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Semantic Triggers, Linguistic Variation and the Mass-Count Distinction¹

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1. Introduction

Although most languages allow nouns to be used with numerals to express cardinality, they differ significantly in how they grammatically encode such expressions. Some languages, like English, require count syntax whereas others, like Mandarin, lack count syntax and typically use classifiers. Here, we ask what appears to be a simple question: how do children determine whether their language makes a distinction between mass and count syntax? This question reveals itself to be subtle and difficult when languages beyond English and Mandarin are considered. We argue that prototypical syntactic and morphological differences between mass-count and classifier languages are not constitutive of this typological difference. The use of classifiers, the combination of numerals with bare nouns, and even plural morphology can occur in both mass-count and classifier languages. As a result,

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such features cannot be sufficient for determining whether or not a language has count syntax. Instead, we argue that it is the relation of these syntactic structures to their semantic interpretations that differentiates languages and guides acquisition. Only mass-count languages can specify exclusive reference to singularities in absence of classifiers or measure words.

This proposal is laid out in three sections. Section 2 reviews the syntactic and semantic differences between mass-count languages and classifier languages, using English and Mandarin as a starting point. Our main conclusion, following many others, is that English makes a mass-count distinction that is not paralleled in classifier languages like Mandarin. Unlike classifiers, the presence or absence of count syntax in English fundamentally shifts the interpretation of individual nouns, whether known or novel. However, despite this difference, Mandarin and English both allow non-count nouns to denote sets of individuals. In Mandarin, any noun that has a count-noun counterpart in English (e.g., *cup*) can be used with or without classifiers to refer to sets of individuals. In English, many mass nouns (like *furniture* and *equipment*) denote individuals. Critically, however, both types of nouns contrast with singular count nouns, which are exclusive to English, and are typically used to talk about single individuals.

Having outlined the cross-linguistic differences between mass-count and classifier languages, Section 3 reviews the evidence of when children acquire count syntax, plural morphology, number words, and classifiers cross-linguistically.

Finally, Section 4 explores the evidence that children might potentially use to determine whether their language makes a mass-count distinction. First, we consider two syntactic cues (pluralization and classifier usage), and argue that each fails to explain how children differentiate mass-count languages and classifier languages early in acquisition. Second, we argue that children are sensitive to semantic differences between nouns, and in particular can use singular reference to infer the presence of count nouns. Our hypothesis is that consistent reference to singularities supports an inductive inference in English that some noun phrases with singular agreement (e.g., those that will eventually be acquired as

singular count nouns) can only denote singleton sets. In other languages, no such consistent evidence is provided for non-plural nouns, and thus no induction regarding singular-plural status is supported. This difference, we argue, is the basis for children's inference that languages like English have count syntax, whereas languages like Mandarin, Armenian, and others do not.

2. English, Mandarin and the Mass-Count Distinction

Mass-count languages like English are typically distinguished from classifier languages according to a cluster of morphological and syntactic differences. In English, count nouns like *chair*, in contrast to mass nouns like *furniture*, demonstrate a singular vs. plural contrast, can occur directly with numerals, and can be modified by quasi-cardinal and distributive quantifiers (see 1a-d).

- (1) a. A chair / some chairs.
- b. One chair / several chairs / each chair
- c. *A furniture / *some furnitures
- d. *One furniture / *several furniture(s) / *each furniture.

Furthermore, mass nouns can be used as the complement of measure words in their bare, singular form whereas count nouns require plural marking (see 2a&b).

- (2) a. Two tons of furniture
- b. Two tons of chairs / *Two tons of chair

Similarly, there are certain quantifiers, such as the comparative quantifiers, that require plural marking for count nouns but not mass-nouns (see 3a&b).

- (3) a. More furniture / *more furnitures
- b. More chairs / *more chair

As demonstrated by the contrasts between *furniture* and *chair* in (1) through (3), these distinctions in English are not a simple reflection of a nominal ontology (individuated/divided denotations versus homogeneous/substance-like denotations). Although the things being talked about and referred to by

furniture and *chair* are relatively similar (individual items of furniture), their syntactic distribution is not.

In contrast to English, classifier languages like Mandarin lack many of these distinctions. Most nouns in Mandarin cannot co-occur directly with number words.² Rather they require classifiers, words akin to English measure words like *piece of* and *grain of* - see the examples in (4).

(4) Mandarin

- a. liang li mi / *liang mi
two CL rice / two rice
'two grains of rice'
- b. liang ge haizi / *liang haizi
two CL children / two children
'two children'

Unlike English, Mandarin has a rich system of such classifiers which can be divided into sortal (as in 4) versus mensural, or non-sortal, subcategories (*ping* 'bottle', *bei* 'cup', *dai* 'bag', *xiang* 'box', etc.). See Tang (2005), Cheng & Sybesma (1999), and Senft (2000) for a discussion.

Another difference between English and Mandarin concerns pluralization. Mandarin does not make an obligatory singular/plural distinction.³ In rare cases where plural marking occurs (or pseudo plural marking as it is sometimes called in the literature -- see Iljic, 1994; Li, 1999; Cheng & Sybesma, 1999; Tang, 2004, 2005), there is no singular counterpart. Nouns that lack plural marking can also refer to plural sets. In addition, there are no quasi-cardinal quantifiers in Mandarin that apply exclusively to one class of noun. Thus, Mandarin nouns exhibit many of the hallmarks of English mass nouns.

² A notable exception may be *ren* (person/people).

³ Mandarin does have a plural marker, namely *men*. However this marker is restricted to animate beings and is only obligatory on personal pronouns (e.g., *wo* = I/me, *wo-men* = we/us).

