

NUMBER MARKING AND THE MASS-COUNT DISTINCTION

Alan Bale (Concordia University)

In this talk, I discuss how various syntactic theories of number features interact with different ontological theories of the mass-count distinction. There are at least two prominent theories of number marking: the high-number theory and the low-number theory. In the high-number theory (e.g., Sauerland 2003), number features are sister to the DP and do not occur within the NP. In the low-number theory (e.g., Bennett 1974), number features are contained within the NP. The syntactic options (high or low) critically interact with the choice of semantic ontology for the mass-count distinction. The high-number theory is incompatible with an ontology where the denotations of mass nouns and count nouns are taken from the same domain and are of the same type (single domain theories, e.g., Chierchia 1998a). Thus, if we know that the high-number theory is on the right track, then we also know that the denotations of mass nouns and count nouns must be taken from different domains or be of different types (as in Link 1983; Rothstein 2010). If we know that the single domain/type theories are on the right track, then we know that number features must combine within the NP.

1 Ontology and typing of count and mass nouns.

Any semantics of the mass-count distinction must map terms from both subcategories to some kind of value associated with some kind of domain. Broadly speaking, there are two main approaches in the literature for implementing such a mapping. One approach assumes that there are two separate domains, or at least two different types of domains—one for count nouns and the other for mass—while the other approach assumes that there is a single domain and type for all nominal terms.¹

The theory outlined in Link 1983 is one of the first to hypothesize two separate domains of interpretation. The two domains reflect a basic object-substance distinction. One domain—the count domain—is a Boolean lattice ordered by the sub-aggregate (or sub-group) relation, while the other—the mass domain—is a semi-lattice ordered by the (material) part-of relation. The count domain has a set of atoms—the individuals in the domain—and the entire domain can be generated from these atoms via the group formation operator. The mass domain doesn't necessarily have any such atoms. Critically, the two domains are completely disjoint.

One of Link's 1983 main motivations for having two separate domains was to explain how objects and the materials that make up these objects behave differently with respect to one and the same predicate. For example, even in contexts where the terms *the ring* and *the gold* seem to pick out one and the same thing (i.e., contexts where the ring is made of pure gold and the only gold that exists is the gold in the ring), the two terms often yield different truth values with respect to qualitative predicates like *is old*, as demonstrated in (1).

(1) The ring isn't old but the gold is.

The sentence in (1) is a completely coherent statement which would be impossible if the count noun *the ring* had the same referent as the mass noun *the gold*. Having separate domains for mass nouns and count nouns—one being the “object” domain and the other being the “material-substance” domain—guarantees the coherency of such sentences.

The distinctions Link makes that help him with the ring-vs-gold problem force him into a difficult position when it comes to comparing count DPs like *the chairs and couches in the room* with mass DPs like *the furniture in the room*. There are many contexts where these two phrases seem to pick out the same plurality of objects (e.g., contexts where the chairs and couches are the only furniture in the room). However, this is not technically possible if the mass noun domain is completely separate from the count

¹For the sake of simplicity, I will not provide a thorough discussion of kind interpretations in this section. Any adequate theory of kind readings ends up providing functions that *lift* predicates into a kind interpretation and *lower* kinds to predicate interpretations (see the discussions in Chierchia 1998a,b; Rothstein 2010; Krifka 1995 among others). This section will focus on the nature of these *lowered*, predicate interpretations.

noun domain. The referents of the two DPs must be separate in the same way that the referent of *the gold* and *the ring* must be separate. However, unlike *gold* and *ring*, there is no object-substance relationship between *furniture* and *chairs and couches*.

