

On the Relationship Between Morphological and Semantic Markedness: The Case of Plural Morphology*

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Abstract

This paper explores two possible connections between the diagnostics for morphological and semantic markedness. One possibility, a positive correlation, predicts that if a grammatical feature is diagnosed as being morphologically marked then it should also be semantically marked. This possibility follows as a consequence of the assumption that features are interpreted as restrictions on denotations. The second possibility, a negative correlation, predicts that if a grammatical feature is diagnosed as being morphologically marked then it should be semantically unmarked. This systematic inconsistency follows from the assumption that features are interpreted as augmenting functions. In our exploration of number marking, we find that the negative correlation is not only theoretically consistent with the semantic literature (in particular Link, 1983), but it is also more consistent with the empirical landscape (as noted by Sauerland, 2008). As a result, the morphological diagnostics lend support to the view that plural features are interpreted as augmenting functions.

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1 Introduction

Is there a link between semantic and morphological markedness? Linguists working on markedness have often implicitly assumed there is. In fact, rarely is a clear distinction made between them. For example, Jakobson (1971) and Greenberg (1966) treat semantic and morphological markedness as symptoms of the same underlying property: markedness in general. Ideally, these “symptoms” should be consistent with each other. However, as conflicts arise, the idealized link between the two phenomena becomes questionable. Some researchers have even given up on the idea that the semantic “symptoms” have any relation to traditional notions of markedness (see Croft, 2003).

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The goal of this paper is to explore and clarify the possible links between semantic and morphological markedness with a concentration on number marking (plural and singular marking). We discuss two ways they might be connected: (1) a positive correlation and (2) a negative correlation. Both correlations assume that markedness facts reflect a particular theoretical property: namely, marked features can be referenced by a grammatical rule and unmarked features cannot (see, Noyer, 1998; Nevins, 2007a; among others). In a hypothesized positive correlation,¹ the evidence for a feature being morphologically marked would be consistent with evidence for it being semantically marked. Ideally, this correlation would follow as a consequence of marked features being referenced by morphological rules and interpretation rules. As we discuss in section 2.1, this type of correlation is possible as long as morphological features are interpreted as restricting the denotations of their stems. However, despite its theoretical plausibility, empirical evidence suggests that a positive correlation is unlikely for number marking. In many languages, the diagnostics for semantic and morphological markedness yield inconsistent results.

The second type of correlation, the negative correlation, has not received much attention from those who work on markedness even though this type of connection is implicit in the work of many semanticists: in particular, those who are influenced by Link's (1983) treatment of the plural morpheme as a closure operation. (A notable exception is Sauerland, 2008, who discusses the negative correlation without adopting a Link-style interpretation of plurality.) The negative correlation predicts that the morphological and semantic diagnostics yield opposite results. This "consistent inconsistency" can be explained if the marked feature is treated semantically as an augmenting function: a function that applies to a set of individuals to create a superset containing groups formed from those individuals in addition to the original set. Once again, the hypothesis that only marked features can be referenced by grammatical rules explains this negative correlation. Although this type of correlation is more plausible for number marking than the positive one, there are still some empirical difficulties involving plural marking on nouns such as *pounds*. In section 4, we outline these problems and discuss how they might be overcome by changing how measurements on elements in nominal denotations are calculated.

Before discussing the details of positive and negative correlations, we should describe exactly what we mean by morphological and semantic markedness. In sections 1.1 and 1.2, we outline the differences between these two phenomena.

1.1 Morphological Markedness

For expository purposes, we assume that the property of being marked or unmarked applies to grammatical features. However, whether particular types of features are needed or how they are represented (monovalent versus bivalent) is beyond the scope of this paper. In the discussion that follows, we attempt to use feature-symbols to represent potential formal morpho-syntactic properties in a theory neutral way. What they represent is "potential" in that we are only committed to the existence of the formal property in the marked cases. In unmarked cases, we remain agnostic about whether

¹Implicit in Jakobson (1971) and Greenberg (1966).

there is a formal property or not. Whether or not unmarked features are part of the morpho-syntactic representation does not change the potential relationships between the semantic and morphological diagnostics reviewed in this paper. Note however, for the sake of simplicity and uniformity, we will discuss unmarked features as if they are a part of the morpho-syntactic representation.

To understand exactly what it means for a formal property to be *marked* or *unmarked*, it is best to first outline the diagnostics used in determining markedness and then review how these diagnostics are commonly interpreted. Many of the diagnostics for markedness are based on the form of certain morphemes and the (grammatical) environments in which they appear. Some of the more common ones are listed in (1) (cf. Croft, 1990, 2003; Greenberg, 1966).

(1) **Morphological Symptoms of Markedness**

- a. Morphemes with unmarked features often have no phonological content.
- b. Morphemes with unmarked features often show more paradigmatic distinctions than morphemes with marked features.
- c. Forms associated with marked features often appear in fewer grammatical environments.

The diagnostic in (1a) states that unmarked, grammatical properties are often not associated with any sound. For example, consider the subject agreement morphemes in Buriat. In this language, first and second person, singular agreement on verbs corresponds with phonological content (eg., *jaba-na-b* (GO-PRES-1sg) ‘I go’, *jaba-na-š* (GO-PRES-2sg) ‘you go’). In contrast, third person, singular agreement corresponds with no such content (eg., *jaba-na-∅* (GO-PRES-3sg) ‘He/she/it goes’).² These facts suggest that 3rd person is likely unmarked whereas the other person features are marked (see, Cysouw, 2003, and Benveniste, 1966, for a more detailed discussion of null marking and person agreement crosslinguistically).

The diagnostic in (1b) states that unmarked grammatical properties are often associated with more paradigmatic distinctions. For example, singular pronouns in English demonstrate more distinctions in terms of gender (e.g., *he*, *she*, *it*) than their plural counterparts (e.g., *they*, *they*, *they*). Hence, it is likely that singular is unmarked whereas plural is marked (see, Croft, 1990, and Harley, 2008, for a discussion of these facts).

Finally, the diagnostic in (1c) states that the phonological forms more commonly associated with marked grammatical properties appear in fewer environments. For example, in North Sámi the sound associated with the dual form of a verb appears only with certain definite subjects. Verbs with indefinite subjects have the same sound as the plural form of the verb. Hence, it is likely that dual is marked (see, Vinka, 2001, for a discussion of the Sámi facts).

The diagnostics in (1) ideally should correlate with some underlying grammatical property that explains the morphological behaviour of morphemes with marked and unmarked features. One possibility is that marked features are the only features that

²We took these examples from Cysouw (2003: 61) who in turn took them from Poppe (1960:57).

can be referenced in grammatical rules.³ For example, the lack of phonological content described in (1a) could be a consequence of Vocabulary Insertion Rules (similar to Halle & Marantz, 1993), where morphemes are represented by a bundle of features and phonological content is inserted based on these features.⁴ Given this type of characterization, the rules for the phonological insertion of the person agreement in Buriat could be represented as follows:

/ *b* / ⇔ [1sg] (insert / *b* / when the morpheme has the feature [1sg])
 / *š* / ⇔ [2nd] (insert / *š* / when the morpheme has the feature [1sg])
 ∅ elsewhere (otherwise insert no phonological content)

Unmarked features cannot be referenced by such rules and hence either phonological content is not assigned or default forms are inserted.⁵ Null marking is a common default form in many types of paradigms.

