infelicitous.

Another set of nouns (Group 2) patterned in between the Groups 1 and 3, not being judged as straightforwardly felicitous as sentences containing nouns that refer to discrete individuals nor as infelicitous as sentences containing nouns that refer to undifferentiated stuff ($n = 7$, $\bar{x} = 3.71$, $p < 0.05$, effect size 0.5–0.8). The distribution of judgments across the Likert scale is generally towards the high (felicitous) end of the scale, though not with the same clear pattern as the distribution of judgments of sentences containing nouns that refer to discrete individuals. In

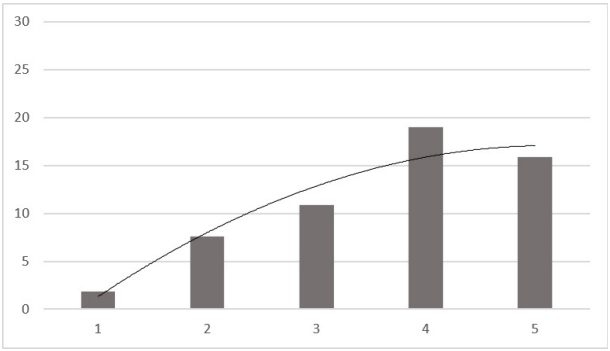

Fig. 7: Average judgments: Nouns referring to collections of discrete entities, Group 2

other words, the third group of sentences only weakly pattern like those containing nouns that refer to discrete individuals.

The average judgments of each class of nouns in this post-hoc analysis are depicted in Figure 8, along with the average judgments of sentences containing nouns that refer to discrete individuals and those referring to undifferentiated stuff. This graph shows three distinct judgment patterns with respect to sentences containing the determiner *nan-byaku to iu* ('hundreds of') and nouns that refer to collections of discrete entities. The nouns in each group are listed in in Table 1, where the category *Felicitous* contains the nouns that occurred in sentences that were judged like those containing nouns that refer to discrete entities, *Weakly Felicitous* contains the nouns that occurred in sentences that were judged differently from those containing nouns that refer to

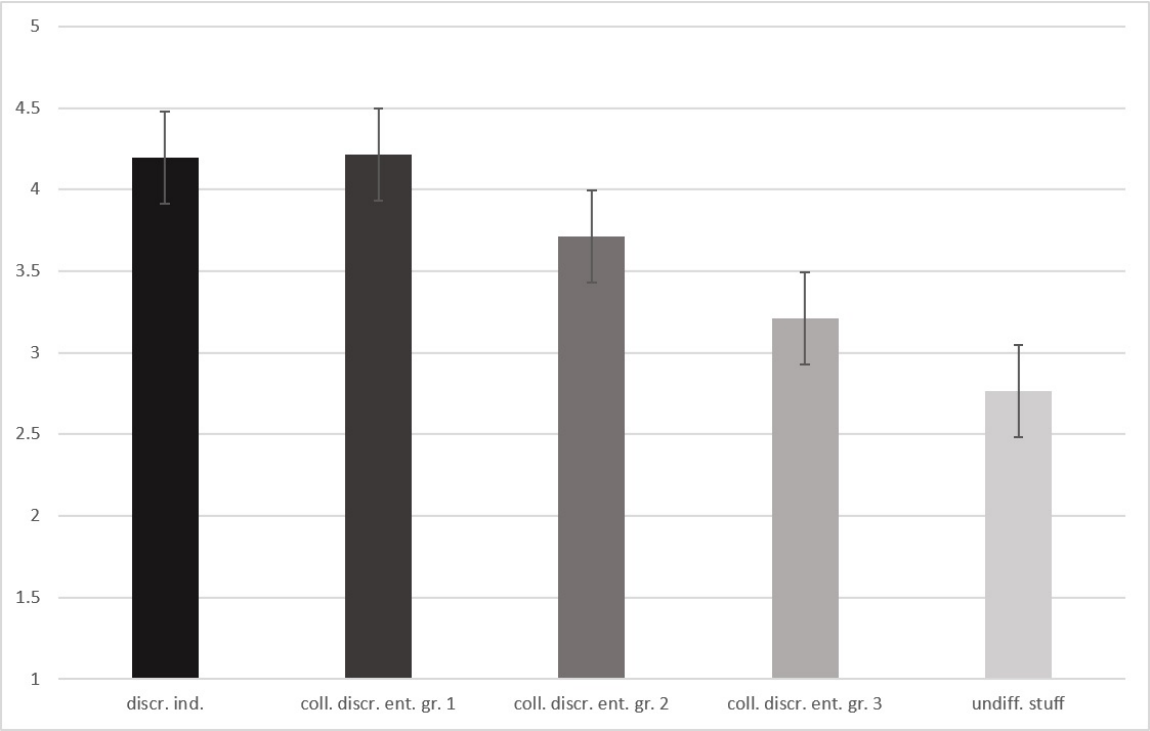

Fig. 8: Average judgment: Post-hoc classes

Table 1: Felicity with *nan-byaku to iu* ('hundreds of')

