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Countability in Absence of Count Syntax: Evidence from Japanese Quantity Judgments

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Abstract

We investigated the interaction of mass-count syntax and item-specific word meanings by comparing quantity judgments in two mass-count languages (English, French) and a classifier language (Japanese). Speakers of both English and Japanese based quantity judgments on volume for substance-mass terms (e.g., judging two large portions of toothpaste to be *more toothpaste* than six tiny portions) but on number for count nouns (e.g., *shoes*) and object-mass nouns (e.g., judging that six small pieces of furniture are *more furniture* than two large pieces). For words that can be used in either mass or count syntax in English (e.g., *string*), English quantity judgments shifted as a function of mass-count syntax (i.e., based on number when used in count syntax, but on volume when used in mass syntax), while approximately 50% of Japanese quantity judgments were based on number, falling between English mass and count judgments. For words that are mass nouns in English but count nouns in French (e.g., *spinach*), quantity judgments shifted as a function of syntax between these languages, while Japanese judgments were not different from the count judgments of French speakers, and were based mainly on number. We argue that, across languages, mass-count syntax is not necessary for nouns to specify individuation, but acts to select from among universally available lexical meanings.

Introduction

How does language affect our conceptual representations of objects and events? Do all humans share a universal conceptual repertoire, or does language actually supply certain concepts? The answers to these questions are of interest not only to the project of understanding how humans acquire conceptual knowledge, but are also essential to understanding how different components of language (e.g., syntax and semantics) are related, and what burden each component bears in the generation of linguistic meaning.

A well documented test case for investigating the relation between language and conceptual representation is the mass-count distinction. In English, count nouns (e.g., *cat*, *table*) can be used in either the singular or plural (*a cat*, *some cats*), can occur with cardinal numbers (e.g., *two tables*), and permit use with quasi-cardinal determiners like *these*, *those*, and *many* (e.g., *many tables*). Mass nouns (e.g., *sand*, *dirt*), however, can occur in none of these contexts (e.g., **some sands*, **two dirt*s), and sometimes occur with quantifiers like *much* and *little* (e.g., *not much milk*). Though most researchers agree about the basic syntactic facts of the mass-count distinction, there is significant disagreement about its effect on the meaning of nouns.

In an early proposal, Quine (1960) set forth a radical Whorfian account of the mass-count distinction in English. According to Quine, the child's production of mass-count morpho-syntax is the first sure evidence that the child represents objects as individual entities that persist in time and space. This is because language provides a hypothesis space for "dividing reference" – splitting the world up into individuals. Quine's view rested on a particular theory of the semantics of the mass-count distinction that is still widely held today, both by linguists and psychologists (Bloom, 1994, 1999; Gordon, 1985, 1988; Landman, 1991; Link, 1998; Macnamara, 1982; Wisniewski, Imai, & Casey, 1996). According to this view, count nouns

divide reference, and supply conceptual criteria for splitting their denotations into individuals. In contrast, mass nouns fail to divide reference, and leave the speaker to construe a word's reference as so much "scattered stuff." Count nouns individuate, but mass nouns do not.

Studies of young infants and children learning English have largely discounted Quine's developmental claim about the origin of the object concept. Very young pre-linguistic infants, who have not acquired mass-count syntax, can represent objects, track their identity over space and time, represent their continuing existence under occlusion, and even compare sets of occluded objects on the basis of one-to-one correspondence (see Carey & Xu, 2001; Feigenson & Carey, 2003; Feigenson, Carey, & Hauser, 2002; Spelke, 1985; Wynn, 1992). In contrast, such representations are not available for tracking portions of non-cohesive substances, such as sand (see Huntley-Fenner, Carey, & Solimando, 2002; see also Soja, Carey, & Spelke, 1991, for evidence that children respect an object-substance distinction in word learning prior to acquiring mass-count syntax, and Imai & Gentner, 1997, for evidence from Japanese children).