Similarly, the lack of paradigmatic distinctions among the morphemes with marked features could be a consequence of Impoverishment Rules (as described in Noyer, 1998, and Nevins, 2007a). Impoverishment Rules delete features on a morpheme before the application of Vocabulary Insertion Rules. For example, to explain the lack of gender distinctions among plural pronouns in English one could hypothesize an Impoverishment Rule that deletes gender features in morphemes with the plural feature, *PL* (as in Harley, 2008). The marked feature becomes a condition for the application of the Impoverishment Rule. Insertion of lexical items would not result in gender distinctions since the features that provide such distinctions would not be present at the time of insertion. Since unmarked features cannot be referenced by a grammatical rule, they cannot serve as a condition for the application of an Impoverishment Rule.

As with lack of paradigmatic distinctions, the fact that the phonological forms associated with the unmarked features appear in more grammatical environments could also follow as a consequence of Impoverishment Rules. For example, to explain the fact that the phonological form associated with dual marking on verbs in North Sámi can only appear when the verb has a definite subject, one could hypothesize an Impoverishment Rule that deletes the dual features on the verb when the verbal subject is indefinite (as in Vinka, 2001). Since the marked feature is deleted, the verb will not have the phonological form associated with it. Also, since unmarked features cannot be referenced by a grammatical rule, they cannot be a target of an Impoverishment Rule.

In summary, the diagnostics in (1) can be associated with the theoretical properties specified in (2).

³In the morphological literature, this characterization has mostly been limited to Impoverishment Rules. In fact, both Noyer (1998) and Harbour (2003) hypothesize the existence of redundancy rules that (only) insert unmarked features. Such rules would necessarily reference unmarked features and never marked features. However, as Vinka (2001) suggests, such redundancy rules might not be needed if one chooses a feature system different from the one adopted by Noyer (1998) and Harbour (2003). For now, we will put the issue of the existence of redundancy rules aside.

⁴Some morphologists, such as Nevins (2007a), explicitly allow Insertion Rules to reference unmarked features, although they do not allow other types of grammatical rules to do so.

⁵Whether the lack of phonological content is due to silence (null content) being a default insertion or whether the lack is due to the absence of any application of an insertion rule is of little consequence for the paper. Both are consistent with what we say about markedness.

- (2) **Marked features are the only features that can be referenced by grammatical rules:**
- a. Unmarked features cannot be targeted by Lexical Insertion Rules.
 - b. Unmarked features cannot trigger Impoverishment Rules.
 - c. Unmarked features cannot be the target of Impoverishment Rules.

The properties in (2) are not the only ones that can account for morphological markedness. However with this type of hypothesis, a clear connection can be established between morphological and semantics markedness.

1.2 Semantic Markedness

Semantic markedness, like morphological markedness, relates to a certain diagnostic. Based on the discussions in Jakobson (1971), Greenberg (1966) and Croft (1990, 2003), the diagnostic can be stated as follows:

- (3) A noun with an unmarked feature can often be used to quantify over more types of entities than a noun with a marked feature. (Jakobson, 1971; Greenberg, 1966; Croft, 1990, 2003; Silverstein 1986)

A classic illustration of the diagnostic in (3) involves the difference between *lion* and *lioness* (see Babaljik & Zocca, this volume). The word *lion* can be used to refer to and quantify over lions of any sex. Thus, if there are two male lions and two female lions in the university hallways, one can (truthfully) say *there are four lions roaming the university hallways*. In contrast, the word *lioness* can only be used to refer to and quantify over female lions. Thus, in the same scenario as above, one could only (truthfully) say *there are two lionesses roaming the university hallways*. Since the noun *lion* can be used to quantify over more types of entities, the diagnostic suggests that *lion* is more likely to have the unmarked feature (in this case [+masc]) whereas *lioness* is more likely to have the marked feature (in this case [+fem]).

Another way of stating (3) is in terms of the subset relation. The generalization in (3) could be due to the denotational nature of nouns. The denotation of a noun with a marked feature might be a subset of the denotation of the same noun with an unmarked feature. This property is represented in (4) where *mF* is the marked feature, *uF* the unmarked feature and *N* the noun.

- (4) $[[N + mF]] \subseteq [[N + uF]]$

This restatement of the diagnostic in set-theoretical terms is a little more restrictive than the original statement in (3). In principle, the semantic diagnostic could also be characterized through presuppositions induced at the Determiner Phrase (DP) level rather than denotations at the Noun Phrase (NP) level: the marked features triggering a presuppositional restriction (such as *entity being talked about must be female*) and the unmarked features triggering no such restriction. In fact, this has been suggested for number marking in Sauerland (2003) and Sauerland, Andersen & Yatsushiro, (2005). However, to simplify the present discussion, we will pursue an approach to plurality at

the NP level with the simplified property in (4). For our purposes, adopting a denotational approach as opposed to a presuppositional one will make very little difference. We will try to be careful to mention (in footnotes) places where the differences might be relevant.

In terms of number marking, the diagnostic specified in (3) and (4) often yields results that are consistent with the hypothesis that plural is unmarked (see Croft, 2003; Krifka, 1989; Sauerland, 2003, 2007; Sauerland, Andersen & Yatsushiro, 2005; Spector, 2003, 2007). For example, the singular noun *child* can only be used to refer to individual children (compare the coherent sentence *That individual is a child* to the incoherent *#Those individuals are a child*). In contrast, the plural noun *children* can often be used to refer to and quantify over singular individuals (a.k.a., singulars) as well as groups of individuals (a.k.a., pluralities). The fact that it can be used to quantify over singulars is demonstrated by the sentences in (5).

- (5) a. If you have children, please raise your hand.
- b. Everyone who has children, please raise your hand.
- c. Do you have children?
- d. Every mother who came to the party brought her children.

Given the commands in (5a) and (5b), one would raise their hand even if they only had one child. Similarly, given the question in (5c), one would answer *yes* even when they only had one child. Furthermore, the statement in (5d) entails that even the mothers with only one child brought that child to the party.⁶ Considering this type of evidence, many semanticists include singulars in the denotation of plural nouns such as *children*.

It should be noted that not all nouns behave the same way in these syntactic contexts. For example, many nouns used to refer to man-made objects (so-called artifact nouns) do not easily permit quantification over singulars, nouns such as *amplifiers*, *brooms*, *forks*, *pencils*, *televisions*, *umbrellas* and *xylophones*.⁷ Yet this sub-class does not yield systematic results. For example, the nouns *books* and *condoms* easily permit quantification over individuals even though the nouns *dictionaries* and *diaphragms* do not. Also, context can influence intuitions with respect to these nouns. For example, one would hesitate to answer *yes* to the question “*Do you have umbrellas on your kitchen table?*” when there is only one umbrella on the table, but one would not hesitate to answer *yes* to the question “*Do you have umbrellas in your store right now?*” when there is only one umbrella on the shelf. In fact, in a store context, or any other context involving inquiries about current inventory, all the artifact nouns seem to permit quantification over individuals.

In contrast to artifact nouns, most natural-kind nouns easily permit quantification over individuals, including animal terms (*cats*, *dogs*, *lizards*, *mice*, *zebras*, etc.), plant terms (*bushes*, *flowers*, *trees*, etc.), geological terms (*rocks*, *stones*, *crystals* etc.), and mental state terms (*emotions*, *ideas*, *fears*, *anxieties*) just to name a few. However, even here, context matters. People are not likely to answer *yes* to the question “*Do you have rocks in your garden?*” when they only have one tiny rock in their garden, however

⁶The sentence in (5d) also implies that at least one mother has more than one child. For details on how to derive this reading, see Sauerland, Andersen & Yatsushiro (2005) and Spector (2007).