Similar to Link (1983), Rothstein (2010) proposes two separate semantic types for mass and count nouns. According to Rothstein (2010), mass nouns are of type $\langle e, t \rangle$ —the type traditionally associated with nouns in general. As a result, all mass nouns are mapped to sets of entities. In contrast, count nouns are associated with something more complex. This complexity has its roots in the contextual sensitivity of counting. As Rothstein notes, it is not always straightforward what counts as *one* versus *two* in any given situation. For example, nouns like *quantity* are highly context sensitive—what counts as *two quantities of sugar* depends on a contextually salient way to package and distribute the sugar. Rothstein (2010) hypothesizes that members of the count domain are a pairing between counting contexts and entities of type $\langle e \rangle$. If we symbolize counting contexts as type c , then we can represent the members of the count domain as type $\langle e \times c \rangle$: the type consisting of ordered pairs where the first member is of type $\langle e \rangle$ and the second member is a counting context. Thus, count nouns are of type $\langle \langle e \times c \rangle, t \rangle$ and are mapped to a set of ordered pairs. The counting context tells us which entities count as being *one* in the context of evaluation, from which it can be derived which entities count as *two*, *three*, etc.

Rothstein’s theory provides a better account than Link’s of the difference between *the chairs and couches in the room* versus *the furniture in the room*. The count DP picks out a member of the count-part of the domain, which is a pairing of a plural entity and a counting context. The mass DP picks out a member of the mass-part of the domain, namely the group that consists of all the furniture in the room. For example, let’s suppose there are only two chairs (*a* and *b*) and two couches (*d* and *e*) in the room. Let’s also suppose that the salient counting context is c_1 , where each chair and each couch counts as *one* in c_1 . In Rothstein’s theory, the entity picked out by *the furniture in the room* would be *abde* whereas the entity picked out by *the chairs and couches in the room* would be $\langle abde, c_1 \rangle$. The DP’s are similar in that they are both associated with the same group, namely *abde*. However they are different since only the count DP is associated with a counting context.

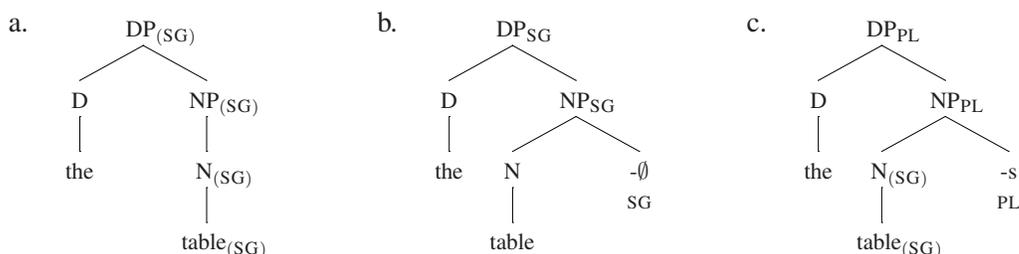
Although there are some advantages to maintaining a type-theoretical difference between mass and count nouns, there are some disadvantages as well. For example, one of the consequences of such a system is that it requires all adjectives and many quantifiers to be systematically ambiguous. Just like you can have phrases like *the red chairs* or *most wicker chairs*, you can also have phrases like *the red furniture* and *most wicker furniture*. However, since *chairs* and *furniture* are not even of the same type in Rothstein’s theory—one is of type $\langle e, t \rangle$ and the other is of type $\langle e \times c, t \rangle$ —this requires *red*, *wicker*, *the* and *most* to be ambiguous between functions that take elements of type $\langle e, t \rangle$ as arguments, versus functions that take elements of type $\langle e \times c, t \rangle$ as arguments. The same holds for all relative clauses and all prepositional phrases that are used to modify a noun. Furthermore, coordinated DPs that involve a mass DP and a count DP—such as *the chairs and the drapery*—would require type-shifting in order to receive a coherent interpretation (see Rothstein 2010 for more details).