Felicitous	Weakly Felicitous	Infelicitous
haikibutsu ('waste')	*shōhin* ('goods/wares')	*hakimono* ('footwear')
kizai ('equipment')	*kagu* ('furniture')	*shinamono* ('wares/articles')
yōfuku ('western clothes')	*shokki* ('dishware')	*kattamono* ('shopped goods')
chōri-ki ('kitchenware')	*sōbi* ('equipment')	*chōri-kigu* ('kitchenware')
yūbin ('mail')	*dōgu* ('tools')	
daidokoro yōhin ('kitchenware')	*yūbinbutsu* ('mail')	
kutsu ('shoes')	*gomi* ('garbage')	

discrete entities, albeit weakly so given their p-value and effect size, and *Infelicitous* contains the nouns that occurred in sentences that were judged differently from those containing nouns that refer to discrete entities with the same p-value and effect size as those the sentences containing nouns that refer to undifferentiated stuff.

3.2 Discussion

Assuming that the results of the study are due solely to the felicity of the composition of the different nouns with the determiner *nan-byaku to iu* ('hundreds of'), these results confirm several predictions and suggest that the lexical encoding of Japanese nouns might not be as uniform with respect to countability as assumed by many analyses of classifier languages. First, as predicted by Sudo (2015), *nan-byaku to iu* ('hundreds of') is felicitous with count nouns and infelicitous with mass nouns. Second, as predicted by Sutton and Filip (2016a), the conceptual class of nouns that refer to discrete individuals is stably count, the conceptual class of nouns that refer to undifferentiated stuff are stably mass, and the conceptual class of nouns that refer to collections of discrete entities is varied with respect to mass and count encoding. These results also

suggest that, despite the fact that all nouns require classifiers in order to be counted, they do not behave uniformly with respect to all morphosyntactic environments indicative of the mass/count distinction. Instead, these results suggest that at least four Japanese nouns (22% of those we tested in the relevant class), *hakimono* ('footwear'), *shinamono* ('wares/articles'), *kattamono* ('shopped goods'), and *chōri-kigu* ('kitchenware'), have the characteristic property of object mass nouns, that they grammatically pattern with mass nouns. Rather than relying on whether or not the average judgment of sentences containing one of these four nouns composed with the determiner *nan-byaku to iu* ('hundreds of') is the same as the average judgment of the sentences containing nouns that refer to undifferentiated stuff composed with *nan-byaku to iu* ('hundreds of') in order to determine infelicity, we assess infelicity based on statistically determined differences of the sets of sentences from those that contain nouns that refer to discrete individuals composed with *nan-byaku to iu* ('hundreds of'). Because both the set of sentences containing nouns that refer to undifferentiated stuff and the group of sentences containing *hakimono* ('footwear'), *shinamono* ('wares/articles'), *kattamono* ('shopped goods'), and *chōri-kigu* ('kitchenware') are judged in a way that displays a statistically significant difference ($p < 0.001$, effect size > 0.8) from the group of sentences containing nouns that refer to discrete individuals composed with *nan-byaku to iu* ('hundreds of'), we consider both the set of sentences containing nouns that refer to undifferentiated stuff and the group of sentences containing *hakimono* ('footwear'), *shinamono* ('wares/articles'), *kattamono* ('shopped goods'), and *chōri-kigu* ('kitchenware') to be equally infelicitous in that they are categorially identically unlike sentences containing nouns that refer to discrete individuals (count nouns).

To confirm that the nouns that refer to collections of discrete entities are individuated in the sense of Barner and Snedeker (2005), and therefore that these nouns have both hallmark properties of object mass nouns, we set up a quantity comparison task for three consultants. Each consultant was given a context in which two people possessed items of the same kind, but in amounts that differed with respect to volume and cardinality. One person's possessions were larger in terms of volume, while the other person's possessions were higher in cardinality.

(8) Mayo no kago ni wa ookii mi-ttsu no men no fukuro to fatatsu no
Mayo GEN basket LOC TOP big 3-CL GEN noodle GEN bag and 2-CL GEN
suika ga hai-tte iru. Ai no kago ni wa chiisai yo-ttsu no men
watermelon NOM contain-TE IRU Ai GEN basket LOC TOP small 4-CL GEN noodle
no fukuro to mi-ttsu no satsuma mikan ga hai-tte iru.
GEN bag and 3-CL GEN satsuma mandarin NOM contain-TE IRU
"Mayo's basket has three large packs of noodles and two watermelons in it. Ai's basket has four small packs of noodles and three satsumas in it."

(9) Dochira no hito no kago ga yori ōku no kattamono o motte
Who GEN person GEN basket NOM more much GEN goods DIR carry
irudeshou?
stay
"Whose basket has more goods?"