Quine's linguistic hypothesis that count nouns individuate but mass nouns do not has also come under attack. Recent evidence has instead supported the idea (Chierchia, 1998; Gillon, 1992, 1999) that both count and mass nouns can denote sets of individuals. For example, using the quantity judgment method, Barner and Snedeker (2005) found that while all count nouns (e.g., *shoes*) denote individuals, mass nouns can denote substances (*mustard*) or individuals (*furniture*). In their study, English-speaking adults and 4-year-olds judged that six small shoes are *more shoes* than two large shoes, but that two large portions of mustard is *more mustard* than six small portions. Also, for mass-count flexible nouns like *string* and *stone*, quantity judgments were based on number when the words were presented to participants in count syntax (*Who has more strings?*) but on volume when the words were presented in mass syntax (*Who has more*

string?). Finally, for object-mass nouns like *furniture* and *jewelry*, both children and adults based quantity judgments systematically on number, and judged that six small pieces of furniture are *more furniture* than two large pieces. Thus, while count syntax always led to quantity judgments based on number, mass syntax did not force one particular dimension of comparison and permitted judgments based on either number or volume. Subsequent studies have found this same asymmetry between mass and count interpretations by testing subjects with novel words using quantity judgment and a word extension task (Barner & Snedeker, 2006; also shown later by Imai & Mazuka, 2007). Also, similar results have been found with action words that can be used in either mass or count syntax (Barner, Wagner, & Snedeker, 2008). In each case, participants base quantity judgments on number for nouns used in count syntax. However, they are more likely to base quantity judgments on number for mass nouns that denote complex objects relative to those that denote simpler ones, and for mass nouns that denote punctual events (e.g., *some jumping*), relative to those that denote durative events (e.g., *some sleeping*).

These results are important for two reasons. First, the fact that mass nouns can individuate in English suggests that count syntax may be unnecessary for specifying individuation on nouns in languages that lack count syntax altogether. As a result, there may be no reason to predict Whorfian cross-linguistic effects whereby speakers of classifier languages, like Japanese, are less likely to think of things in the world as individuals relative to speakers of mass-count languages like English (e.g., see Lucy, 1992; Quine, 1960; Imai & Gentner, 1997, for discussion). If nouns can individuate without count syntax in English, they should do so equally well in classifier languages like Japanese.

Second, the asymmetry raises the question of exactly how mass-count syntax interacts with lexical representations to determine the meaning of noun phrases. For mass nouns like

furniture and *mustard*, mass syntax appears to have little effect on meaning. Item-specific lexical information, perceptual properties of referents, and perhaps other factors not related directly to language (e.g., cultural-specific uses for objects) may each affect the measuring dimensions of nouns used in mass syntax (see Barner & Snedeker, 2006; Smith, Colunga, & Yoshida, 2003; Samuelson & Smith, 1999; Yoshida & Smith, 2003a, b). For other words, like *string* and *stone*, syntax appears to systematically shift which aspects of an entity are referred to (e.g., its status as an individual, or its substance). The expression *some strings* refers to individual entities, whereas *some string* refers to the stuff from which these entities are made.

There are at least two ways to explain why only some words shift meaning with shifts in mass-count syntax. Barner and Snedeker (2005) propose that some lexical items, but not others, come equipped with a conceptual principle of individuation. In languages like English, where mass-count syntax is obligatory, the expression of this conceptual information must be licensed grammatically by a grammatical feature (IND) that is either contributed by count syntax or is specified lexically on particular mass nouns. According to this proposal, flexible words like *string* and *stone* have a conceptual principle of individuation and require count syntax for its expression, since the grammatical feature IND is not specified lexically. These words also provide a second, unindividuated interpretation, which is expressed in these cases by use in mass syntax (e.g., *some string* is a quantity of unindividuated stuff). Words like *furniture* and *jewelry*, on the other hand, are lexically specified for IND, and as a result they refer to individuals when used in mass syntax but cannot be used in count syntax in English (see Barner & Snedeker, 2005, for details). These words do not have alternate interpretations associated with them (e.g., there is no uniform substance from which furniture is made), and thus they never occur as mass nouns that quantify over continuous stuff. When mass-count syntax varies, meaning is unable to vary

with it.