Despite these differences, it is important to note that Mandarin *does* make some distributional distinctions that reflect a nominal ontology. For example, certain classifiers, like *ge* in (3), require that their nominal complements have individuated denotations – in other words, that the complement nouns can be used to refer to individuals – see Cheng & Sybesma (1999). Unlike in English, this distributional difference is tied closely to the nature of the nominal denotation. There are no minimal pairs like *furniture* vs. *chair* in Mandarin: i.e., pairs of nouns that can both be used to refer to individuals but have distinct syntactic distributions. Sometimes languages that have these ontologically-based distinctions have been said to demonstrate a mass-count contrast---see, Cheng & Sybesma (1999); Wilhelm (2008). We distinguish between languages like Mandarin that encode the ontological distinctions from languages like English which encode a syntactic distinction that crosses ontological boundaries. It is the latter that we are calling mass-count languages.

In the following sections we draw attention to semantic distinctions between these two syntactic systems that are relevant to acquisition. One difference is that count syntax has a unique semantic property, namely that it triggers coercions from substance-like denotations to individuated denotations. A second difference concerns bare nominals. Count syntax in English includes bare nominals with singular denotations (e.g., sets of individuals such as {a, b, c}) as well as nominals with number neutral denotations (e.g., sets of individuals and groups such as {a, b, c, ab, ac, bc, abc}). In contrast, all bare nouns in Mandarin are number neutral. After noting these differences, we highlight a key similarity between the two language types: a parallelism between English object-mass nouns like *furniture* and Mandarin bare nouns.

2.1 Count syntax and coercion.

Despite the syntactic differences listed at the beginning of Section 2, some researchers have suggested that the contrast between English and Mandarin is merely a phonological illusion, and that count syntax and classifiers are represented by the same functional head in the syntax (cf., Krifka, 1995; Cheng & Sybesma, 1999; Borer 2005). However, there is an interesting distinction between

classifier syntax and count syntax that is unexplained by this hypothesis. Specifically, in English, count syntax does not just *signal* individuation; it *triggers* it grammatically. The absence of count syntax often results in an unindividuated or substance-like interpretation. In contrast, classifier syntax (at least default/sortal classifier syntax) is not necessary for individuation in Mandarin, and its removal does not result in substance-like interpretations.

In previous work, we have argued that comparative judgments reveal predictable semantic differences between nouns used in mass and count syntax in English, a method which also reveals differences between count syntax and Mandarin classifiers (Bale & Barner, 2009; Barner & Snedeker, 2005, 2006). Consider the sentences in (5-8).

- (5) a. Mary has more bananas than Jane does.
b. Mary has more banana than Jane does.
- (6) a. Mary has more water than Jane does.
b. Mary has more waters than Jane does.
- (7) a. Mary has more rocks than Jane does
b. Mary has more rock than Jane does.
- (8) a. Mary has more blickets than Jane does.
b. Mary has more blicket than Jane does.

As shown in (5), nouns that are typically used in count syntax, like *banana*, always denote individuals as count nouns, but never when used in mass syntax. As a result, the sentence in (5a) is evaluated on the basis of number, whereas (5b) is evaluated on the basis of mass or volume. Similarly, in (6) the noun *water*, which is typically used as a mass noun can only denote individuals when used in count syntax (6b). Again, the decision of “who has more” is based on number for the count usage (e.g., number of portions) but on volume for the mass usage. Mass-count flexible words like *rock* (7) also shift their interpretation as a function of mass-count syntax. Other examples include *stone*, *paper*, *string*, *chocolate*, *idea*, *hope*, *thought*, etc. Finally, in (8) novel words like *blicket* shift interpretation

according to their syntactic frame (Barner & Snedeker, 2006). In general, all English nouns used in count syntax denote individuals. Also, nouns that can be used in count syntax to denote individuals can never be used as mass nouns to denote countable things (for a review, see Bale & Barner, 2009; for experimental evidence in adults and children, see Barner & Snedeker, 2005).

In contrast, manipulating the presence or absence of classifiers in Mandarin causes no such shift in interpretation. As noted by Krifka (1995), Cheng & Sybesma (1999), and Borer (2005), the classifiers that are closest in meaning to count syntax are the so-called sortal/default classifiers such as *ge* in (9).

(9) Mandarin

a. Liang ge haizi

Two CL child

“Two children”

b. Liang ge pingguo

Two CL apple

“Two apples”

(10) Mandarin

a. Liang li mi

Two CL(grain) rice

“Two grains of rice”

b. Liang ba mi

Two CL(handful) rice

“Two handfuls of rice”.

Unlike mensural classifiers which specify how a noun’s referent should be portioned and counted (like English measure words) -- see examples in (10) -- default classifiers only specify that the noun’s referent can be counted, the method of individuation being determined by the content of the noun itself. However, unlike count syntax, the absence of these default classifiers does not force a noun into a

substance-like interpretation. For example, the sentences in (11) are used to talk about individual children and whole apples rather than their corresponding substances.

(11) Mandarin

- a. Haizi pao (le).

Child run (aspect)

“The children ran.”

- b. Zhangsan de pingguo.

Zhangsan ps. apple

“Zhangsan has apples.”

The lack of coercion is true for comparative constructions as well. Consider the sentences in (12).

(12) Mandarin

- a. Zhangsan de pingguo bi Lisi de pingguo duo.

Zhangsan ps apple than Lisi ps apple more.

“Zhangsan has more apples than Lisi.”

- b. Zhangsan de pingguo bi Lisi de haizi duo.

Zhangsan ps apple than Lisi ps child more.

“Zhangsan has more children than Lisi.”

Even when classifiers are not present, the nouns *pingguo* (apple) and *haizi* (child) denote individuals.

As a result, the comparatives in (12) are evaluated by number, not mass or volume.⁴ Thus, Zhangsan

⁴ In most contexts, (12a) is evaluated by number. There are some contexts where an evaluation via mass is possible, such as when the apples are sliced into pieces and hence the individuals are de-emphasized (literally destroyed). In general, when the individuals are not de-emphasized, the comparative prefers an evaluation by number. In the special circumstances, it is possible that a coercion operator derives the correct interpretation of the noun.

has more *pingguo* than Lisi if she has a greater number of apples, even if Zhangsan's apples are very tiny and overall weigh less (or take up less space) than Lisi's.