Other approaches to the mass-count distinction assume that count nouns and mass nouns map to subsets within the same general domain (for example, see Gillon 1992, Krifka 1995, Chierchia 1998a, Bale and Barner 2009, Chierchia 2010 among others). According to these types of theories, count nouns and mass nouns have the same semantic type, the only difference being that count nouns require that their denotations contain atomic minimal parts whereas mass nouns are underspecified in this respect. Theories differ in terms of what it means to be an atomic minimal part, however in all theories, there is no ambiguity among the quantifiers that apply to both plural and mass nouns, nor is there any ambiguity among the adjectives. Also critical to these theories, within a certain context, mass DPs and count DPs can denote one and the same plurality. For example, in the context specified above where the chairs and couches are the only pieces of furniture in the room, the referent of the count DP *the chairs and couches in the room* is exactly the same as the referent of the mass DP *the furniture in the room*.

2 The Syntax of Singular and Plural.

There are two main approaches to number marking: one that hypothesizes that number features are either inherently part of the noun or adjoined directly to the noun (low number theories), and another that hypothesizes that such features adjoin to the entire determiner phrase (high number theories). The first approach, which is the more traditional analysis of number, is partly motivated by maintaining a close connection between overt plural morphology and number features (see the discussions in Bennett 1974, Verkuyl 1981, Link 1983, Chierchia 1998a, Rothstein 2010 among others). For example, consider the representation of the definite DPs *the table* and *the tables* in (2).

(2) Tradition Lexical and Syntactic Theory of Nominal Number Features



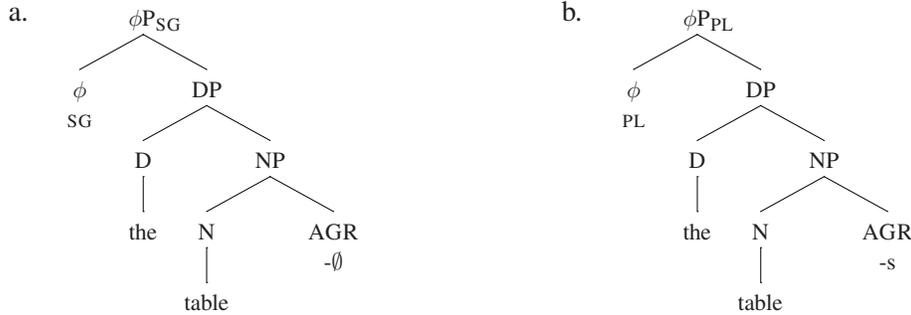
The representations in (2) abstract away from several important details. For example, theories differ in whether singular nouns are marked with a feature or whether they are “singular” by virtue of not being plural (hence the use of brackets around the singular feature in 2a). Also, theories differ in whether they hypothesize a null singular morpheme or not (contrast 2a with 2b). Independent of these differences, an important aspect of all of the representations in (2) is that the number features are contained within the NP and only affect the DP syntactically through feature percolation or selectional restrictions.

Semantically speaking, the interpretation of the number features depends on how the bare noun is interpreted. If the bare noun denotes a set of atoms (e.g., $\llbracket cat \rrbracket = \{a, b, c\}$ where a, b and c are the individual cats), then the plural morpheme is usually interpreted as a function that maps an atomic set to either its closure under the group formation operator (i.e., $\llbracket PL \rrbracket = * = \lambda P. \{x : x = \bigcup Q \text{ for some } Q \subseteq P\}$, where \bigcup is the generalized join operator; e.g., $\{a, b, c\} \mapsto \{a, b, c, ab, ac, bc, abc\}$) or only to the set of pluralities that can be formed from the members of the atomic set (i.e., $\llbracket PL \rrbracket = \textcircled{*} = \lambda P. *P - P$; e.g., $\{a, b, c\} \mapsto \{ab, ac, bc, abc\}$). The singular feature in contrast would have no effect (i.e., it would be an identity function). Alternatively, if the bare noun denotes a set that contains all the atoms and the pluralities that can be formed from these atoms (e.g., $\llbracket cat \rrbracket = \{a, b, c, ab, ac, bc, abc\}$ where a, b and c are the individual cats), then the singular features would restrict the noun to its atoms (i.e., $\llbracket SG \rrbracket = \lambda P. \{x : \text{ATOM}(x) \ \& \ x \in P\}$; e.g., $\{a, b, c, ab, ac, bc, abc\} \mapsto \{a, b, c\}$), whereas the plural features would either not affect the noun or would restrict it to its non-atomic members (i.e., $\llbracket PL \rrbracket = \lambda P. \{x : x \in P \ \& \ \neg \text{ATOM}(x)\}$; e.g., $\{a, b, c, ab, ac, bc, abc\} \mapsto \{ab, ac, bc, abc\}$).²