⁷We would like to thank an anonymous reviewer for pointing out this partial systematicity.

they are likely to answer *yes* to the question “*Do you have rocks sitting on your kitchen table?*” when they only have one such rock on the table. In contrast, people are likely to answer *yes* to the question “*Do you have boulders in your garden?*” when they have only one boulder in their garden. As an anonymous reviewer suggested, what seems to be relevant in these contexts is an expectation with regards to number. In contexts where the presence (or ownership) of a singular object is normally given or assumed, it is difficult to get speakers to use the plural to quantify over individuals.

Clearly much more work needs to be done to figure out whether there is a systematic pragmatic influence on how nouns are used to talk about singularities. However, we will not attempt to characterize this influence in this paper. For now, we will simply observe that every noun, given the proper context, can be used to quantify over singularities. Furthermore, there are even some plural nouns that permit quantification over singularities in any given context, namely those that do not have singular counterparts such as *scissors*, *pants*, *shorts*, and *clothes*. Given these facts, it seems reasonable to hypothesize that the denotations of plural nouns contain singulars even though pragmatic factors sometimes obscure this property.⁸

Assuming this characterization is on the right track, the formal relationship between plural and singular nouns can be represented as in (6).⁹

$$(6) \quad \llbracket \text{N} + \text{SG} \rrbracket \subseteq \llbracket \text{N} + \text{PL} \rrbracket$$

The diagnostic tells us that singular is semantically marked in English whereas plural is unmarked. In sections 2.1 and 2.2 we will explore whether a connection can be made between the result of the semantic diagnostic and the results of the other tests for morphological markedness specified in section 1.1.

2 Correlations

2.1 Positive Correlations

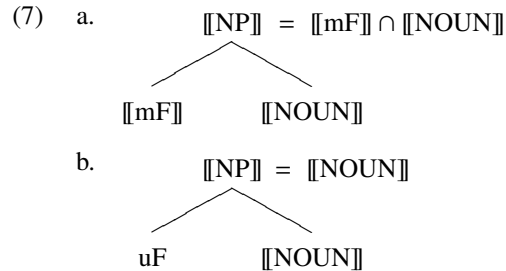
It is possible that semantic markedness has a direct connection to morphological markedness. Recall that the grammatical hypothesis that (possibly) underlies the morphological diagnostics involves the conjecture that unmarked features cannot be referenced by a grammatical rule. This can be extended straightforwardly to semantics. Since semantic interpretation rules are grammatical rules, it follows that unmarked features cannot affect interpretation whereas marked features can. Furthermore if the grammatical features adjoined to nouns are treated as modifying restrictors (much like adjectives), then

⁸In the literature on plurality, there have been many attempts to explain why in many syntactic contexts plurals do not always allow reference to or quantification over singulars. Much of the discussion centers on a competition between the singular noun and the plural noun (see Krifka, 1989; Sauerland, Andersen & Yatsushiro, 2005; Spector, 2007). Such a story is bolstered by the fact that plural nouns without any singular counterpart (so-called pluralia tantum words such as *scissors*) are always able to quantify over individuals (e.g. *those scissors are blue* can mean *that paper-cutting instrument is blue*, although *those children are blue* cannot mean *that child is blue*).

⁹Alternatively, on the presuppositional account, we could characterize the situation by assuming that singular features induce a presupposition on the DP whereas plural features do not. In fact, this is exactly how Sauerland (2003) characterizes the differences between the plural and singular.

there would be a positive correlation between the semantic diagnostic specified in section 1.2 and the morphological ones specified in section 1.1. All diagnostics would be ways of accessing information about the same underlying grammatical property. For the sake of clarity, we provide some examples below of what this positive correlation would look like.

Two ways that a noun could be affected by a feature on a morpheme are represented schematically in (7).



In (7a), a noun is combined with a marked feature, *mF*. Like the noun itself, this feature is assigned a denotation by the semantic interpretation function. The interpretation of the marked feature is then intersected with the interpretation of the noun, which yields the denotation for the entire noun phrase. As a result of intersective modification, the denotation of the noun combined with the marked feature will always be a subset of the denotation of the noun before it combines with the marked feature.

In contrast to (7a), (7b) represents the combination of a noun with an unmarked feature, *uF*. Since the unmarked feature cannot be referenced by grammatical rules, the interpretation function does not assign it a denotation. Given the interpretation rule in (8), the unmarked feature would not have any affect on the noun phrase.

- (8) If a phrase **ZP** immediately dominates nodes **X** and **Y** where **X** is assigned an interpretation and **Y** is not assigned an interpretation (or has been marked for deletion), then $\llbracket \text{ZP} \rrbracket = \llbracket \text{X} \rrbracket$.

An interpretation rule like the one in (8) is commonly assumed for deletion related to agreement and for many types of prepositions. With this type of interpretation rule, the interpretation of the noun combined with the unmarked feature is equivalent to the interpretation of the noun before it combines with the unmarked feature. Thus, it follows from both (7a) and (7b) that the interpretation of a noun with a marked feature is a subset of the interpretation of the same noun with an unmarked feature.¹⁰

¹⁰Under a presuppositional account of semantic markedness, a similar correlation could exist between semantic and morphological markedness. Recall that in the presuppositional account, morphological features combine with the DP and either have no effect (if they are semantically unmarked) or they induce presuppositional restrictions (if they are semantically marked). To establish a correlation with morphological markedness, one could assume that the marked features are interpreted and, when interpreted, they induce certain presuppositions. In contrast, one could assume that the unmarked features are not interpreted and hence have no presuppositional effect. As a result, use of DPs with the morphologically and semantically marked features would be more restricted than use of DPs with the unmarked features. The presuppositional correlation is basically isomorphic to the account in (7) where marked features are interpreted as restricting the noun's denotation.

To put this in more concrete terms, let's consider the example given in section 1.2 of *lion* versus *lioness*. Let's suppose that the interpretation of the root noun $\sqrt{\text{lion}}$ is simply the set of all lions in a given context (males and females). For the sake of the example, we assume that this set is $\{a, b, c, d, e, f\}$. Furthermore, let's suppose that the interpretation of the marked feature $+fem$, associated with the morpheme *-ess*, is simply the set of all female individuals in a given context. For the sake of the example, we assume that this set is $\{a, b, c, g, h, i\}$. By hypothesis, the unmarked feature, $+masc$, is not assigned an interpretation. Given these assumptions, the interpretation of *lioness* and *lion* is represented in (9).

$$(9) \quad \begin{array}{l} \llbracket \text{lion-ess} \rrbracket = \\ \llbracket \sqrt{\text{lion}} \rrbracket \cap \llbracket +fem \rrbracket = \end{array} \quad \left| \quad \begin{array}{l} \llbracket \text{lion (+masc)} \rrbracket = \\ \llbracket \sqrt{\text{lion}} \rrbracket = \end{array} \right. \\ \{a, b, c\} \subseteq \{a, b, c, d, e, f\}$$

The interpretation of the noun with the marked feature ends up being a subset of the interpretation of the noun with the unmarked feature.¹¹