Experimental evidence collected in our labs corroborates this intuition. First, when Japanese-speaking adults are asked to make comparative judgments for sentences containing translations of English count nouns (e.g., *cup*), their judgments do not differ from those of English speakers, and are based exclusively on number (Barner, Inagaki, & Li, 2009; Inagaki & Barner, 2009). Similarly, Japanese and English speakers do not differ when interpreting nouns that denote substances (e.g., *butter*). Finally, when tested with translations of nouns that are mass-count flexible in English (e.g., *string*, *stone*), Japanese speakers base their judgments on number about 50% of the time, exactly half-way between the English results for mass and count judgments for the same types of words. In Mandarin, similar results are found (Cheung, Barner, & Li, 2010, in prep). Note that adding classifiers has no effect on interpretation, except for words whose counterparts are mass-count flexible in English (presumably because the classifier disambiguates between two pre-existing lexical meanings –i.e., individual vs. non-individual; see Cheung, Barner, & Li, 2010, in prep; Pelletier, forthcoming).

2.2 Count syntax and singularity

There is a contrast between two types of bare nouns in English. This contrast, which involves semantic number, does not exist in Mandarin. As discussed in Gillon (1992, 1999) and Chierchia (1998, forthcoming) the denotations of bare count nouns typically contain individuals but not groups (i.e., no pluralities), whereas the denotations of mass nouns can contain both individuals and groups. For example, consider the contrast between the count noun *boy* and the mass noun *furniture* when they appear in predicate position as in (13) and (14).

- (13) a. John is a boy.
b. Brad is a boy.
c. #John and Brad are a boy.

- (14) a. This chair is furniture.

b. That table is furniture.

c. That table and this chair are furniture.

When (13a) and (13b) are true, it is extremely odd to assert (13c). In contrast, (14a) and (14b) together entail (14c). This pattern demonstrates that the denotations of singular count nouns do not contain groups whereas the denotations of mass nouns do. In other words, mass nouns are unspecified for number (see Bale, Gagnon & Khanjian, in press, and Wilhelm, 2008, for a discussion of this point; see also Corbett's discussion of General Number in Corbett, 2000).

Similar observations can be made for definite descriptions. For example, the sentence in (15a) presupposes that there is only one boy salient in the context whereas (15b) does not.

(15) a. The boy is outside on the balcony.

b. The furniture is outside on the balcony.

Note that, according to many speakers, the NP *the furniture* in (15b) can only be used to talk about a plurality of objects. However, this intuition does not reflect the literal meaning of *furniture*. As predicted by Gricean principles (specifically the Maxim of Quantity, Grice, 1975), it would be awkward to use the superordinate word *furniture* instead of a basic term like *chair* or *table*, especially when there is only one item being talked about. Such awkwardness can be controlled by eliminating the possible use of the basic term epistemically. For example, in a situation where one is informed that either a chair or a table is on the balcony but not both (perhaps the informant forgets which item was on the balcony), the sentence in (15b) is appropriate.

In contrast to the English examples, bare nouns in Mandarin are always number neutral (see Krifka, 1995; Tang, 2005, 2004; see also Kang, 1994, for similar observations about Korean). Consider the sentences in (16) and (17).

(16) Mandarin

a. Zhangsan shi haizi.

Zhangsan be child.

“Zhangsan is a child.”

b. Lisi shi haizi.

Lisi be child.

“Lisi is a child.”

c. Zhangsan he Lisi shi haizi.

Zhangsan and Lisi be child.

“Zhangsan and Lisi are children.”

(17) Haizi pao (le). [repeated from 11a]

Child run (aspect)

“The child/children ran.”

The noun *haizi* (child) is representative of all nouns in Mandarin that are used to talk about individuals. Like mass nouns in English, when the noun *haizi* is used in predicate position as in (16), the noun can be true of both individuals and groups. In fact, (16a) and (16b) entail (16c). Also like mass nouns in English, when the noun appears with a definite interpretation it can be used to talk about pluralities or groups. The sentence in (17) can be used to refer to a specific child or a specific group of children. There is no implication involving number. (Note that, unlike English, there are no definite articles in Mandarin. The definite interpretation occurs as the default interpretation when the noun appears in subject position.)

2.3 Mandarin bare nouns and English object-mass nouns

Despite the differences between English and Mandarin discussed in Sections 2.1 and 2.2, there is at least one important similarity regarding the lexical representation of Mandarin nouns like *pingguo* (*apples*) and English object mass-nouns like *furniture*. As already shown in Section 2.2, both types of noun are number neutral. Besides this shared property, they both also induce a comparison by number without requiring count syntax or classifier syntax. Furthermore, they both combine with semantically inert measure terms.

2.3.1. Comparison by number in absence of count syntax

Several previous reports have claimed that object-mass nouns like *furniture* and *jewelry* have atomic, countable individuals in their denotations and are represented like plural count nouns (Gillon, 1992, 1999; Chierchia, 1998; Krifka, 1995; Bale & Barner, 2009; Barner & Snedeker, 2005, 2006; Barner, Wagner, & Snedeker, 2008). Bale & Barner (2009) demonstrated this using comparative constructions. As shown in Section 2.1, English nouns that can appear in count syntax *never* denote individuals when used as mass nouns. In contrast, object-mass nouns like *furniture* denote individuals and can never appear in count syntax (in fact, in other languages, like French, their translations are often count nouns, e.g., *meubles*, *vêtements*, etc.). Consider the examples in (18) and (19).

- (18) a. Mary has more footwear than Jane does.
b. Mary has more furniture than Jane does.
c. Mary has more clothing than Jane does.
- (19) a. ??Mary has more footwears than Jane does.
b. ??Mary has more furnitures than Jane does.
c. ??Mary has more clothings than Jane does.