In contrast to the low-number theories, Sauerland (2003) proposes that number features are sister to the DP. The so-called plural morpheme is the result of an agreement process, much like the agreement affixes that sometimes appear on verbs and adjectives. In this type of theory, the phrases *the table* and *the tables* have the syntactic representations in (3).

(3) High Number Marking

²For a discussion of some of the cross-linguistic differences between restriction and augmentation, see the discussions in Bale et al. 2011; Harbour 2003.



Although all number features are essentially an identity map (i.e., they map any argument onto itself and thus $\llbracket \phi \rrbracket(\llbracket DP \rrbracket) = \llbracket DP \rrbracket$), they have different effects due to certain preconditions they impose on the DP. For example, $\llbracket \phi_{SG} \rrbracket(\llbracket DP \rrbracket)$ is defined only if the $\llbracket DP \rrbracket$ is an atomic minimal part or a “mass.” For now, I am deliberately leaving the definition of what it means to be a “mass” unspecified. I mention it only as a stand-in for the idea that singular morphology can be used with mass DPs. In contrast to a ϕ -head with a singular feature, $\llbracket \phi_{PL} \rrbracket(\llbracket DP \rrbracket)$ is always defined. However, due to MAXIMIZE PRESUPPOSITION (Heim, 1991), use of the plural feature often implies that the singular feature could not be used and that the $\llbracket DP \rrbracket$ is hence not an atomic minimal part nor a “mass.” A critical aspect of Sauerland’s theory is that the ability of certain number features to combine with a DP is based solely on the semantic properties of the DP and not on any type of syntactic restriction.

Sauerland (2003) provides two main arguments for the structures in (3). First, such structures allow for a unified approach to common nouns like *tables* and pronominal plurals like *we* and *they*. Although common noun phrases can host a plural affix, pronominal DPs cannot; yet both DPs trigger plural agreement on the auxiliary and verb. In Sauerland’s (2003) theory, the similarities and differences between the two types of DPs can be easily explained. Both DPs trigger plural agreement because they are both sister to a ϕ -head that has a plural feature. However, pronominal DPs differ from common noun DPs in that there is no NP layer and hence no agreement affix.

The second argument for Sauerland’s (2003) structures is more semantic than syntactic. As discussed in Lasnik 1995, the same coordinated structure can be used with either plural or singular agreement. However, the choice of agreement influences the type of interpretation that is given to the coordinated DP. For example, the phrase “texting and driving” in (4a) is understood as a warning about a single event of driving while texting. In contrast, “texting and driving” in (4b) is understood as warning about two separate types of events.

- (4) a. Texting and driving is dangerous.
 b. Texting and driving are dangerous

This type of semantic agreement falls out naturally from Sauerland’s theory where number features adjoin after the DP has already been formed. The choice of number feature depends on the nature of the referent (one event versus two) rather than the syntactic composition of the coordinate structure.

There are many differences between high-number versus low-number theories. I will not review all of them here (see Sauerland 2003, for a more thorough discussion). What is critical in terms of the mass-count distinction is that the choice of theory has consequences for our semantic representations of *furniture* type nouns.