A second solution stems from the Quinian view that syntax leads speakers to posit semantic distinctions. Specifically, words that can be used flexibly may contrast in meaning when used in mass and count syntax because syntax actually invites the speaker to posit different meanings for each form (see Booth & Waxman, 2003, Waxman & Braun, 2005, for a proposal of this kind). Rather than beginning with a multi-faceted concept that supports both individuated and unindividuated interpretations, children learning language may initially posit only one interpretation or “construal” per lexical item, and posit additional interpretations for each new syntactic expression of a word. Thus, for a word like *string* children may begin by assuming that the word does not individuate (e.g., it refers to a kind of substance). When they hear the word used in two contrasting frames, however, they may posit a second meaning, for example, assigning the existing meaning to mass syntax, and the new individuated meaning to count syntax.

Here, we contrasted these possibilities by investigating how both lexical semantics and syntactic frames contribute to the meaning of mass and count noun phrases, in a cross-linguistic study of Japanese, English, and French. We were interested in (1) how nouns are interpreted in absence of mass-count syntax in Japanese, and (2) how their meanings differ in the context of English and French mass-count syntax. These questions are relevant not only to resolving how syntax and lexical representations combine to create noun phrase meanings, but also to the Whorfian question of whether acquiring count syntax changes the way speakers think about objects in the world.

Using the methods of Barner and Snedeker (2005), we compared quantity judgments for nouns in Japanese, which lacks mass-count syntax, with nouns in English and French. We

hypothesized that if nouns which shift meaning in English mass-count syntax (e.g., *string*, *stone*) have a different underlying lexical structure than nouns that do not shift meaning (e.g., *furniture*, *mail*), then this difference should be evident in the absence of mass-count syntax (i.e., in Japanese). In Japanese, words like *string* may support multiple interpretations that are differentially selected by mass or count syntax, whereas words like *furniture*, which always individuate, may only support one interpretation. However, if mass-count syntax acts as an invitation to posit new and contrasting meanings, and changes the way speakers think about objects, nouns in Japanese may only support one, single interpretation and may be less likely to individuate than equivalent nouns in English or French.

To test these possibilities, we asked the following questions:

1. Does the presence of count syntax change the interpretation of canonical count nouns in English (e.g., *shoe*) relative to equivalent nouns in Japanese (e.g., *kutu*), which lacks count syntax?
2. Are words that denote substances as mass nouns in English (e.g., *mustard*) less likely to individuate in Japanese (e.g., *karasi*)?
3. Are words that denote individuals when used as mass nouns in English (e.g., *furniture*) less likely to individuate in Japanese (e.g., *kagu*)?
4. Do words that appear flexibly in both mass and count syntax in English (or that differ in mass-count status across English and French) support a single interpretation in Japanese, or do they support both individuated and unindividuated interpretations as in English?

Below, we test these questions in three experiments.

Experiment 1

The first experiment compared the interpretation of count nouns that denote objects (e.g., *cup*), mass nouns that denote non-solid substances (e.g., *mustard*), and mass nouns that denote solid objects (e.g., *furniture*) in speakers of Japanese and English. The purpose of the study was to determine whether the presence of mass-count syntax in English caused cross-linguistic differences in the interpretation of these words.