It is possible that the interpretation of number features on nouns parallels the example given in (9). For example, let's suppose that the interpretation of the root noun $\sqrt{\text{child}}$ is the set of all individual children in a given context combined with the set of all possible groups consisting only of those individual children. For the sake of argument, we assume that this set is $\{a, b, c, ab, ac, bc, abc\}$, where a, b and c are the individual children and ab, ac, bc and abc are all the possible groups. Furthermore, let's suppose that the interpretation of the singular feature, *SG*, is the set of all individuals in a given context. For argument sake, we assume this set is $\{a, b, c, d, e, f, g\}$. As with $+masc$, the (semantically) unmarked feature *PL* is not assigned an interpretation and hence the interpretation of *children* is equivalent to the interpretation of $\sqrt{\text{child}}$. (Recall, the evidence presented in section 1.2 led to the conclusion that *PL* was semantically unmarked in English.) Given these assumptions, the interpretation of singular and plural nouns can be represented as in (10).

$$(10) \quad \begin{array}{l} \llbracket \text{child (SG)} \rrbracket = \\ \llbracket \sqrt{\text{child}} \rrbracket \cap \llbracket \text{SG} \rrbracket = \end{array} \quad \left| \quad \begin{array}{l} \llbracket \text{child-ren (PL)} \rrbracket = \\ \llbracket \sqrt{\text{child}} \rrbracket = \end{array} \right. \\ \{a, b, c\} \subseteq \{a, b, c, ab, ac, bc, abc\}$$

The denotation of the singular is a subset of the denotation of the plural.

We have shown that semantic markedness can be understood in a similar vein as morphological markedness: the markedness diagnostics, irrespective of whether they talk about reference or morphological form, tell us which features can be referenced by a grammatical rule and which cannot. The *great hope* is that all the diagnostics yield consistent results. If the semantic diagnostic tells us that plural is unmarked then the morphological diagnostics should too.

¹¹See Percus, this volume, for a more indepth discussion of restriction and gender features.

2.2 Negative Correlations

Although it is possible that the semantic and morphological diagnostics for markedness are consistent, such a consistency is actually unexpected when one considers the details of number marking. As discussed in section 2.1, a positive correlation between the two types of diagnostics is predicted only if the following two conditions hold: (1) an unmarked morpheme cannot affect the interpretation of a noun (since such features cannot be referenced by any grammatical rule) and (2) a noun phrase is interpreted as the intersection of the interpretation of the root noun and the interpretation of the features adjoined to that root. The idea that morphological features restrict the denotation of a root noun (similar to adjectives) might be likely for something like gender features, however number features are slightly different. The standard view in the semantic literature is that plural features are associated with a function that takes a set of singular individuals (a singular denotation) and creates a set of pluralities based on the individuals in the original set. (For arguments against this standard view, see Bale, in press, Krifka, 1989, and Sauerland, 2003.)¹² This type of interpretation was promoted by Link (1983) who demonstrated how such an interpretation could help account for distributive interpretations of an NP subject as well as certain presuppositions introduced by definite determiners. If one were to adopt something like Link’s interpretation for the plural morpheme, then one would no longer expect a positive correlation between the two diagnostics. In fact, what would be expected is a negative correlation. To spell out this negative correlation, let’s consider some of the details of a Link-style interpretation.

In Link (1983), a *join* or *sum* operator was introduced that took two individuals and joined them together to form a group. Although he used the symbol \oplus for this operator, we will stick to the convention of using the regular join symbol \vee . Also, as in section 2.1, we will use single letters to represent individuals and a series of letters to represent groups. Thus if a and b are individuals, then $a \vee b = ab$. Furthermore, this join operator can combine two groups to form an even larger group. For example, if ab and cd are two groups, then $ab \vee cd = abcd$. With this join operator, one can define a closure operation on sets as in (11).

- (11) **Definition of the group-closure function \bigvee :** \bigvee is function from a set X to a set Y such that Y is the smallest set satisfying the following properties:¹³
- a. $X \subseteq Y$
 - b. If x, y are members of Y , then $x \vee y$ is a member of Y .

The operator \bigvee can take a set of singular individuals as an argument and then yield a set that contains all those individuals and also any possible group that can be formed from those individuals. Alternatively stated, the result of applying \bigvee to a set is an augmented set that includes all the groups that can be formed from the individuals in

¹²Bale (in press) reviews some problems for the standard view involving plural morphology on measure nouns. Krifka (1989) discusses similar types of issues with a focus on the use of plurals with numbers that are less than one. Sauerland (2003) outlines a separate set of problems concerning relational nouns, cumulativity and the syntactic position of the plural morphemes.

¹³Link (1983) represented this operation with the symbol ‘*’, hence sometimes it is called the “star-operator”.

the original set. For example, given a set $\{a, b, c\}$, the application of \vee to that set would be $\{a, b, c, ab, ac, bc, abc\}$: $\vee\{a, b, c\} = \{a, b, c, ab, ac, bc, abc\}$.

Instead of interpreting the singular feature SG as a restriction of the root noun as in section 2.1, one could interpret the plural feature PL as this augmenting function.¹⁴

$$(12) \quad \llbracket PL \rrbracket = \vee$$

Furthermore, the root noun could simply be interpreted as a set of singular individuals. For example, the interpretation of \sqrt{child} could simply be the set of all individuals who are children. There would be no groups in the denotation.¹⁵

Given these assumptions, let's reconsider what our predictions would be for the semantic diagnostics presented in section 1.2. As discussed in section 1.1, the morphological diagnostics suggest that morphologically unmarked features cannot be reference by grammatical rules. As mention before, this extends straight-forwardly to the semantic domain where it was suggested that unmarked features cannot affect the interpretation of a noun. With the possibility that features can be interpreted as augmenting functions, it follows that a noun can be affected by a marked feature by having its denotation expanded. For example, the plural feature can expand the denotation of the root noun as shown in (13).

$$(13) \quad \begin{array}{c} \llbracket NP \rrbracket = \llbracket PL \rrbracket(\llbracket NOUN \rrbracket) = \vee(\llbracket NOUN \rrbracket) \\ \swarrow \quad \searrow \\ \llbracket NOUN \rrbracket \quad \llbracket PL \rrbracket \end{array}$$

As a consequence, the interpretation of the root noun will always be a subset of the interpretation of the NP.

In contrast to the plural feature, the singular feature would not affect the interpretation of the root noun as shown in (14).

$$(14) \quad \begin{array}{c} \llbracket NP \rrbracket = \llbracket NOUN \rrbracket \\ \swarrow \quad \searrow \\ \llbracket NOUN \rrbracket \quad SG \end{array}$$

Let's consider the interpretation of the nouns *child* ($\sqrt{child} + SG$) and *children* ($\sqrt{child} + PL$) in this type of system. For the sake of the example, we assume that $\llbracket \sqrt{child} \rrbracket$ is the set $\{a, b, c\}$.

¹⁴This interpretation is slightly different from Link (1983). Link did not allow for singulars to appear in the plural denotation. Thus the plural feature was actually interpreted as the function $\lambda P. \vee P - P$.

¹⁵Note, unlike the case with the positive correlation, it is difficult to draw a parallelism between the set-theoretical account of plural as an augmenting function on the NP and some kind of presuppositional account that would apply to the DP. In other words, it is not at all clear if a negative correlation could be established through a presuppositional account like in Sauerland (2003) and Sauerland, Andersen and Yatsushiro (2005).