In each sentence in (18), the judgment is based on number (for experimental evidence, see Barner & Snedeker, 2005). Despite lacking count syntax, and despite the fact that many nouns in English require count syntax to denote individuals, these nouns denote individuals as mass nouns. Thus, these English mass nouns resemble nouns like *haizi* and *pingguo* in Mandarin, which also denote individuals without count or classifiers syntax (as shown in Section 2.1 with the examples in (11) and (12)).

2.3.2. Object-mass nouns and measure words

Another similarity between Mandarin bare nouns and English object mass-nouns can be found in the use of measure words (see Gillon, 2011). As noted in (9) in Section 2.1, when nouns like *haizi* and *pingguo* combine with numerals they require the intervening classifier *ge*, which appears to contribute little to the interpretation and serves the syntactic function of licensing numeral use. For many nouns,

including novel or low frequency words, this default classifier can be used instead of item-specific classifiers.

Such default classifiers are semantically similar to English measure words like *item* and *piece*, which can also be used for a variety of nouns. Critically, they can be used to combine numerals with object-mass nouns like *furniture*, *clothing*, and *equipment* as shown in (20).

- (20) a. Two items/pieces of furniture
b. Two items/pieces of clothing
c. Two items/pieces of equipment

As with *ge*, these measure words do not specify the nature of the units to be counted. Instead, the relevant units for counting are determined by the lexical semantics of the mass noun: namely the atomic minimal parts in its denotation. As a result, comparative judgments involving these measure words generate results that are identical to those not involving measure words.⁵

2.3.3 Summary

In summary, Mandarin nouns like *haizi* and *pingguo* and English object-mass nouns: (i) denote individuals in absence of count or classifier syntax, (ii) can be used with semantically inert classifiers or measure words, and (iii) are underspecified for number, and thus can refer to either groups or individuals. These facts suggest two conclusions about the semantics of these words. First, they all have atomic minimal parts in their denotations -- e.g., individual children or pieces of furniture. The presence of atomic minimal parts provides semantic units for counting (independent of classifiers or measure words) and guides comparative judgments, inducing a comparison by number thereby explaining why they can be used with semantically inert measure words or classifiers.⁶ Second, both

⁵ Note that a piece of furniture cannot be any piece or part - e.g., a leg of a chair - but must correspond to whole units like chairs, tables, etc.

⁶ Alternatively, both Mandarin bare nouns and English mass nouns might denote kinds, as suggested by Chierchia (1998). However, with such a denotation, the grammar would require a function that

types of nouns have denotations that not only contain atomic minimal parts, but also contain all the groups that can be formed from these minimal parts. In other words, their denotations are complete, join semilattices. This characteristic explains why such nouns can be used to talk about individuals or any group of individuals, in contrast to English bare count nouns (see Figures 1 & 2).

Figure 1. Representation of the denotation of *haizi* in a context where *a*, *b* and *c* are the individual children. The grey lines represent the subaggregate relation. The elements *a*, *b*, *c*, are the *minimal parts* in the denotation since there are no other members that are subaggregates of them. Furthermore they are *atomic* since they do not have any over-lapping parts (no subaggregates that are a part of two or more minimal parts).

Figure 2. Representation of the denotation of the count NP *boy* without the plural morpheme in a

converts kinds into sets, just as a system with set denotations requires a function that converts sets into kinds. In either case, it is the sets that contain the atomic minimal parts and thus that are relevant to our discussion.

context where a , b and c are the individual boys. Note that the denotation does not contain any groups.

2.4 *Acquiring English vs. Mandarin*

The goal of this paper is to explain how children identify and learn to interpret count syntax when it appears in their language, i.e., to explain how children discover that their language is a mass-count language, like English, rather than a language lacking such a distinction, like Mandarin. To begin, we have provided arguments to support the claim that Mandarin does not have count syntax (though it does have classifiers and measure words which often function semantically like English measure words).

The differences between these languages have important consequences for lexical representation in acquisition. If a language lacks count syntax, then the task of acquiring words that are used to refer and talk about individuals is greatly simplified. There is only one type of noun that can do this and so only one way that such a noun can be lexically represented. In contrast, if the language the child is acquiring has count syntax, then the task becomes more complex. Words that are used to refer to individuals can be represented in two ways - as a lexical item compatible with count syntax or as an object mass-noun, which can never be used in count syntax (see Figure 3).

In Sections 3 and 4 we explore how children identify whether their language has count syntax in early acquisition, beginning with a review of when they first become sensitive to the mass-count distinction in English. We argue that, when acquiring English, children identify the basic syntax and semantics of the mass-count distinction by around 24 months of age, and that count nouns are identified as those that grammatically specifically singular reference.

Figure 3. The different acquisitional tasks once a child knows that he/she is acquiring a language with count syntax or without.

3 English and Mandarin Heuristics and the Age of Distinction

The earliest sign that children are sensitive to the mass-count distinction in English is their use and comprehension of singular-plural morphology and agreement by around the age of 24 months (Barner, Thalwitz, Wood, Yang, & Carey, 2007; Brown, 1973; Cazden, 1968; Clark & Nikitina, in press; Fenson, Dale, Reznick, Bates, Thal & Pethick, 1994; Kouider, Halberda, Wood, & Carey, 2006; Mervis & Johnson, 1991). For example, when shown two computer screens depicting sets of novel objects, 24-month-old children are more likely to look at the screen that depicts a plural set when told “*Look! There are some blickets*” than when they hear “*Look! There is a blicket!*” At this early age, children use verb agreement to guide their interpretation, as shown by the time course of their eye gaze (which shifts reliably to the plural set immediately after the verb), and as shown by their failure to differentiate singular and plural forms used without verbal agreement – e.g., “*Look at the blicks!*”

Other quantifiers begin to emerge in child speech at around the same time. Children begin using *more* at 19 months, *some* and *all* at 26 months, the indefinite determiner *a* at 27 months, and *another* at 29 months (Fenson et al., 1994). Children’s comprehension of these words appears to emerge at around the same time, and is correlated with their comprehension of numerals like *one*, *two*, and *three* (Barner, Chow, & Yang, 2009). At around 2 years of age most children can recite part of their count list, and by 2 and a half have acquired the meaning of *one*. Between 6 and 9 months later they learn the meaning of *two*, then *three*, and then at around 3 and a half or 4 they understand that the last word used in a counting sequence labels the cardinality of the whole set (see Wynn, 1990, 1992). Children’s acquisition of quantifiers and number words is also correlated in Japanese, although number word acquisition begins slightly later, perhaps owing to the relative paucity of number marking in Japanese relative to English (Barner, Libenson, Cheung, & Takasaki, 2009; Sarnecka et al., 2007).