Our consultants were asked to judge who had more of the item in question, and for each of the nouns that refer to collections of discrete entities in our study, the person whose possessions were larger in cardinality was judged to have the larger amount. Following Barner and Snedeker (2005) and Inagaki and Barner (2009), we interpret the results of these cardinality judgment task as indication that the nouns in question denote individuated entities that can be compared according to cardinality. Having this property, combined with the results of our study, suggest

that we have at least some evidence for thinking that there are at least some nouns in Japanese that have both of the hallmark properties of object mass nouns.

However, the nature of the differences between average acceptability judgments militates against any strong conclusions regarding whether or not Japanese has a class of object mass nouns. For example, the results were presented with the assumption that the judgments of sentences containing nouns that refer to discrete individuals, like *isu* ('chair'), constituted the baseline for acceptability, and that infelicity is determined by being deviant from this baseline by a statistically significant amount ($p < 0.001$, effect size > 0.8). However, the average judgment of the least acceptable sentences containing nouns that refer to collections of discrete entities like *hakimono* ('footwear') was not as low as the average judgment of the sentences containing nouns that refer to undifferentiated stuff like *yuki* ('snow'). If the average judgment of sentences containing nouns referring to undifferentiated stuff was assumed to be the baseline for infelicity, then the least felicitous sentences containing nouns referring to collections of discrete entities might be classified as *weakly infelicitous* on account of the fact that they they might not statistically pattern identically to the sentences containing nouns that refer to undifferentiated stuff.

In addition to the differences between the two least felicitous groups of sentences, the fact that judgments of sentences that contain nouns that refer to collections of discrete individuals were graded suggests that more than the felicity of nouns and the determiner that selects for count nouns was at issue in our acceptability judgment task. Differences in the complexity of sentences, for example length, lexical items, topic, syntax, etc., might have contributed to some sentences being rated more high or low than others. To investigate the cause of graded judgments and to possibly get a clearer picture of the countability of these nouns, we reviewed the test items with a different consultant than the one who provided the test sentences. This consultant noted several ways in which sentences might be judged to be at least partly unacceptable aside from infelicity of the determiner+noun composition. For example, some sentences were particularly long and could have included commas in order to make them easier to parse. The fact that these sentences were less straightforward to parse could have resulted in lower acceptability judgments. Additionally, certain sentences contained vocabulary of different registers, one which is more formal and one which is more casual, and this mismatch of register might have caused some participants in the study to give lower judgments. Low judgments could also be accounted for, in some cases, due to world knowledge conflicting with the information in the sentence. For example, one sentence described a piano store that sold hundreds of pianos on a single day, which participants might have thought to be very unlikely and therefore less acceptable. This review of test items showed that, across all conceptual classes of nouns, sentences could have been judged to have low acceptability for reasons other than the composition of the target noun and the determiner *nan-byaku to iu* ('hundreds of').

Given the number of reasons why each of the test sentences might have gotten a low judgment, it is less clear whether the results are indicative of genuine object mass nouns or not. When asked to help clarify this picture by reflecting on the felicity of the individual determiner+noun compositions, the consultant reported that both *shinamono* ('wares/articles') and *kattamono* ('shopped goods') seemed particularly strange composed with *nan-byaku to iu*, though the felicity of *hakimono* ('footwear') and *chōri-kigu* ('kitchenware') with this determiner is less clear. We take these results to suggest that, given the current state of research, *shinamono* ('wares/articles') and *kattamono* ('shopped goods'), seem to be the most promising candidates for being considered object mass nouns in Japanese. Further investigation is necessary to see if the results for *hakimono* ('footwear') and *chōri-kigu* ('kitchenware') and other nouns that refer to collections of discrete entities can be upheld in this and other morphosyntactic environments that

are diagnostic of the mass/count distinction in Japanese. What we can conclude from this study is that there is set of nouns that refer to collections of discrete entities that straightforwardly pattern with count nouns and others that seem like they might not when it comes to being felicitously combined with *nan-byaku to iu* ('hundreds of'). In other words, more investigation is required, both in terms of controlling for potential confounds and testing more grammatical environments.

4 Analysis

In this section, we outline what an analysis of the mass/count distinction in classifier languages would look like on the assumptions that (a) bare nouns are kind denoting, and (b) the mass/count distinction in classifier languages is not perfectly aligned with the substance/object distinction. Assumption (b) is, however, something that we concede is only weakly supported by the study we have reported. As for assumption (a), an analysis of classifier languages that assumes that nouns are kind denoting is attractive because, from this assumption, it arguably follows that classifier languages do not have obligatory number marking, allow bare arguments, and require the use of classifiers in counting constructions (Chierchia, 2015), see above. However, given that, standardly, formal theories do not distinguish between kinds for count predicates and kinds for mass predicates even if some do implicitly assume a distinction between kinds of objects and kinds of substances (in order to account for the distribution of shape-based classifiers, for instance), there is a *prima facie* tension between assumptions (a) and (b).