3 High and low number marking and the mass-count distinction.

If the high-number analysis of grammatical number is on the right track then this has some interesting consequences for the ontological status of the mass-count distinction. Recall from the previous section that in the high-number analysis, number features are sister to the DP and that they are interpretable in the sense that they impose certain pre-conditions on the adjacent DP—that is, if the adjacent DP is

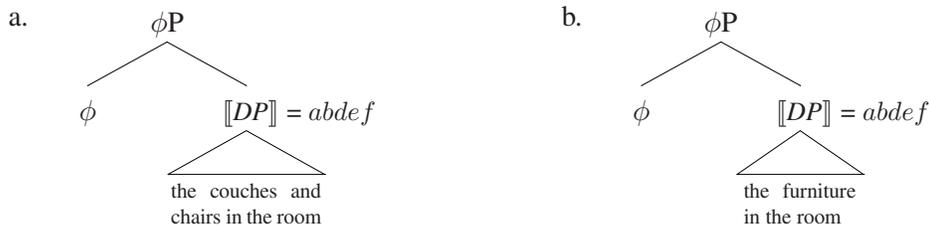
referential (i.e., of type $\langle e \rangle$).³ For now, the details of the interpretation can be glossed over. A more important point is this: in the high-number theory, the distribution of referential DPs with respect to number is predicted to be solely based on the nature of their referent, not their syntactic category.

Let's consider a couple of DPs with respect to this observation, namely the mass DP *the furniture in the room* and the count DP *the couches and chairs in the room* that were discussed in section 1. When appearing in the subject position, these DPs demonstrate opposite agreement patterns. Note that we are using a modifier that generally resists a kind interpretation (i.e., *in the room*) and a predicate that applies to concrete individuals rather than kinds (i.e., *unexpectedly heavy*) in order to suppress the kind interpretation. We want to assess the DPs when they are being used to refer to specific entities.

- (5) a. The furniture in the room **is** unexpectedly heavy.
 b. * The furniture(s) in the room **are** unexpectedly heavy.
- (6) a. The couches and chairs in the room **are** unexpectedly heavy.
 b. * The couches and chairs in the room **is** unexpectedly heavy.

If the two DPs refer to the same aggregate—namely the collection of couches and chairs in the room, then the different patterns of agreement are completely unexpected. As shown in (7a), in the high-number theory, the two DPs would be sister to the ϕ -head, and the semantic constraints imposed by the features in that head should affect each DP in the exact same way.

- (7) Where the aggregate *abdef* is the group containing all the couches and chairs in the room:



Whatever features are natural for (7a) should also be natural for (7b) and vice versa. The semantic details shouldn't matter since, in terms of their referent, the two DPs are identical.

Within the confines of the high-number theory, the only way to explain how these two DPs result in completely opposite agreement patterns is to hypothesize that they in fact do not refer to the same thing. Such a hypothesis falls out as a natural consequence of theories that maintain two separate domains, one for mass nouns and the other for count nouns (Link 1983; Rothstein 2010). However, as mentioned in section 1, maintaining such an ontology complicates the grammar. As an alternative, one could maintain a single domain ontology but also insist that aggregates consisting of couches and chairs are not members of the denotation of *furniture*. However, this would have undesirable consequences. For example, one would have to maintain that one is pointing at different entities when using the count DP “those pieces of furniture” as opposed to “that furniture,” even when one is physically pointing to one and the same group of items. Thus, the syntactic implementation of number marking is closely tied to our semantic account of the mass-count distinction: adopt the high-number theory and accept the ontological consequences, or reject the ontological consequences and thus also reject the high-number theory.

Note that the low-number theory does not make the same predictions with respect to the ontology of mass and count nouns. In the low-number theory, the number marking on the DP is purely syntactic. Semantically speaking, the noun phrase *furniture* can contain all the same pluralities as the noun phrase *couches and chairs*. The difference between the two types of phrases is that *couches and chairs* involves the combination of bare nouns with plural morphemes whereas *furniture* does not. The number marking on the noun phrase percolates up to the DP. Critically, the number marking on the DP does not rely on denotational or referential differences in the associated NP.

³If the adjacent DP is not referential—if it is of type $\langle \langle e, t \rangle, t \rangle$ —then it must move to some propositional level and the semantic conditions imposed by the number feature apply to the trace variable rather than to the DP itself.

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