- (15) a. $\begin{array}{c} \text{[[NP]]} \\ \swarrow \quad \searrow \\ \text{[[}\sqrt{\text{child}}\text{]]} \quad \text{SG} \\ = \{a, b, c\} \end{array} = \{a, b, c\}$
- b. $\begin{array}{c} \text{[[NP]]} \\ \swarrow \quad \searrow \\ \text{[[}\sqrt{\text{child}}\text{]]} \quad \text{[[PL]]} \\ = \{a, b, c\} \quad = \vee \end{array} = \vee\{a, b, c\} = \{a, b, c, ab, ac, bc, abc\}$

Clearly the denotation of the singular noun *child* is a subset of the denotation of *children* even though it is the plural feature that is referenced by the interpretation rule. Hence, perhaps the diagnostic in section 1.2 has the wrong characterization. At least when it comes to number marking, it is possible that the noun with the marked feature will be able to quantify over more types of individuals (both singulars and pluralities) than the noun with the unmarked feature. What is expected then, at least with number marking, is that the semantic diagnostic and the morphological diagnostics should yield systematically opposite results.

3 Empirical Landscape

The *great hope* for the theory of markedness is that the semantic and morphological diagnostics yield consistent results and thus support a positive correlation. The *lesser hope* is that the semantic and morphological diagnostics are in systematic disagreement and thus support a negative correlation. In this section, we review number marking in Western Armenian and English in some detail. We then conclude this section with some comments on universal trends.

3.1 Western Armenian

Western Armenian is slightly different from English in that the semantic diagnostic does not support the hypothesis that plural is unmarked. In Western Armenian, plural is associated with the morpheme *-er* (or *-ner* depending on the syllable structure of the stem). Singular is usually associated with null marking. For example, the singular form of the noun *jenk* (building) appears in (16a) whereas the plural form appears in (16b).

- (16) a. *jenk-ə desar*
 building-(def) saw(2,sg)
 “You saw the building”
- b. *jergu jenk-er-ə desar*
 two building-(def, pl) saw(2,sg)
 “You saw the two buildings”

As shown in (16), there is a clear singular and plural distinction in Western Armenian.

Unlike in English, when a plural noun appears in an *if*-clause, in a yes-no question, or in the restrictor of a universal quantifier, the noun is not able to quantify over singular individuals. For example, consider the sentences in (17).

- (17) a. bəzdig-ner unis?
child-(indef,pl) have(2,sg)
“Do you have (two or more) children?”
- b. jete bəzdig-ner unis, dun kəna.
if child-(indef,pl) have(2,sg), home go(2, sg)
“If you have (two or more) children, then go home!”
- c. amen mart vor bəzdig-ner uner vodk-i ga,jne-tsav
All person that child-(indef,pl) had foot-(Gen/Dat) stand-up
“Everyone who had (two or more) children stood up”

Given a context where it is clearly relevant whether a person has one or more children versus no children and where it is not relevant whether a person has one child versus more than one, Armenian speakers find the question in (17a) awkward. In fact they often suggest that one should use the singular form of the noun instead. However, when told that (17a) is the intended question, speakers will answer *no* if they only have one child but *yes* if they have more than one. Also, given the request in (17b), speakers judge that in order to obey the command one need not go home if they have only one child. Similarly, the sentence in (17c) is true in a context where the only ones who stood up were people who had two or more children. Clearly, in these types of contexts, the plural noun does not permit quantification over individuals. Yet, if a plural noun can quantify over singular individuals at all, it would be precisely these environments (downward entailing environments) that should allow for such quantification (see Krifka, 1989; Sauerland, 2003, 2008; Sauerland, Andersen & Yatsushiro, 2005; Spector, 2003, 2007 for a discussion). Note that the Armenian speakers we consulted, who were all bilingual, had no difficulty interpreting plural nouns in French and/or English as if they quantified over singular individual. The behaviour of the plurals in these types of context is specific to Armenian. This evidence suggests that plural is not the semantically unmarked form in Western Armenian.¹⁶

Although this conclusion is inconsistent with the hypothesis that the plural form is semantically unmarked universally, it is consistent with the idea that the semantic diagnostic and the morphological diagnostics yield similar results within the same language. The only morphological diagnostic that applies in Western Armenian is the one involving null marking. As is clear from the data in (16) and (17), the plural feature is associated with phonological content whereas the singular feature is not, suggesting that singular is morphologically unmarked whereas plural is marked. Thus, the evidence is consistent with the plural feature being marked both semantically and morphologically.

¹⁶One downward entailing context is left out of this diagnostics and this involves negation. This has been left out for the sake of simplicity. The results from negation are not at all clear and might even speak in favour of the plural being unmarked. However there are several complications that must be controlled for. For a more extensive discussion of negation in Western Armenian see Bale & Khanjian (in press).

3.2 English

In English, evidence from regular present tense agreement and from past tense agreement for the auxiliary “to be” could be erroneously interpreted as supporting an analysis involving a morphologically-marked, singular feature. For example, consider the paradigms in (18) along with the potential vocabulary insertion rules for the agreement morpheme and the auxiliary given in (19).

(18)	To Run (present tense)		To Be (past tense)	
	<i>SG</i>	<i>PL</i>	<i>SG</i>	<i>PL</i>
1	rʌn	rʌn	wʌz	wəʀ
2	rʌn	rʌn	wəʀ	wəʀ
3	rʌnz	rʌn	wʌz	wəʀ

(19) **Insertion Rules:**

- a. /z/ ⇔ [AGR, -participant, -speaker, pres, SG]
- ∅ ⇔ [AGR, pres].
- b. /wʌz/ ⇔ [√be, -participant, past, SG]
- /wəʀ/ ⇔ [√be, past]

In (18), the numbers in the left hand column represent person agreement, where as *SG* and *PL* in the second row represent number agreement. On the surface, the singular forms represent exceptions (3rd singular [z] and 1st/3rd singular [wʌz]) to a more general default form (-∅ and [wəʀ]). The rules in (19) is one way that these surface forms could be derived through Vocabulary Insertion Rules. Such rules crucially involve the feature **SG**.

However, as is often the case with syncretism in a single paradigm, there are other ways to interpret the English data. Notice that in both paradigms in (18) the plural cells always share the same phonological realization. As suggested by Harley (2008) and Bobaljik (2001), such syncretism within and across paradigms can be explained by Impoverishment Rules that delete morphological features before the Vocabulary Insertion applies. For these paradigms, the operative Impoverishment Rule would delete all person features in the environment of the plural feature **PL**. Hence, the following Impoverishment Rule and Vocabulary Insertion Rules would account for the paradigms in (18).

- (20) **Impoverishment Rule:** In verbal (agreement) heads, person features are deleted in the environment of **PL**.

(21) **Insertion Rules:**

- a. /z/ ⇔ [AGR, -participant, -speaker, pres]
- ∅ ⇔ [AGR, pres].
- b. /wʌz/ ⇔ [√be, -participant, past]
- /wəʀ/ ⇔ [√be, past]

The plural cells in the two paradigms are all realized as the default form due to the fact that all person features have been deleted before vocabulary insertion: the relevant deleted features being the [-participant] feature (not a participant in the conversation) and the [-speaker] feature (not the speaker in the conversation).¹⁷ Note, the only number feature referenced in the morphological rules in (21) is the **PL** feature that triggers the impoverishment.