The *prima facie* tension between (a) and (b) can be alleviated, however, by adding to a theory a distinction between kinds which are associated with count predicates and mass kinds which are associated with predicates that cannot be grammatically counted. That is to say that we must draw a distinction between kinds that form count predicates under something along the lines of Chierchia's (2010; 2015) 'up' $^{\cup}$ operator, and kinds that form mass predicates under something along the lines of Chierchia's (2010; 2015) 'down' $^{\cap}$ operator. This sort of analysis is what we outline below, namely one in which: nouns in Japanese are kind denoting and so cannot be felicitously enter into counting constructions without an intervening classifier; but despite being kind denoting, nouns come out of the lexicon in some sense, 'count' or 'mass' thus accounting for the possibility of being infelicitous with determiners like *nan-byaku to iu* ('hundreds of'). The former point is pretty common in the literature (see Krifka, 1995; Chierchia, 1998a,b, 2010, 2015; Nemoto, 2005; Li, 2011; Rothstein, 2017, and others). The latter point is not exactly novel either insofar as a suggestion for a distinction between count and mass kinds is hinted at in the presented version of Chierchia (this volume). What is novel, is a theory that formally implements both of these points.

On the (albeit tentative) assumption of (b), above, other accounts of counting constructions in classifier languages do not quite have the right combination of features to capture the kind of grammatical patterns that our studies have suggested may be required, namely that Japanese nouns seem to have a grammaticized lexicalized mass/count distinction, and, of the mass nouns in Japanese, at least some appear to be object mass. A straight-forward application of Chierchia's (2010; 2015) theory, for example, is not possible, given that it is custom designed to exclude the possibility of object mass nouns from classifier languages (on this analysis, only number marking languages encode mass nouns as singleton properties, and only this feature licenses a copycat effect in which stably atomic predicates can come to have mass denotations).

On the other hand, analyses in which nouns in classifier languages come out of the lexicon as predicates (Muromatsu, 2003; Sudo, 2016; Erbach et al., 2017; Bale and Coon, 2014)[2] lose the

[2]Bale and Coon (2014) argue for this analysis for Chol (Mayan) in which classifiers are obligatory with some

above stated properties of being able to simply derive, for example, bare arguments and lack of obligatory number marking in classifier languages (see, Chierchia, this volume).

An analysis along the lines of Krifka (1995) is the closest to what we need. It assumes that nouns in classifier languages denote *concepts* (such that the set of concepts is a superset of the set of kinds), and that counting classifiers, semantically, play the dual role of mapping numerals to numerical modifiers, and shifting concepts 'up' to the set of object units that are realizations of them. Our strategy will be to follow this dual-purpose approach for classifiers in Japanese. However, our approach will also allow for the possibility that, despite the fact that bare nouns in Japanese are interpreted as kinds, some of those that denote physical objects are nonetheless (in a sense to be elaborated upon) mass nouns.

Here we use the same analysis as (Sutton & Filip, this volume) which is based on compositional DRT (Muskens, 1996) enriched with mereology along the lines proposed for domain-level plurality by Brasoveanu (2008). Our enrichment to this framework is to allow for discourse referents for properties. Specifically, we propose that (count) nouns make available a *counting base* property (see also Khrizman et al., 2015; Landman, 2016; Sutton and Filip, 2016a, amongst others), that specifies, for any given context, the set of entities that count as one for the relevant noun. (See, Sutton & Filip, this volume for the basis for this enrichment to compositional DRT).

Following Rothstein (2010); Sutton and Filip (2016a); Filip and Sutton (2017), we assume that count nouns are interpreted relative to a context i. For us, contexts license individuation schemas $\mathcal{S}_i$ that are applied to the extensions and counting bases of singular count nouns. Application of an individuation schema yields a quantized (QUA, Krifka 1989) predicate (for a brief discussion of why we opt for 'quantized relative to a context' as opposed to 'disjoint relative to a context', see Sutton & Filip, this volume):

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

For a context i and an individuation schema licensed by that context $\mathcal{S}_i$, $\mathcal{S}_i(P)$ is a maximally quantized subset of P ($\mathcal{S}_i(P) \subseteq_{max.QUA} P$):

(11) $$Q \subseteq_{max.QUA} P \leftrightarrow Q \subseteq P \wedge QUA(Q) \wedge \forall R[R \supseteq Q \wedge R \subseteq P \wedge QUA(R) \rightarrow R = Q]$$

Mass nouns, we assume, are not sensitive to the particular context of utterance when it comes to determining what counts as one. We model this by saturating the lexical entries of mass nouns with the null individuation schema ($\mathcal{S}_0$) which, semantically, denotes the identity function.