By at least 30 months of age children are sensitive to the mass-count distinction when learning new words. When shown a novel object with a distinctive shape and material, and taught a novel label for it,

children are more likely to infer that the word denotes a kind of object when it is used in count syntax than when it is used in mass syntax (Soja, 1992). Specifically, when shown two new referents – one that matches the original only in shape, and the other that matches only in substance – children are more likely to point to the shape-match when tested with count syntax than when tested with mass syntax. However, it is critical to note that 30-month-olds, 3- and 4-year-olds, and even adults exhibit categorical responses only for count syntax (i.e., systematically picking the shape match when tested with solid objects). When tested with mass syntax, subjects of all ages are more equivocal, and are equally likely to extend novel mass nouns to objects as to substances, consistent with the idea that mass syntax is neutral with respect to individuation (for review, see Barner & Snedeker, 2006).

By some reports, cross-linguistic differences emerge in the interpretation of novel words between 24 and 20 months. Many studies have now documented that when English-speaking children are presented with a novel word used in mass-count ambiguous syntax – e.g., Look at the blicket! – they are much more likely to extend the word by shape than by substance (e.g., Landau, Smith, & Jones, 1988). This behaviour, however, is significantly less pronounced in children and adults who speak classifier languages like Japanese and Mandarin (Imai & Gentner, 1997; Li, Dunham, & Carey, 2009). For example, when shown novel objects with relatively simple shapes, English-speaking 30-month-olds are more likely than same aged Japanese children to extend a label for the object by shape. This is likely because English-speaking children must assign a syntactic representation to the ambiguous noun, and since count nouns are more frequent in children's language input (Samuelson & Smith, 1999), they are more likely to infer that the novel word is a count noun and thus that it denotes a kind of individual (Barner, Inagaki, & Li, 2009; Papafragou & Gleitman, 2004; Li & Gleitman, 2002; Li, Dunham, & Carey, 2009). Consistent with this hypothesis, adult bilingual speakers of Mandarin and English are more likely to extend a novel ambiguous word by shape when tested in English than when tested in Mandarin, suggesting that grammatical differences between the languages drive the differences in word learning, and thus the lexical representations that are assigned to words (Barner, Inagaki, & Li, 2009).

Extending these findings, Gordon (1985) and Barner & McKeown (2005) tested how children used and interpreted novel words after hearing them in syntactically neutral environments like the one above. Critically, these studies manipulated not only the shape and substance of objects, but also the number of referents. In the Barner and McKeown study, children were shown either a single novel object or a set of ten objects of the same kind. Children then heard the object(s) labelled with mass-count neutral syntax – *Look! This is my blicket!* Next, they were shown a plural set and asked to label it. In this study and in Gordon's, children were more likely to use a plural form of the noun if they had first heard the word used to label a singleton set than if it had labelled a plural set. In other words, children assumed that the word was a mass noun if it was used to refer to a plural set, since it lacked plural morphology. Consistent with this, children who labelled the plural set with a plural noun were more likely to extend the word to other objects with the same shape, whereas children who omitted the plural extended the word to objects that shared the same substance. This suggests that children used numerical cues to infer the mass-count status of words, affecting both their use of the plural and whether they extended the word by shape or substance (Barner & McKeown, 2005).

Critically, Mandarin-speaking 4-year-olds children show a different pattern of results. Data collected for this paper with Pierina Cheung indicate that Mandarin 4-year-olds showed no difference in their interpretation of nouns when they were first used to label singleton or plural sets (these children were not given a singular-plural elicitation task, since plural marking is not obligatory in Mandarin). Overall, their judgments resembled those of English-speaking children who did not use the plural. This pattern of results is consistent with the idea that only English-speaking children are required to assign a syntactic mass-count representation to ambiguous novel nouns. It also supports the idea that reference to singleton sets is, by default, mapped to count syntax barring evidence to the contrary. Whereas Mandarin-speaking children encode novel nouns identically when they label sets of one object or more than one, English-speaking children draw on both syntactic and semantic assumptions when assigning novel words their lexical representations.

In summary, children make different assumptions about nouns (both novel and known) based on the type of language they have acquired. English children are sensitive to count syntax by 24 months and seem to understand the semantic consequences of this syntax when learning new words by at least 30 months. Mandarin children do not demonstrate the same kinds of assumptions as English children with regards to plurality and individuation.

4. Possible Triggers for a Parametric Distinction

Having described the course of children's acquisition of mass-count syntax and semantics in English – that children acquire the mass-count distinction between 24 and 30 months of age – we now focus our attention on possible triggers: What factors lead English and Mandarin speakers to such different syntactic and lexical systems? In this section we discuss two possibilities. The first involves the use of morphosyntactic cues. As we argue in Section 4.1, few morpho-syntactic cues that are available to children at the age of 2 could alone indicate to a child that their language contains count syntax. Many correlates of count syntax are also found in some classifier languages that clearly lack count syntax, such as Western Armenian.