As thoroughly argued by Harley (2008) for English pronouns and in Bobaljik (2001) for Russian case marking, the Impoverishment Rule in (21) has an advantage that the insertion rules in (19) do not. Although the insertion rules can account for within paradigm syncretism, they cannot explain why other paradigms would demonstrate the same kind of syncretism even though they have different default phonological realizations. The Impoverishment Rule in (21) on the other hand, predicts that syncretism of the plural forms should occur in paradigm after paradigm. The deletion rule removes any potential person distinctions. In English, this is an empirically well-attested fact. The person distinctions among other auxiliaries also syncretize in the plural form, as shown in (22).

(22)	To Have (present tense)	To Be (present tense)		
	<i>SG</i>	<i>PL</i>		<i>SG</i>
				<i>PL</i>
	1	hæv	hæv	æm
	2	hæv	hæv	ar
	3	hæz	hæv	ɪz
				ar

In fact, English never makes a person distinction in any of its plural agreement forms despite often having such distinctions in the singular. This cross-paradigm fact or “meta-syncretism” can only be explained by the analysis with Impoverishment Rules: an analysis that crucially involves a morphologically marked plural feature.

In summary, despite surface appearances, the verbal paradigms in English support the hypothesis that plural features are morphologically marked. Such evidence is consistent with other diagnostics. For example, the singular is not associated with any phonological content whereas the plural is, namely /z/, suggesting that singular is morphologically unmarked whereas the plural is marked (although see Borer, 2005, for arguments to the contrary). Furthermore, as discussed in section 1.1, the plural pronouns in English, in contrast to singular pronouns, never demonstrate any distinction in gender, once again suggesting that plural could be triggering Impoverishment Rules. In contrast to the morphological evidence, the semantic diagnostics for English, discussed in section 1.2, clearly reveal that the plural form is semantically unmarked. Hence, in English we have a potential contradiction between the semantic and morphological diagnostics.

¹⁷Things are actually more complicated in English, especially if third person is morphologically unmarked. See Nevins, 2007a, 2007b and Harley, 2008 for a discussion. Since we are concentrating on number in this paper, we will forego a discussion of these potential complications.

3.3 General Trends

As is well known, crosslinguistically most languages pattern just like English with respect to morphological markedness, except perhaps without the surface complications. As described in Greenberg's Universal 35 (Greenberg, 1963), there are many languages where the singular feature is not associated with any overt phonological content but where the plural is, but few where the opposite is true. Such a pattern supports the hypothesis that plural features are often morphologically marked. Also, as discussed in Croft (1990), there are many languages where the plural members of a paradigm syncretize in contrast to the singular members, but few with the opposite pattern. This kind of evidence often supports the existence of meta-syncretisms and thus suggests that plural features trigger Impoverishment Rules and hence are morphologically marked.

In contrast to the morphological diagnostics, the semantic diagnostic often yields the opposite result. In many languages (French, German, Italian, Spanish, etc.), when plural nouns appear in downward entailing contexts (embedded in questions, in the antecedent of conditionals or in the restriction of universal quantifiers) they permit quantification over individuals as well as pluralities (see, Sauerland, Andersen & Yatsushiro, 2005, for a discussion of these facts and others). Just like in English, there are usually complex interactions with pragmatic factors, but the trend is the same. We hesitate to label this trend a *universal* since so few languages and language families (relatively speaking) have been adequately investigated using proper downward entailing contexts. Also, at least one language, Western Armenian, seems to buck this trend.

Still, evidence points in the direction of a systematic mismatch between the morphological and semantic diagnostics. Overall, the plural features seem to be morphologically marked but semantically unmarked.

4 Problems for a Negative Correlation

The *lesser hope* in establishing a connection between the morphological diagnostics and the semantic one is that the inconsistencies between them are systematic. As pointed out in section 2.2, if number features can be interpreted as augmenting functions and if there is a relationship between being morphologically marked and being referenced by grammatical rules, then one would expect that language after language would have the denotation of a noun with the morphologically unmarked number feature being a subset of the denotation of the same noun with the morphologically marked number feature. As mentioned in section 3.3, preliminary evidence suggests that many languages pattern in this way.

This connection between the semantic and morphological diagnostics is promising. However, there are some problems. Recently, the idea that the plural feature can be interpreted as an augmenting function has come under some scrutiny. For example, Bale (in press) mentions three problems for this type of interpretation (Sauerland, 2003, also discusses problems for an augmenting function). In this section, we will review one of these problems and discuss a potential solution. Our goal here is to outline a program of research rather than to offer complete solutions to the problems concerning the interpretation of the plural feature. In fact, this section should read more like a

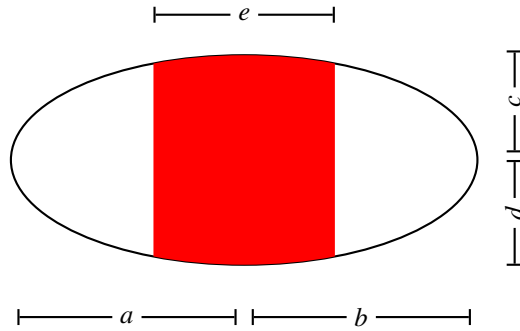


Figure 1: A graphical representation of the two pound lump of mashed potatoes sitting on the table. The vertical strip in the center represents the spilt food dye. The brackets represent the different places pointed to in the order indicated by the alphabetical order.

warning: If one thinks it is empirically justified to maintain a connection between the semantic diagnostic and the morphological diagnostics, then there is some theoretical work to be done and some hard problems to solve.

One problem that needs to be solved centers around the use of the singular noun phrase *pound of potato* and the plural noun phrase *pounds of potato*.¹⁸ As demonstrated in Bale (in press), the way these phrases are used is inconsistent with the idea that the plural feature is interpreted as a Link-style augmenting function. To understand the problem, let's briefly set up a context in which to evaluate these types of phrases. Consider a situation where there is a two-pound lump of mashed potatoes sitting on a table. Suppose that while cooking, food dye is spilt on the potatoes putting a stripe down the center of the lump (see figure 1). In this situation, demonstratives and finger-pointing can be used to talk about certain portions of the lump. For example, one could point to the left half of the lump and truthfully utter the sentence in (23a). One could also point to the right half and truthfully utter the sentence in (23b). Furthermore, one could point to the top half and truthfully utter the sentence in (23c) and to the bottom half and truthfully utter the sentence in (23d). Finally, one could point to the center stripe of the lump and truthfully utter the sentence in (23e).

- (23) a. This pound of potato is partially red. (left-half, *a*)
 b. That pound of potato is also partially red. (right-half, *b*)
 c. This other pound of potato is partially red. (top-half, *c*)
 d. That other pound of potato is partially red. (bottom-half, *d*)
 e. However, this pound of potato is completely red. (center, *e*)

For convenience, we have labeled the different pounds of potato with the letters *a* through *e*. The letters are meant to indicate where one is pointing when uttering the sentences in (23).

¹⁸In this section, we will focus on measure phrases. However, as mentioned by a reviewer, similar problems might exist for nouns that refer to scattered or decomposable objects such as *meals* and *manikins*.

The fact that all five sentences are possible in this situation has some consequences for the denotation of the phrase *pound of potato*. It suggests that *a, b, c, d* and *e* are all members of the singular denotation. In other word, the set $\{a, b, c, d, e\}$ is a subset of the denotation of *pound of potato*.