Similarly to Krifka's (1995) OU function, we assume that object denoting nouns include in their lexical semantics a function $\mathcal{O}$ such that, $\forall P[\mathcal{O}(P) \subseteq P]$ and $\mathcal{O}(P)$ is the set of entities which could count as one P on perceptual or functional grounds. Critically, for some predicates, $\mathcal{O}(P)$ doesn't denote a set that is a suitable input to the grammatical counting operation, since for some P, $\neg QUA(\mathcal{O}(P))$. In such cases, to get a count concept, we would need the application of an individuation schema, i.e., $\mathcal{S}_i(\mathcal{O})(P)$.

Finally, we assume the standard, 'down' operator (Chierchia, 2010, 2015, amongst others) as it applies at the DRS condition level, but also at the DRS level, here defined only for single condition DRSs. In (13), k is a discourse referent for a kind:

(12) $$^{\cap}(P) = \lambda w.\iota P(w)$$

(13) $$^{\cap'}(\lambda w.\lambda v.[\ |P(w)(v)|]) = \lambda w.[k|k = {}^{\cap}(P)(w)]$$

numericals and ungrammatical with others. It is not presupposed that this analysis applies to languages such as Japanese, Mandarin, etc.

For the inverse function,'up', we slightly adapt Chierchia's definition in a way to be made clear below that reflects the fact that we do not make an atomicity assumption. (In brief, we make use of the fact that kinds specify counting bases, the sets of entities that count as one, and 'up' maps kinds to those entities that are part of the upward closure of the counting base under mereological sum.)

Incorporating these ingredients into Compositional DRT, we can distinguish between lexical entries for (object denoting) count nouns such as *kutsu*, 'shoe(s)' (14) , and object denoting mass nouns such as *chōri-kigu*, 'kitchenware', (15). Both denote kinds, and both specify a counting base (and make available a discourse referent for the counting base, $cbase_p$). However, the context of utterance plays a role in determining the counting base of count kinds, but not mass kinds (since mass kinds are saturated with the null individuation schema).

(14) $$[\![\text{kutsu}]\!]^i = \lambda w \left[\begin{array}{|c|}\hline cbase_s \;\; k_s \\ \hline k_s = {}^{\cap}({}^*\mathcal{S}_i(\mathcal{O})(\mathsf{shoe}))(w) \\ cbase_s = \lambda v' \;\; \boxed{{}^*\mathcal{S}_i(\mathcal{O})(\mathsf{shoe})(w)(v')} \\ \hline\end{array}\right]$$

$[\![\text{chōri-kigu}]\!]^i$ has two key differences to $[\![\text{kutsu}]\!]^i$: (i) the counting base (cbase) for $[\![\text{chōri-kigu}]\!]^i$ is saturated with the null individuation schema, and so (ii) unlike $[\![\text{kutsu}]\!]^i$, the counting base for $[\![\text{chōri-kigu}]\!]$ does not specify a quantized set.

(15) $$[\![\text{chōri-kigu}]\!]^i = [\![\text{chōri-kigu}]\!] = \lambda w \left[\begin{array}{|c|}\hline cbase_k \;\; k_k \\ \hline k_k = {}^{\cap}({}^*\mathcal{S}_0(\mathcal{O})(\mathsf{kitchenware}))(w) \\ cbase_k = \lambda v' \;\; \boxed{{}^*\mathcal{S}_0(\mathcal{O})(\mathsf{kitchenware})(w)(v')} \\ \hline\end{array}\right]$$

However, we also want to allow for mass noun concepts to be shifted into countable ones (as part of the semantics of counting classifiers, for example). This can be done by applying a maximally quantizing individuation schema to a mass noun concept. We define this via the operation **S** in (16), the output of which is a count concept, namely, when applied to $[\![\text{chōri-kigu}]\!])^i$, it returns a kind denoting term for kitchenware that specifies a quantized set of items of kitchenware, relative to the context.[3]

(16) $$\mathbf{S}([\![\text{chōri-kigu}]\!])^i = \lambda w \left[\begin{array}{|c|}\hline cbase_k \;\; k_k \\ \hline k_k = {}^{\cap}({}^*\mathcal{S}_i(\mathcal{O})(\mathsf{kitchenware}))(w) \\ cbase_k = \lambda v' \;\; \boxed{\mathcal{S}_i(\mathcal{O})(\mathsf{kitchenware})(w)(v')} \\ \hline\end{array}\right]$$

We can now define the 'up' $^{\cup}$ operation as it applies to DRSs. Importantly, under our analysis, kinds have a standard extension, but *also* specify a counting base set. Hence $^{\cup}$ applied to a DRS for a kind ($^{\cup}(\mathbf{k})$) returns a property that denotes all entities and sums of entities in the counting

[3]We provide a simplified version of the operation here. Part of the operation, for example, would more fully be specified as ${}^{\cap}\mathcal{S}_i{}^{\cup\cap}({}^*\mathcal{S}_0(\mathcal{O})(\mathsf{kitchenware})_w$ which reduces to the main condition in (16), since for all P, $\mathcal{S}_i(\mathcal{S}_0(P) \leftrightarrow \mathcal{S}_i(P))$

base of the kind ($cbase_{\mathbf{k}}$).