Another possible trigger relies on children reasoning inductively about how adults use the bare noun (in English, the singular noun) to refer to singularities. The key distinction between mass and count nouns, in our view, is not that count nouns can refer to sets of countable individuals (mass nouns can too). Instead, it is that only count nouns can denote sets consisting exclusively of single individuals. By beginning acquisition with the assumption that reference to singulars should be reflected grammatically, children learning English could locate the corresponding singular-plural distinction as a first step towards acquiring the mass-count distinction. Mandarin-speaking children, in contrast, will find no corresponding grammatical correlate of singular reference, and thus no inductive basis for acquiring a singular-plural distinction or the superordinate distinction between mass and count. The details of this second possibility are outlined in Section 4.2.

4.1 Problems for a morphosyntactic trigger

Although we cannot show definitively that there is no purely morpho-syntactic trigger for the acquisition of count syntax, we do believe that the most salient differences between mass-count and classifier languages are unlikely candidates. These cues include the presence of a rich classifier system, the presence or absence of a plural morpheme, and the direct combination of numerals and noun stems. As we demonstrate in this section, none of these cues is sufficient either because they are found in both types of language, or because they are not available to children at 2 years of age, when they begin to acquire count syntax in English.

4.1.1 Classifiers as triggers

One of the major differences between Mandarin and English is the presence of a rich classifier system. This obvious sharp contrast between these two languages is one possible way that a child might distinguish the type of language he is acquiring. However, there are two problems with this hypothesis. First, Mandarin children appear to struggle with mastering the intricacies of its classifier system until at least the age of 5 or 6. For example, Li, Barner and Huang (2008) report that Mandarin children become sensitive to the shape specifications of classifiers only by around 3 years of age, and don't exhibit adult-like interpretations until around the age of 6 (for related findings see Cheung, Barner, & Li, 2010; Uchida & Imai, 1999; Matsumoto, 1985; Erbaugh, 1986).

Second, classifiers share many distributional similarities with measure words in mass-count languages. On the surface, it is difficult to tell the two systems apart. Consider the measure noun phrases listed in (21).

- (21) a. Three cups of milk, one gram of saffron, two pounds of iron, etc.
 b. Two items/pieces of furniture, two items/pieces of clothing, etc.

As shown in (21a), English measure words mediate the relationship between numerals and nouns just like classifiers in Mandarin. As shown in (21b) and in Section 2.3.2, in English there are default measure words that behave much the same way as default classifiers like *ge* in Mandarin. Although

there are subtle differences between measure words and classifiers given a wider grammatical context (see Cheng & Sybesma, 1999), children as old as 3 are almost completely insensitive to such differences, and the addition of a default classifier like *ge* has no effect on how they interpret a novel noun. In particular, children under the age of 6 do not infer that a novel noun refers to a kind of object from the presence of default classifiers (Cheung et al., 2010). Thus, it is very unlikely that children could use the presence of classifiers in their language to infer that it does not contain count syntax.

In summary, the hypothesis that a rich classifier system can serve to trigger the course of acquisition is problematic due to the late acquisition of classifier systems as well as the similarities between classifiers and measure words. Any adequate theory that would want to maintain this hypothesis would have to specify the distinctive feature of classifiers that is detectable by children between the ages of 24- and 30-months.

4.1.2 Numeral composition and plural marking as triggers

Two additional differences between Mandarin and English involve the composition of numerals and plural marking. English allows numerals to combine directly with nouns (no mediating classifier is needed) and also has a systematic plural/singular distinction. In contrast, Mandarin usually requires classifiers to mediate the combination of nouns and numerals and, although it has an infrequently used plural marker, it does not have an obligatory plural/singular distinction, as noted in Section 2. It is possible that either (or both) of these characteristics act as a trigger in determining the type of language a child is acquiring.

However, as we look at other languages, the plausibility of this diminishes. Particularly relevant is Western Armenian (but see also Turkish as discussed in Bale, Gagnon & Khanjian, in press, and Korean as discussed in Kang, 1994). Western Armenian is like Mandarin in that it has a rich classifier system that can be divided into non-sortal (22a) versus sortal (22b) subcategories. It even has a default classifier (*had*) similar to the Mandarin classifier *ge* (see 22b).

(22) Western Armenian

a. jergu kilo xentsor

two CL apple

“two kilograms of apples”

b. jergu had xentsor

two CL apple

“two apples”

Like the classifier *ge*, *had* can be used with a variety of different nouns and does not provide any specific semantic content regarding the status of individuals in the denotation. Rather, the noun itself specifies what is to be counted, namely the atomic minimal parts in its denotation.

Western Armenian, like Mandarin, does not have any quasi-cardinal quantifiers that apply exclusively to one class of noun, nor does it have minimal noun-pairs such as *chair* vs. *furniture*, pairs which can both be used to refer to individuals but which have different syntactic patterns. These distributional facts are characteristic of classifier languages.

Also like Mandarin, Western Armenian does not make a systematic singular/plural distinction. Although Western Armenian has a plural marker, *-ner*, that is similar to the Mandarin morpheme *-men* (see the example in 23a), the so-called singular nouns in Western Armenian -- nouns without plural marking -- do not have a singular meaning. For example, the bare noun *dəgha* (boy) is underspecified with respect to number (see, Donabédian, 1993; also Borer, 2005). The sentence in (23b) can be used to talk about one boy running or several boys.

(23) Western Armenian

a. Dəgha-ner vaze-tsin

Boy -PL run-past(3,pl)

“More than one boy ran.”

b. Dəgha vaze-ts.

Boy run-past(3,sg)

“One (or more) boys ran.”

c. Aram-ə dəgha e.

Aram-def boy is.

“Aram is a boy.”

d. Aram-ə yev Nanor-ə dəgha en.

Aram-def and Nanor-def boy are

“Aram and Nanor are boys.

Similarly *dəgha* can be predicated of individuals as in (23c) or groups as in (23d), just like the object-mass terms such as *furniture* in English and the common noun terms such as *haizi* (child) in Mandarin.