A problem arises for a Link-style plural function when one considers how it would combine with *pound of potato*.¹⁹ If *a, b, c, d* and *e* are all members of the singular denotation, then a Link-style plural function will form lots of different groups. Specifically, since *a* and *b* are members of the singular denotation, the group *ab* must be a member of the plural denotation. Since *c* and *d* are members of the singular denotation, the group *cd* must also be a member of the plural denotation. Furthermore, since *a, b* and *e* are members of the singular denotation, the group *abe* must be a member of the plural denotation. These groups, created as a consequence of the augmenting function, lead to some interesting and wrong empirical predictions. For example, if the numeral modifiers *two* and *three* simply restrict the denotation to groups that have two members and three members respectively (as is commonly assumed), then the denotation of *two pounds of potato* should contain the groups *ab* and *cd* (see (24b)) while the denotation of *three pounds of potato* should contain the group *abe* (see (24c)).

- (24) a. $\llbracket \text{pounds of potato} \rrbracket = \{\dots, ab, cd\dots, abe\dots\}$
 b. $\llbracket \text{two pounds of potato} \rrbracket = \{\dots, ab, cd\dots\}$
 c. $\llbracket \text{three pounds of potato} \rrbracket = \{\dots, abe\dots\}$

The problem with these denotations is that they predict that it would be possible to point at the two pound lump of potato on the table and talk about it as *three pounds of potato*. There is a group, namely *abe*, that has three individual pounds in it. Hence, the sentence in (25a) is predicted to be coherent in the context specified above. The denotations in (24) also predict that the phrase *the two pounds of potato* could not be used to refer to the two pound lump of potato on the table. For example, the sentence in (25b) should be unacceptable. The definite determiner requires there to be a unique two pound group. However, as shown in (24b) there is no unique two pound group.

- (25) a. At least three pounds of potato are on the table./I put at least three pounds of potato on the counter.²⁰
 b. I poured red dye on the two pounds of potato.

Both of these predictions are incorrect. The sentence in (25a) is quite odd in a context where there is a two-pound lump of potato on the table, yet the sentence in (25b) is perfectly acceptable.

¹⁹For simplicity we treat *pound of potato* as the phrase to which the plural combines. This is due to the fact that it is easier to represent the denotation of this phrase on paper. However this treatment of the plural morpheme is not necessary to make our point. The same problems arise even if the plural morpheme applies only to the phrase *pound*, the argument *of potato* somehow combining with the noun at some later point.

²⁰There is an abstract concept of pound that is not problematic and can appear in sentences like “Just five minutes ago I pointed to five different pounds of potato.” Here, the predicate applies to each possible pound separately even if the pounds overlap materially. This reading is not problematic for the join-closure operation. The problematic reading only occurs when one refers to a measurement of an aggregate of material as in (25a) and (25b). A reviewer suggested that such readings might be block when NP appears within the VP as in “there are at least three pounds of potato on the table.” Speakers that we talked to did not agree with the review’s intuitions. Clearly more research needs to be done.

This problem can be solved if one interprets root nouns as being inherently plural while also interpreting the singular feature (SG) as a restrictor on the root noun (restricting the noun to singularities, see Bale, in press, for details). However, such a solution relies on allowing the singular feature to influence the interpretation of the noun phrase: something which should be avoided if one wants to try to maintain a connection between semantic and morphological markedness.

An alternative solution involves two parts: (1) a slight modification of the singular denotation of *pound of potato* and (2) a more intricate way of measuring groups. One of the implicit assumptions specified above is that the denotation of the singular noun phrase *pound of potato* consists of atoms, each atom being one pound of potato. Atoms in the denotations of singular nouns are traditionally treated as having no internal structure. However, this assumption need not hold. It is possible that the singular denotation of pound of potato is simply the set of all the aggregates of potato material that weigh one pound. Furthermore, the fact that this material is divisible (that the pound of potato can be divided into two clumps of potato, each weighing less than a pound) and the fact that some pounds share material could all be represented in the denotation of the singular noun phrase. To see how this could be done, let's reconsider the diagram of the two pound lump represented in figure 1 with the divisions represented in figure 2. In figure 2, we have labeled these divisions with the letters m through t . With these divisions, one can represent the pound a as the group of aggregates $mnqr$ ($a = mnqr$). Similarly, one can represent the pound b as $opst$ ($b = opst$), c as $mnop$ ($c = mnop$), d as $qrst$ ($d = qrst$), and e as $nors$ ($e = nors$). (Note, we are no longer following the convention that a group or complex aggregate is always represented by a series of letters. We allow for the letters $mnqr$ and a to be used interchangeably. Both represent the same aggregate.)

With this kind of representation of the internal structure of the pounds, some of our problems specified above begin to disappear. Recall that one of the problems was that the augmenting function formed the group abe . However, now the group abe is simply the join of $mnqr$ and $opst$ and $nors$: $abe = mnqr \vee opst \vee nors$. Yet, the join of $mnqr$ and $opst$ and $nors$ is equivalent to the join of a and b : $mnqr \vee opst \vee nors = mnopqrst = mnqr \vee opst$. Hence, ab is equivalent to abe . In other words, in a context where there is only a two pound lump of potato, the join operator is not creating groups that are larger than groups formed by joining two individual pounds.

Another problem specified above was that there were at least two groups with two pounds in them, namely ab and cd . However, the group ab is simply the group $a \vee b$ which is equivalent to $mnqr \vee opst$ which in turn is equivalent to $mnopqrst$. Similarly, the group cd is simply the group $c \vee d$ which is equivalent to $mnop \vee qrst$ which in turn is equivalent to $mnopqrst$. Hence, $ab = cd$. In other words, there is no distinction between ab and cd . They are one and the same group.

Although the problems created by the join operator seem to disappear when the internal structure of each pound of potato is represented in the denotation, one problem concerning measurement still remains. Normally, a measurement function is assumed to count all the indivisible atoms in a group. Thus, for any group x , the cardinality of x is equal to the number of atoms in x . However, by using divisible pounds in the denotation of *pound of potato*, counting becomes much more difficult. One can no longer count the indivisible atoms since no such atoms are part of the aggregates. A possible alternative to counting indivisible atoms would be to count the number of

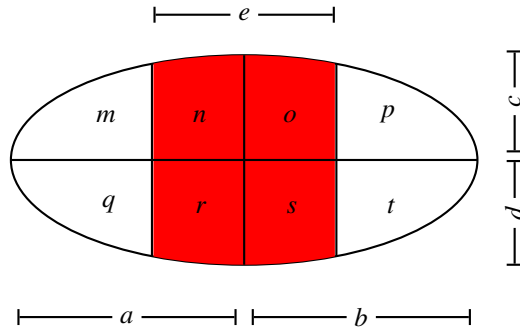


Figure 2: Two pound lump of potato with labeled sections.

minimal parts that are a part of the original group. Minimal parts are the members of a denotation that are not subgroups of any other member of the denotation. They are also the only elements that are in both the singular and plural denotation. For *pounds of potato* this would include all the singular pounds such as *a, b, c, d, e* etc. However this type of counting would yield empirically incorrect results. For example, the aggregate *mnopqrst* contains at least five different minimal parts – *a, b, c, d* and *e* – but its cardinality should be two.