(17)
$$^{\cup}(\mathbf{k}) = \begin{cases} \lambda w.\lambda v.\left[\begin{array}{c} cbase_{k'} \\ \hline {}^{*}cbase_{\mathbf{k}}(w)(v) \\ cbase_{k'} = cbase_{\mathbf{k}} \end{array}\right] & \text{if } k_w \text{ is defined} \\ \varnothing, & \text{otherwise} \end{cases}$$

For example, applied to $[\![\text{kutsu}]\!]^i$, we get the following, a properties of shoes and sums thereof:

(18)
$$^{\cup}[\![\text{kutsu}]\!]^i = \lambda w.\lambda v.\left[\begin{array}{c} cbase_s \\ \hline {}^{*}\mathcal{S}_i(\mathcal{O})(\text{shoe})(w)(v) \\ cbase_s = \lambda v' \left[\mathcal{S}_i(\mathcal{O})(\text{shoe})(w)(v')\right] \end{array}\right]$$

Following Krifka's (1995) proposal for numerical expressions in Mandarin, we assume that numerical expressions in Japanese denote numerals of type n. Sortal classifiers in Japanese, we propose, encode the following three roles: (i) They are functions from numerals and shift numerals (of type n) into numerical modifiers; (ii) They shift kind denoting terms into predicates using the $^{\cup}$ operator (presupposing that the predicate is object denoting); (iii) They apply $\mathbf{S}$ to the interpretation of the argument noun, thus shifting any object denoting mass predicate into a count predicate. These three things taken together allow for any object denoting noun in Japanese to be felicitously counted. Put simply, like in the account of Chierchia (2010), classifiers turn kinds into predicates (the right type of argument for a numerical modifiers), however, like the analyses Krifka (1995) and Bale and Coon (2014), sortal classifiers also shift numerals into numerical modifiers. Thirdly, unlike any other account, instead of merely shifting kinds into predicates, they shift object denoting count and mass kinds in to object denoting count predicates. The derivation for *chōri-kigu itsu-tsu* ('five pieces of kitchenware') is given in (19-21).

(19)
$$[\![\text{itsu}]\!] = 5$$

(20)
$$[\![\text{tsu}]\!]^i = \lambda n.\lambda k.\lambda v.\left[\begin{array}{c} \mu_{\#}(v, cbase_k) = 5 \\ \hline \left[\begin{array}{c} u \\ \hline cbase_k(\text{u}) \end{array}\right] \Rightarrow \left[inannimate(u)\right] \end{array}\right]; {}^{\cup}\mathbf{S}(k)(w)(x)$$

(21)
$$[\![\text{chōri-kigu itsu-tsu}]\!]^i = \lambda w.\lambda v.\left[\begin{array}{c} cbase_k \\ \hline {}^{*}\mathcal{S}_i(\mathcal{O})(kitchenware)(w)(v) \\ cbase_k = \lambda v' \left[\mathcal{S}_i(\mathcal{O})(kitchenware)(w)(v)\right] \\ \mu_{\#}(v, cbase_k) = 5 \\ \left[\begin{array}{c} u \\ \hline cbase_k(\text{u}) \end{array}\right] \Rightarrow \left[inannimate(u)\right] \end{array}\right]$$

If it is indeed the case that *nan-byaku to iu* ('hundreds of') selects for count kinds, then this can be modeled as a sensitivity to whether or not the counting base for the relevant noun is quantized. On the assumption that *nan-byaku to iu* ('hundreds of') means, *approximately some*

multiples of hundreds of and where $100n$ is a free variable that ranges over multiples of 100, then the semantics for *nan-byaku to iu* ('hundreds of') is that of an approximate number quantifier:

(22a) $$[\![\text{nan-byaku-to-iu}]\!]^i = \lambda k.\lambda w.\lambda v.\boxed{\begin{array}{c}\mu_{\#}(v, cbase_k(w)) \approx 100n \\ QUA(cbase_k(w))\end{array}}; {}^{\cup}(k)$$

(22b) $$[\![\text{nan-byaku-to-iu isu}]\!]^i = \lambda w.\lambda v.\boxed{\begin{array}{c}{}^{*}\mathcal{S}_i(\mathcal{O})(chair)(w)(v) \\ cbase_c = \lambda v'\boxed{\mathcal{S}_i(\mathcal{O})(chair)(w)(v')} \\ \mu_{\#}(v, cbase_c(w)) \approx 100n \\ QUA(cbase_c(w))\end{array}}$$

Nan-byaku to iu isu ('hundreds of chairs') denotes the set of sums of chairs that have a cardinality of around 100, 200, 300 etc. such that this cardinality is defined in terms of the counting base for individual chairs with the precondition that the counting base set is quantized. If nouns such as *chōri-kigu* ('kitchenware') denote mass kinds, then, since, by hypothesis, $[\![\text{chōri-kigu}]\!]^i$ would specify a non-quantized counting base, it would be infelicitous to compose *chōri-kigu* ('kitchenware') with *nan-byaku to iu* ('hundreds of') .