Method

We tested 22 undergraduates at Osaka Prefecture University and Osaka University of Foreign Studies and 20 Harvard undergraduates with object-denoting count nouns (*kutu* ‘shoe,’ *roosoku* ‘candle,’ *sara* ‘plate,’ *kappu* ‘cup’), substance-denoting mass terms (*karasi* ‘mustard,’ *ketyappu* ‘ketchup,’ *hamigakiko* ‘toothpaste,’ *piinattubataa* ‘peanut butter’), and object-denoting mass terms (*kagu* ‘furniture,’ *hoosekirui* ‘jewelry,’ *yuubinbutu* ‘mail,’ *irui* ‘clothing’). English speakers were asked to make quantity judgments for nouns used with either mass or count syntactic cues (depending on the word class), while Japanese speakers were asked to make quantity judgments without mass-count syntax (since the distinction is absent in Japanese). For the count and object-mass items, participants were presented with two characters, one who had two large objects, the other who had six tiny objects. The two large objects always had a greater overall volume than the six tiny objects. For example, for the noun *shoe* subjects were shown a character with two large shoes and another with six tiny shoes (where the six shoes amounted to less overall stuff than the two large ones). For substance-mass items, one character had two large portions of stuff (e.g., *toothpaste*) and the other had six tiny portions. For each word, participants were asked which character had more (English: *Who has more shoes?*, Japanese: *Dotira-no hito-ga yori-ookuno kutu-o motte-iru desyoo?*). See Figures 1-3 in the Appendix for example test

items.

Figure 1. English and Japanese quantity judgments for count nouns (*shoe*), substance mass nouns (*mustard*), and object mass nouns (*furniture*).

Results

The results are shown in Figure 1. There was a main effect of word type, $F(2, 80)=1066.18, p < .001$, but no effect of language, $F(1, 40)=.87, p > .35$, and no interactions, $F(2, 80)=1.58, p > .21$. For count nouns English speakers based quantity judgments on number 98% of the time, compared to 92% for Japanese speakers. English speakers based 0% of quantity judgments on number for substance-mass terms compared to 2% for Japanese speakers. Finally, English speakers based 94% of judgments on number for object-mass terms, compared to 90% for Japanese speakers. Thus, syntax had no significant effect on interpretation. Mass syntax did not cause English speakers to base judgments on mass or volume for nouns like *furniture* and *jewelry*. Also, the lack of count syntax in Japanese caused no difference between Japanese and

English speakers.

Experiment 2

The second experiment investigated words that vary in mass-count status in English (e.g., *string*, *stone*), to determine whether Japanese speakers also assign multiple interpretations to these words. If syntax is required for generating multiple meanings for a word, then Japanese speakers, unlike English speakers, should assign a single meaning to such words. However, if multiple meanings arise independent of syntax, then Japanese speakers should also be willing to assign multiple meanings to particular words, and treat them as ambiguous in meaning.

Methods

In Experiment 2, we tested 22 undergraduates at Osaka Prefecture University and Osaka University of Foreign Studies and 20 Harvard undergraduates with nouns that can appear as either mass or count nouns in English (*isi* ‘stone(s),’ *himo* ‘string(s),’ *tyokoreeto* ‘chocolate(s),’ *kami* ‘paper(s)’). Again, participants were presented with two characters: one who had two large items (e.g., two strings), the other who had six tiny items (e.g., six strings). English speakers were given quantity judgments with either mass or count syntactic cues between subjects (e.g., *Who has more string?* or *Who has more strings?*). Japanese speakers were again presented words without mass-count syntax (e.g., *Dotira-no hito-ga yori-ooku-no himo-o motte-iru desyoo?* ‘Which person has more string?’). See Figure 4 in the Appendix for example test items.

Results

The results are shown in Figure 2. A one-way ANOVA revealed an overall effect of language groups, $F(2, 39)=30.21, p < .001$. Scheffé tests showed that English speakers based significantly more judgments on number when words were presented in count syntax (100% of the time) than in mass syntax (13%; $p < .001$). However, Japanese speakers based around half of their judgments on number (48% overall). This was significantly different from English judgments for count syntax ($p < .001$), and for mass syntax ($p < .01$). These results indicate that Japanese speakers' judgments for nouns that are mass-count flexible in English fall almost exactly between the mass and count judgments of English speakers. Apparently these words are treated as ambiguous, as though both meanings encoded by English mass-count syntax are available to Japanese speakers.

Figure 2. English and Japanese quantity judgments for mass-count flexible nouns (*string(s)*, *stone(s)*).