Another similarity between Mandarin and Western Armenian concerns the behaviour of nouns in comparative constructions. As demonstrated in (24a), the noun *xentsor* (apple) is often used with the default classifier, *had*, when it is combined with a numeral.

(24) Western Armenian

a. jergu had xentsor

two CL apple

“two apples”

b. Aram-ə Nanor-e-n aveli xentsor uni.

Aram-def Nanor-abl-def more apple has-pres(3,sg)

“Aram has more apples than Nanor”

As demonstrated in (24b), the bare noun *xentsor* can appear in comparative constructions with neither classifier syntax nor plural morphology. When it does, the comparison is made in terms of the number of individual apples rather than in terms of a continuous measurement of mass or volume, just like the object-mass term *furniture* in English or the common noun term *pingguo* (apple) in Mandarin (and unlike the noun *apple* in English).

In summary, Western Armenian has almost all of the distributional and semantic characteristics that

distinguish Mandarin from mass-count languages like English. This evidence supports the hypothesis that Western Armenian does not have English-like count syntax. Rather, like in Mandarin, all the object-denoting nouns in Western Armenian have the distributional and semantic characteristics of English object-mass nouns (as discussed in Section 2.3).

Although Western Armenian is similar to Mandarin in these respects, there are two significant differences. First, unlike the Mandarin plural marker (*-men*), which is not commonly used and can only appear on nouns with animate, human denotations, the Western Armenian plural marker (*-ner*) is frequently used and can attach to any noun that can refer to individuals (see Bale & Khanjian, 2009, and Bale, Gagnon & Khanjian, 2011, for a detailed discussion). Second, the combination of numerals with nouns in Western Armenian does not always require a classifier. This is demonstrated by the phrases in (25).

(25) Western Armenian

a. jergu xentsor-ner

two apple-PL

“two apples”

b. jergu dəgha-ner

two boy-PL

“two boys”

The use of classifiers in Western Armenian is optional. Although the direct combination of numerals with nouns is a characteristic more commonly associated with mass-count languages, there are other classifier languages that demonstrate similar properties (see Kang, 1994). Despite this one difference from Mandarin, when all characteristics are taken into consideration, Western Armenian is clearly more like Mandarin than English.

Given these characteristics of Western Armenian, it seems unlikely that plural marking or the lack of classifiers in noun phrases with numerals could indicate to a child that their language makes a mass-

count distinction. Like Mandarin, Western Armenian does not have count syntax. Yet the distributional characteristics of plural marking and numeral modification resemble English, at least in terms of surface distribution (although crucially not in terms of meaning). If such characteristics were to trigger count syntax, then one would expect the syntactic and semantic facts of Western Armenian to be quite different: there should be a systematic singular-plural contrast; there should be minimal pairs like *chair* vs. *furniture*; there should be quasi-cardinal determiners that apply to only one class of noun; there should be measure phrases instead of a classifier system; the lack of plural marking (or classifier marking) in comparatives should trigger coercions; plurals should be obligatory in measure phrases; etc. Western Armenian has none of these characteristics. To maintain the hypothesis that plural marking and numeral composition are triggers for count syntax, one would have to explain how a child can detect the difference between English and Western Armenian plural vs. non-plural marking, or between the two types of numeral composition. In Section 4.2, we explore one possible way that a child might be able to do this. Critically, this possibility requires that the child use semantic cues to distinguish English plural marking from Western Armenian plural marking.

4.2 Induction on the use of bare nouns.

We have argued that the key distinguishing property of mass-count languages is that they permit nouns which denote only sets of individuals without any groups (e.g., singulars). In classifier languages like Mandarin and Western Armenian, such meanings are not possible – any noun can be used to refer to both groups and individuals. This observation suggests a possible mechanism by which children could identify count syntax in their language. If a child were provided with evidence that certain nouns in their language input have only singular denotations, this might allow them to infer that their language makes a mass-count distinction.

Given only positive linguistic evidence, it is impossible to infer deductively that a noun's denotation only contains single individuals. Even if it is obvious in a particular context that the noun is being used to refer to a singular thing, such a usage is also consistent with a nominal denotation that contains both

groups and individuals. For example, in the utterance “Look at the blicket!” the novel word blicket could be replaced with either a singular noun (e.g., *cat*), an object-mass noun (*furniture*) or a Mandarin bare noun that is consistent with any quantity of things. Assuming a deductive learning mechanism, a child who did not yet know whether her language makes a mass-count distinction would be unable to decide from a single utterance (or even from many) which grammatical representation best fits the available data.

A more plausible strategy involves inductive inference. For example, given a conspicuous use of certain nouns to denote only single individuals without a plural, a child could infer inductively that such bare nouns can *only* denote a set of individuals. This inference in isolation would trigger the difference between Armenian and English, and would account for the key difference between mass-count and classifier languages more generally. This type of inference, based on conspicuous correlations in language input, is ubiquitous in other areas of language acquisition. Inductive inference is necessary for acquiring category labels and extending them to novel referents (e.g., to label an unfamiliar cat as a *cat*). Also, it is likely needed to distinguish terms like *cat* from superordinate terms like *animal*. In one demonstration of this, Xu and Tenenbaum (2007) showed that when adults were provided with novel category labels that referred consistently to a specific type of dog, they were unlikely to infer that the label meant *dog*, but more likely to infer that it meant *dalmation* or *poodle*, even though each type of thing is consistent with the *dog* hypothesis. As Xu and Tenenbaum show, inductive processes that capitalize on conspicuous correlations are readily implemented in inferential Bayesian models that mirror human learning.

Returning to our example, consider the data that children receive regarding the singular nouns *chair* and *furniture*. For the sake of discussion, we will limit our attention to predicative, definite and existential uses of these nouns. Given the intricacies of predication (see Gillon, 1992; Scha, 1981; Schwarzschild, 1995; Lasersohn, 1995; Langendoen, 1978; among others), it would be difficult for the child to determine whether use of the noun with other quantifiers (such as the universal) would involve

quantification over singular individuals or groups. The sentences in (26a-d) and (27a-d) are representative of utterances that a child might hear with *chair* and *furniture*.