5 Conclusions

Our findings for Japanese raise the possibility that we may not be getting a complete picture from the standard view of classifier languages advocated in Chierchia (2010; 2015, this volume) and Muromatsu (2003), among others, upon which the mass/count distinction in *all* classifier languages is solely reflected in the syntax and semantics of their classifier systems. We suggest that there is some evidence for the nascent idea that Japanese has a grammaticized lexical mass/count distinction, which is systematically reflected in the syntax and semantics of at least some Japanese nouns. This would mean that Japanese, and perhaps other classifier languages, might be typologically closer than has been previously assumed to number marking languages like English which have a bona fide grammaticized lexical mass/count distinction. Such a conclusion, if right, would require some alterations to theories of classifier languages in which bare nouns refer to kinds, namely, one which can distinguish between kinds that are mapped to count predicates and kinds which are mapped to mass predicates. We outlined how such an analysis would look. In sum, while our empirical and theoretical results may not be entirely uncontroversial, they at least raise important questions about the nominal systems in classifier languages. Furthermore, we hope to have paved the way for future studies to develop a battery of tests with a wide range of quantifiers to tap into the putative mass/count status of nouns in Japanese, and other classifier languages.

References

Bale, A. and J. Coon (2014). Classifiers are for numerals, not for nouns: Consequences for the mass/count distinction. *Linguistic Inquiry 45*(4), 695–707.

Barner, D. and J. Snedeker (2005). Quantity judgments and individuation: Evidence that mass nouns count. *Cognition 97*(1), 41–66.

Brasoveanu, A. (2008). Donkey pluralities: plural information states versus non-atomic individuals. *Linguistics and Philosophy 31*(2), 129–209.

Bresnan, J. (2007). Is syntactic knowledge probabilistic? Experiments with the English dative alternation. *Roots: Linguistics in Search of its Evidential Base 96*, 77–96.

Bresnan, J. and M. Ford (2010). Predicting syntax: Processing dative constructions in American and Australian varieties of English. *Language 86*(1), 168–213.

Cheng, L. L.-S. and R. Sybesma (1998). Yi-wan tang, yi-ge tang: Classifiers and massifiers. *Tsing Hua journal of Chinese studies 28*(3), 385–412.

Chierchia, G. (1998a). Plurality of Mass Nouns and the Notion of "Semantic Parameter". In S. Rothstein (Ed.), *Events and Grammar: Studies in Linguistics and Philosophy Vol. 7*, pp. 53–103. Kluwer.

Chierchia, G. (1998b). Reference to kinds across language. *Natural Language Semantics 6*(4), 339–405.

Chierchia, G. (2010). Mass nouns, vagueness and semantic variation. *Synthese 174*(1), 99–149.

Chierchia, G. (2015). How universal is the mass/count distinction? Three grammars of counting. In Y. Li and W. Tsai (Eds.), *Chinese syntax: A cross-linguistic perspective*, pp. 147–177. Oxford University Press Oxford.

Chierchia, G. (this volume). Mass vs. count: Where do we stand? In T. Kiss, F. Pelletier, and H. Husíc (Eds.), *The Semantics of the Mass-Count Distinction*. Cambridge: Cambridge University Press.

Chomsky, N. (1964). Degrees of grammaticalness. In J. Fodor and J. Katz (Eds.), *The Structure of Language*, pp. 384–389. Prentice Hall Inc.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*. Lawrence Earlbaum Associates.

Doetjes, J. (2012). Count/mass distinctions across languages. In C. Maienborn, K. von Heusinger, and P. Portner (Eds.), *Semantics: An International Handbook of Meaning*, Volume 3, pp. 2559–2580. Walter de Gruyter.

Erbach, K., P. R. Sutton, H. Filip, and K. Byrdeck (2017). Object mass nouns in Japanese. In A. Cremers, T. van Gessel, and F. Roelofsen (Eds.), *Proceedings of the 21st Amsterdam Colloquium*, pp. 235–244. Institute for Logic, Language, and Computation at the University of Amsterdam.

Featherston, S. (2005). The decathlon model of empirical syntax. In *Linguistic evidence*, pp. 187–208. Walter de Gruyter.

Filip, H. and P. Sutton (2017). Singular Count NPs in Measure Constructions. *Proceedings of Semantics and Linguistic Theory (SALT) 27*, 340–357.