Experiment 3

The third experiment extended the logic of Experiment 2 to investigate words that vary in mass-count status cross-linguistically, in English and French. Words like *spinach*, *toast*, and *hair*

are used as mass nouns in English, whereas equivalent words are used in count syntax in French. By testing Japanese speakers with these words, we asked what effect mass-count syntax has on word interpretation cross-linguistically.

Methods

In Experiment 3, we tested 22 undergraduates at Osaka Prefecture University and Osaka University of Foreign Studies, 20 Harvard undergraduates, and 16 speakers of French (students at College Montmorency in Laval, Québec) with nouns that appear in mass syntax in English (*spinach*, *hair*, *pasta*, *toast*) but are used as count nouns in French (*épinards*, *cheveux*, *pates*, *rotis*). Again, participants made quantity judgments for comparisons of two large items versus six tiny items. English speakers were given quantity judgments with mass syntactic cues and French speakers with count syntactic cues, while Japanese speakers were again given no cues to mass-count syntax (*hoorensou* ‘spinach,’ *kami* ‘hair,’ *pasuta* ‘pasta,’ *toosuto* ‘toast’). See Figure 5 in the Appendix for example test items.

Results

The results are shown in Figure 3. A one-way ANOVA revealed an overall effect of language groups, $F(2, 55)=24.21$, $p < .001$. Scheffé tests showed that English speakers based significantly fewer judgments on number (11% of the time) than Japanese speakers (68%; $p < .001$) and French speakers (77%; $p < .001$). However, there was no significant difference between Japanese and French speakers ($p > .72$). Thus, for English and French speakers, syntax had significant effect on their interpretation of cross-linguistic variable nouns such as *spinach/épinards*, whereas in the absence of mass-count syntax, Japanese speakers based their judgments largely on number, much like French speakers.

Figure 3. English, Japanese, and French quantity judgments for cross-linguistic variable nouns (*spinach*, *pasta*).

Discussion

For count nouns (*kappu* ‘cup’), substance mass nouns (*karasi* ‘mustard’), and object-mass nouns (*kagu* ‘furniture’), Japanese quantity judgments did not differ from those of English speakers, indicating that nouns in Japanese can individuate to the same extent as equivalent nouns in English despite lacking count syntax. Item-specific information (e.g., lexical semantics, perceptual properties of referents, etc.) is sufficient to support individuation by nouns. Adding count syntax does not change the interpretation of these words.

For mass-count flexible nouns (*himo* ‘string(s)’), English speakers based quantity judgments on number for count uses and on volume for mass uses, replicating the finding of Barner and Snedeker (2005). For equivalent words, Japanese speakers based quantity judgments on number about 50% of the time—about midway between the count and mass judgments of English speakers. This suggests that both number and volume are available as dimensions of

measurement for these words in Japanese, despite the lack of a mass-count contrast. This result is consistent with the idea that certain lexical items support multiple construals of objects in the world, and that in English these different construals can be selected by mass-count syntax.

For cross-linguistically variable nouns (*spinach/épinards/hoorensou*), English speakers, for whom the words are mass nouns, based judgments on volume, French speakers, for whom these words are count nouns, based judgments on number, and Japanese speakers, in absence of mass-count syntax, based judgments mostly on number as well. This again indicates that both number and volume are available as dimensions of measurement for these words, and that mass-count variation between English and French leads to differences in quantity judgments. The fact that Japanese judgments patterned with French rather than English also provides strong support for the idea that Japanese nouns can individuate in absence of count syntax, and can even do so to a greater degree than equivalent nouns in a mass-count language such as English.

Based on these findings, we offer the following conclusions:

1. In the absence of mass-count syntax, the denotation of Japanese nouns is determined by item-specific information. Items differ in interpretation as a function of the nature of the things they refer to, and therefore can individuate without explicit grammatical marking of number.
2. Count syntax specifies quantification based on number (e.g., *strings* in English, *épinards* ‘spinach’ in French). Therefore, its interpretation is relatively uniform. Count nouns always denote individuals and quantify by number.
3. Mass syntax does not specify a dimension of measurement, leaving this to item-specific information. Therefore, mass syntax is consistent with both number (e.g., *furniture*) and volume (e.g., *mustard*).