- (26) a. Look, a chair is on the balcony.
- b. The chair is on the balcony.
- c. That chair is dirty.
- d. That thing on the balcony is a chair.
- (27) a. Look, some furniture is on the balcony.
- b. The furniture is on the balcony.
- c. That furniture is for sale.
- d. Those two things on the balcony are furniture.

Consistent with the Gricean Maxim of Quantity, the sentence in (26a) would typically be used when there is one chair on the balcony or at least when there is only one chair salient to the conversation. Also, due to the semantics of the definite determiner and the demonstrative, the sentences in (26b) and (26c) are exclusively used to refer to a single chair. Furthermore, when the noun appears in predicate position as in (26d), it can only be truthfully applied to individuals (rather than groups).

This pattern with *chair* contrasts sharply with the pattern for *furniture*. As shown in (27), the noun *furniture* is often used to quantify over groups (27a), refer to groups (27b&c) and also as a predicate of groups (27d).

It is our hypothesis that children, whether acquiring a language like English or one like Western Armenian, will notice that there is a plural morpheme in their target language: a morpheme that often correlates with reference to or quantification over groups. By noticing the correlation between nouns that denote single individuals and nouns that lack plural morphology, children could inductively infer that single individuals *cannot* occur with plural morphology, thereby acquiring a singular-plural distinction. The steps in this acquisition process are outlined in (28).

(28) STEPS IN THE ACQUISITION OF COUNT SYNTAX

- i. The child hears plural being used to talk about groups/pluralities of objects
- ii. The child notices that whenever bare forms of nouns are used, they refer to single objects.
- iii. The child infers inductively that single objects *cannot* be referred to by plural nouns, and therefore that plurals are used only for reference to groups.
- iv. The child concludes that his target language has count syntax.

This acquisition process correctly predicts that children exposed to languages like Western Armenian or Mandarin should not acquire a mass-count distinction. First, Mandarin has no systematic plural marker (the marker *men* is restricted to human animate nouns). Second, as discussed in Sections 2 and 4.1, nouns which can be used to talk about single individuals are often also used to talk about groups in both Western Armenian and Mandarin. Recall the examples from (11), (16) and (23) repeated below.

(29) Mandarin

- a. Haizi pao (le).

Child run (asp).

“The children/child ran.

- b. Zhangsan he Lisi shi haizi.

Zhangsan and Lisi be child.

“Zhangsan and Lisi are children.”

(30) Western Armenian

- a. Dəgha vaze-ts.

Boy run-3-past(3,sg)

“One (or more) boys ran.”

- b. Aram-ə yev Nanor-ə dəgha en.

Aram-def and Nanor-def boy are

“Aram and Nanor are boys.

Common nouns like Mandarin's *haizi* (child) and Western Armenian's *dəgha* (boy) are often used without plural morphology to quantify over and refer to groups ((29a) & (30a)) and are also often used as a predicate of groups ((29b) & (30b)).

In summary, the acquisition procedure outlined in (28) could be used to reliably trigger the acquisition of count syntax for English children while also correctly not triggering such an acquisition for Mandarin and Western Armenian children.

5 Conclusion

As argued in Section 2, the mass-count distinction in English does not reflect a simple ontological distinction between denotations with and without individuals. Rather it is a syntactic distinction that has subtle semantic implications. Critically, individuation is not exclusively encoded by count syntax. Mass syntax permits individuated denotations as well (*furniture, equipment, etc.*). Yet, there is an essential difference between individuated denotations associated with mass syntax and those associated with count syntax: singular nouns with count syntax only denote a set of single individuals whereas those with mass syntax denote both individuals and groups.

As argued in Section 4, the presence of plural morphology alone does not reliably signal count syntax. However, languages with count syntax always have both plural morphology and singular nouns that denote sets of individuals. In acquisition, children could infer that their language contains count syntax by observing that it makes a distinction between plural and non-plural nouns, and that some of the non-plurals denote singleton sets. This inference would license a host of additional inferences about the language, none of which appear to drive children's initial acquisition of the distinction.

If the language has count syntax, then the child will know to be sensitive to selectional distinctions based on this syntax (*each* vs. *all*). They will know that some variations in form depend on this syntax (*much* vs. *many*), that there is no classifier system but rather a variety of measure nouns,

that there are two types of singulars (count vs. mass singulars), and that there are two types of nouns that encode individuation (object mass-nouns, regular count nouns), not to mention all the syntactic and semantic consequences that follow from this knowledge.

In contrast, a child who fails to detect count syntax has inferred that their language contains only one type of noun that encodes individuation, and that all determiners in the language select for nouns based only on semantic distinctions (not syntactic distinctions). The child will also know to be sensitive to the presence of a rich classifier system that could possibly be divided syntactically as well as semantically into two categories: sortal vs. mensural.

Furthermore, the lexical acquisition strategy children employ is in-part determined by the properties of the language they are exposed to. Children that fail to detect count syntax have a straightforward way of gathering grammatical information about a word from how it is used. For words that are used to refer to individuals, children can infer that they are nouns with an individuated denotation. For words that are not used to refer to individuals, children can infer that they are nouns without an individuated denotation. Such information aids the child in acquiring a lexicon.

In contrast, children that have acquired count syntax do not have such a straightforward way of gathering grammatical information. For words that are used to refer to non-individuals, children can infer that they are mass nouns with non-individuated denotations. However, for words that are used to refer to individuals, children have two possible options to consider: such words might be mass nouns with individuated denotations or they might be count nouns with singular denotations. Children would need to pay attention to other aspects of how the word is used (e.g., use in singular syntax to denote only singularities) to determine which of the two is more likely.

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