A third possible way of defining a measurement function would be to count the number minimal parts that partition a group for some arbitrarily chosen partition.²¹ To spell this out in more detail, let's review the definition of a partition. A partition of a group x is a set of aggregates Y such that the join of all the members of Y is equal to x ($\bigvee Y = x$) and for any two members z and w of Y , there is no aggregate that is both a subgroup of z and w ($z \wedge w = \emptyset$). In other words, no two members of Y overlap. Thus, in assigning a measurement to a group x in a denotation Z , one simply chooses a set of minimal parts in Z that partition x and then take the cardinality of this partition as the measurement of x .

In (26) we define a function that maps groups (with the denotations they are a part of) to a measurement. The definition is more complicate than the regular cardinality function due to the fact that a couple of conditions must be placed on the denotations and groups to which the function applies in order to make sure that the function is definable.

- (26) **Definition of the counting function μ :** Suppose x is a member of the denotation Z , μ is a function from $\langle x, Z \rangle$ to $n \in \mathbb{N}$ and is defined only if (i) x can be partitioned by a set of minimal parts in Z and (ii) for any two such partitions of x , call them S and T , $|S| = |T|$. When defined, $\mu(x, Z) = n$ where $n = |Y|$, Y an arbitrarily chosen partition of x that contains only minimal parts from Z .

²¹In the semantic literature, partitions are best known in the analysis of reciprocity (see Fiengo and Lasnik, 1973). Furthermore, *covers*, of which a partition is a species, prove to be very useful in accounting for the semantics of cumulativity and distributivity (see Gillon, 1992, and Schwarzschild, 1996).

The condition specified in (i) guarantees that the groups being measured can be partitioned. The condition in (ii) ensures that the choice of partition does not matter since all possible partitions have the same cardinality. For any x and Z that meet the conditions in (i) and (ii), there is a unique n such that $\mu(x, Z) = n$.

With this measurement function, we can now define the numeral modifiers as in (27).

- (27) a. $\llbracket \text{two} \rrbracket = \lambda P. \{x : x \in P \ \& \ \mu(x, P) = 2\}$
 b. $\llbracket \text{three} \rrbracket = \lambda P. \{x : x \in P \ \& \ \mu(x, P) = 3\}$

The modifier *two* restricts the plural denotation to all the groups that measure 2 according to the definition in (26), while *three* restricts the denotation to groups that measure 3. If the plural denotation contains indivisible atoms, then the measure function μ is no different from the regular cardinality function: every group has only one possible partition into minimal parts and the cardinality of this partition is equivalent to the number of atoms that are a part of the group. In contrast, if the plural denotation contains minimal parts that have internal structure, then the μ function yields slightly different results. For example, let's reconsider the context above where there is a two pound lump of potato sitting on a table. With this context in mind, consider the singular denotation of *pound of potato* partially given in (28a). This denotation contains all the potato aggregates that weigh one pound where each aggregate can be divisible. The plural denotation would be formed by applying \vee to (28a), yielding a denotation that is partially represented in (28b). If the modifier *two* were to apply to this denotation, then the result would be a set that contains only one member, namely the group *mnopqrst* which represents the entire potato-lump (see (28c)). It is only this aggregate that can be partitioned by two minimal parts. For example, the set $\{mnop,qrst\}$ partitions this group and its cardinality is equal to 2. In contrast, if the modifier *three* applies to the plural denotation, the result would be an empty set (see (28d)). There is no member of the plural denotation that can be partitioned by three minimal parts.

- (28) a. $\llbracket \text{pound of potato} \rrbracket = \{mnqr, opst, mnop,qrst, nors, \dots, etc\dots\}$
 b. $\llbracket \text{pounds of potato} \rrbracket = \{mnqr, opst, mnop,qrst, nors, \dots, mnopqrst\}$
 c. $\llbracket \text{two pounds of potato} \rrbracket = \{mnopqrst\}$
 d. $\llbracket \text{three pounds of potato} \rrbracket = \{ \}$

The fact that (28c) contains one unique member is consistent with the coherent use of such an NP with a definite determiner. With the denotation in (28c), a sentence like *I poured red food dye on the two pounds of potato* no longer induces any kind of presupposition failure. Furthermore, the fact that (28d) is empty explains why one cannot talk about the two-pound lump as *three pounds of potato*.

In summary, by changing the way groups are measured and the way singular denotations are represented, one can overcome the problem introduced by *pounds of potato* while maintaining the hypothesis that plural features are interpreted as an augmenting function. Whether this solution is empirically feasible given more evidence (such as the other problems specified in Bale, in press, and Sauerland, 2003) is a topic for future research. However, if this solution is feasible, then a theoretical connection between morphological and semantic markedness seems to be plausible.

5 Conclusion

There are at least two lessons that can be learned from exploring the connection between morphological and semantic markedness. The first lesson is that one cannot know what the predicted behaviour of a morphologically marked feature would be in terms of interpretation and reference without knowing the details of how the semantic system would treat that feature. If the semantic system interprets that feature as a restrictor, then the morphological and semantic diagnostics for markedness should be in agreement. Since the marked feature restricts the denotation of the stem, the interpretation of the stem with the marked feature will always be a subset of the interpretation of the stem with the unmarked feature. On the other hand, if the semantic system treats the marked feature as an augmenting function (a function from a set to one of its supersets), then the morphological and semantic diagnostics should be systematically inconsistent with each other. Since the marked feature augments the denotation of the stem, it follows that the interpretation of the stem with the marked feature will always be a superset of the interpretation of the stem with the unmarked feature.

In our exploration of number marking we showed that it is theoretically possible to treat either the plural morpheme as an augmenting function or the singular morpheme as a restrictor. However, only the treatment of the plural morpheme as an augmenting function is consistent with the facts concerning markedness. In most languages, the plural morpheme is morphologically marked and yet the interpretation of the noun with the plural feature is generally a superset of the interpretation of the same noun with the singular feature.

The second lesson learned from our discussions concerns how work on markedness might influence our choice between theories in semantics. As shown in section 4, one might want to retain the interpretation of the plural morpheme as a closure operator despite the difficulties that this type of operator has with certain data (*the problem of too many pounds*).

Although the scope of this paper was rather limited and avoided some thorny issues, we believe that many of the conclusions we came to can be extended. For example, we did not discuss conditional markedness (features only being marked in certain grammatical contexts but not others). However, we believe that the same kind of theoretical connections can be made with respect to this kind of markedness as we have made in the simpler cases in this paper. Also in this paper, we avoided discussing dual marking. Although clearly more research needs to be done with respect to dual marking, especially concerning the behaviour of duals in downward entailing contexts, the general lesson should not change. If the feature responsible for distinguishing plurals from duals is marked, the results of the semantic diagnostic will depend on whether this dual feature has a restrictive interpretation (restricting the plural denotations to groups with two members), an augmenting interpretation (expanding the singular to include groups with two members) or neither. The issue is complicated but the extension of the discussion in this paper is straightforward.

Before concluding, it should be noted that the analysis and discussions in this paper rested on a particular assumption about the morphological diagnostics: namely that they reflect the underlying grammatical principle that only marked features can be referenced in grammatical rules. With this assumption, a grammatical connection be-

tween the morphological and semantic diagnostics becomes plausible. However, this underlying grammatical principle might turn out to be false, in which case, the possible connections between the semantic and morphological diagnostics becomes much more difficult to figure out. In fact, it remains a strong possibility that there is no connection between subset relations among denotations in semantics and the distributional patterns of features in morphology.

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