There are two remaining questions to be addressed. First, why did Japanese speakers base their judgments for cross-linguistic variable nouns (e.g., *hoorensoo* ‘spinach’) mostly on number, despite volume being a good candidate dimension for judgment, as shown by English judgments? Based on the results of this study, we cannot offer a definitive answer to this question. However, we offer the following possibility:

4. Words that have both number and mass interpretations available (i.e., mass-count flexible nouns like *string(s)* and cross-linguistic variable nouns like *spinach*) may favor one interpretation to another in absence of mass-count syntax (depending on their item-specific information).

Consistent with this possibility, Japanese speakers’ judgments of ambiguous nouns (e.g., *isi* ‘stone,’ *hoorensoo* ‘spinach’) seem to vary on an item-by-item basis. As shown in Table 1, Japanese speakers’ number-based judgments of mass-count flexible nouns are not uniformly at 50%, and their judgments of cross-linguistic variable nouns are not uniformly number-based.

Table 1. Japanese Number-based Judgments for Individual Mass-count Flexible Nouns

Items	Judgment based on number (%)
<i>isi</i> ‘stone’	72.7
<i>tyokoreeto</i> ‘chocolate’	13.6
<i>kami</i> ‘paper’	45.5
<i>himo</i> ‘string’	59.1
<i>hoorensoo</i> ‘spinach’	59.1
<i>kami</i> ‘hair’	81.8
<i>pasuta</i> ‘pasta’	54.5
<i>toosuto</i> ‘toast’	77.3

and Cross-linguistic Variable Nouns in Percentages

The second question is this: If mass syntax does not specify a dimension of measurement,

why does the interpretation of English mass nouns *not* simply mirror that of the corresponding Japanese nouns, especially in the case of mass-count flexible nouns (e.g., *himo* ‘string’) and cross-linguistic variable nouns (e.g., *hoorensou* ‘spinach’)? Although our data cannot directly address this, we offer one possible suggestion:

5. When a lexical item is clearly ambiguous, providing conceptual or perceptual information that supports measuring both by volume and number, children learning a mass-count language may assume that the individuated interpretation is reserved for count syntax. Therefore, they may conclude that the mass noun being acquired quantifies by volume. This bias in how syntax and semantics are mapped can be overridden by direct evidence to the contrary, as when nouns are used in mass syntax to refer to sets of individuals (see Barner & McKeown, 2005).

In conclusion, this investigation supports the idea that individuation can be encoded by nouns cross-linguistically in absence of count syntax, and that for some words count syntax has no effect on interpretation. Rather than being required to generate individuated interpretations for nouns, count syntax may simply select between universally available meanings of nouns. Count syntax, in this context, is not a Quinian invitation to form object-based categories. Instead, it disambiguates between pre-existing construals, and specifies that an entity is being referred to as an individual. Japanese speakers access the same meanings as speakers of other languages, but lack explicit syntactic cues for disambiguating these meanings when interpreting noun phrases.

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Appendix

Example Test Items

English: *Who has more shoes?*

Japanese: *Dottira-no hito-ga yori-ookuno kutu-o motte-iru desyoo?*

Figure 1. Example test items for count nouns.

English: *Who has more mustard?*

Japanese: *Dotira-no hito-ga yori-ookuno karasi-o motte-iru desyoo?*

Figure 2. Example test items for substance-mass nouns.

English: Who has more furniture?

Japanese: *Dotira-no hito-ga yori-ookuno kagu-o matte-iru desyoo?*

Figure 3. Example test items for object-mass nouns.

English: *Who has more string(s)?*

Japanese: *Dotira-no hito-ga yori-ookuno himo-o motte-iru desyoo?*

Figure 4. Example test items for mass-count flexible nouns.

English: *Who has more spinach?*

Japanese: *Dotira-no hito-ga yori-ookuno hoorensoo-o matte-iru desyoo?*

French: *Qui a le plus d'épinards?*

Figure 5. Example test items for cross-linguistic variable nouns.