Gillon, B. S. (1999). The lexical semantics of English count and mass nouns. In *Breadth and depth of semantic lexicons*, pp. 19–37. Springer.

Iljic, R. (1994). Quantification in Mandarin Chinese: Two markers of plurality. *Linguistics 32*, 91–116.

Inagaki, S. and D. Barner (2009). Countability in absence of count nouns: Evidence from Japanese quantity judgments. *Studies in language sciences 8*, 111–125.

Keller, F. (2000). *Gradience in grammar: Experimental and computational aspects of degrees of grammaticality*. Ph. D. thesis, University of Edinburgh.

Khrizman, K., F. Landman, S. Lima, S. Rothstein, and B. R. Schvarcz (2015). Portion readings are count readings, not measure readings. In *Proceedings of the 21st Amsterdam Colloquium*.

Krifka, M. (1989). Nominal reference, temporal constitution and quantification in event semantics. In R. Bartsch, J. F. A. K. van Benthem, and P. van Emde Boas (Eds.), *Semantics and Contextual Expression*, pp. 75–115. Foris Publications.

Krifka, M. (1995). Common nouns: A contrastive analysis of English and Chinese. In G. Carlson and F. J. Pelletier (Eds.), *The Generic Book*, pp. 398–411. Chicago University Press.

Landman, F. (2011). Count nouns – mass nouns, neat nouns – mess nouns. *Baltic International Yearbook of Cognition, Logic and Communication 6*(1), 1–67.

Landman, F. (2016). Iceberg semantics for count nouns and mass nouns: The evidence from portions. *The Baltic International Yearbook of Cognition Logic and Communication 11*, 1–48.

Li, X.-P. (2011). *On the semantics of classifiers in Chinese*. PhD Thesis, Bar-Ilan University.

Link, G. (1983). The logical analysis of plurals and mass terms. In *Meaning, Use, and Interpretation of Language*, pp. 127–146. Walter de Gruyter.

Mahowald, K., P. Graff, J. Hartman, and E. Gibson (2016). Snap judgments: A small n acceptability paradigm (snap) for linguistic acceptability judgments. *Language 92*(3), 619–635.

Muromatsu, K. (2003). Classifiers and the count/mass distinction. In *Functional Structure(s), Form and Interpretation: Perspectives from East Asian languages*, pp. 65–96. Routledge.

Muskens, R. (1996). Combining Montague Semantics and Discourse Representations. *Linguistics and Philosophy 19*, 143–186.

Nemoto, N. (2005). On mass denotations of bare nouns in Japanese and Korean. *Linguistics 43*(2), 383–413.

Newmeyer, F. J. (2007). Commentary on Sam Featherston, 'Data in generative grammar: The stick and the carrot'. *Theoretical Linguistics 33*(3), 395–399.

Rothstein, S. (2010). Counting and the mass/count distinction. *Journal of Semantics 27*(3), 343–397.

Rothstein, S. (2017). *Semantics for Counting and Measuring*. Cambridge University Press.

Soja, N., S. Carey, and E. S. Spelke (1991). Ontological categories guide young children's inductions of word meaning: Object terms and substance terms. *Cognition 38*(2), 179–211.

Sorace, A. and F. Keller (2005). Gradience in linguistic data. *Lingua 115*(11), 1497–1524.

Spelke, E. S. (1985). Perception of unity, persistence, and identity: Thoughts on infants' conceptions of objects. In J. Mehler and R. Fox (Eds.), *Neonate cognition: Beyond the blooming buzzing confusion*, pp. 89–113. Erlbaum.

Sprouse, J. (2007). Continuous acceptability, categorical grammaticality, and experimental syntax. *Biolinguistics 1*, 123–134.

Sudo, Y. (2015). Countable nouns in Japanese. *Proceedings of WAFL 11*(1), 1–11. To appear.

Sudo, Y. (2016). The semantic role of classifiers in Japanese. *Baltic International Yearbook of Cognition, Logic and Communication 11*(1), 1–15.

Sutton, P. R. and H. Filip (2016a). Counting in context: Count/mass variation and restrictions on coercion in collective artifact nouns. *Semantics and Linguistic Theory 26*(0), 350–370.

Sutton, P. R. and H. Filip (2016b). Mass/count variation: A mereological, two-dimensional semantics. *Baltic International Yearbook of Cognition, Logic and Communication 11*(1), 1–45.

Sutton, P. R. and H. Filip (2018). Restrictions on subkind coercion in object mass nouns. In R. Truswell, C. Cummins, C. Heycock, B. Rabern, and H. Rohde (Eds.), *Proceedings of Sinn und Bedeutung 21*, pp. 1195–1213. University of Edinburgh.

Sutton, P. R. and H. Filip (2019). The count/mass distinction for 'granular' nouns. In H. Filip (Ed.), *Counting and Measuring in Natural Language*, pp. 375–415. Cambridge University Press.