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RESEARCH

2 + 2 = 3: Number contrasts in Blackfoot

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Blackfoot nominals are singular, plural or general in number. The existence of languages with either a singular-plural opposition or a plural-general opposition is well-attested in the literature. Following Bliss (2013), we argue that Blackfoot has both systems, albeit in different contexts. We propose that the co-existence of these two systems in Blackfoot is due to the exceptional nature of plural specification in this language – it is alternatively realized as a head or modifying feature in the syntactic representation (in the sense of Wiltschko 2008). We show that regardless of whether plural is syntactically a head or a modifying feature, the semantic interpretation is the same. This is consistent with Rullmann & You's (2006) finding that plural marking has the same denotation no matter whether it contrasts with singular or with general number.

Keywords: singular; plural; general number; verb class; Blackfoot

1 A three-way number contrast in Blackfoot

In this paper we explore the syntax and semantics of number marking in Blackfoot, which shows some typologically rare patterns.[1] In particular, we observe that Blackfoot has nominals that are unambiguously singular, indicated by the singular demonstrative, as in (1a) and nominals that are unambiguously plural (marked by means of a plural suffix on both the demonstrative and the noun), as in (1b). In addition, Blackfoot has bare nominals that can be interpreted as either singular or plural, and hence can be described as displaying *general number* in the sense of Corbett (2000) and Rullmann & You (2006), as in (1c).[2]

(1) a. Nit-a'pihkahtoo-'p-wa amo aipasstaam.
1-sell.TI-TH-3SG DEM.SG apple
= 'I'm selling 1 apple.'
≠ I'm selling >1 apple.

b. Nit-a'pihkahtoo-'p-yi amo-istsi aipasstaam-istsi.
1-sell.TI-TH-3PL DEM-PL apple-PL
= 'I'm selling >1 apple.'
≠ I'm selling 1 apple.

[1] Blackfoot is an Algonquian language spoken in Alberta (Canada) and Montana (USA). If not otherwise indicated the data presented here come from our fieldwork with speakers of the Siksika dialect. The data were collected under ethics approval by the Conjoint Faculties Research Ethics Board at the University of Calgary (reference #7328). Like the other Algonquian languages, Blackfoot is a head-marking language where full DPs are always optional and arguments are obligatorily indexed on the verb. See Bliss (2013) for a detailed description and analysis of Blackfoot clause structure.

[2] See Section 2 for discussion of verbal morphology.

c. Nit-iponota'si-wa aipasstaam.
1-sell.AI-3SG apple
= 'I'm selling ≥1 apple.'

Hence, Blackfoot presents us with a three-way contrast in number as in (2).

(2) singular :: plural :: general

On most analyses of feature specifications, the existence of a three-way contrast is surprising. Features are typically conceived of as either mono-valent (privative) or bi-valent (binary). On the assumption that features are mono-valent, contrast comes about as a result of distinguishing the presence of a feature from its absence, as in (3a). Thus, if [F] is plural, then the absence of F (i.e., the unmarked case) is interpreted as singular. In contrast, on the assumption that features are bi-valent, contrast comes about as a result of having a positive or negative specification, as in (3b). Thus, if [F] is plural, then [+F] will correspond to a plural specification and [–F] will correspond to a singular interpretation.

(3) a. [F] :: –
b. [+F] :: [–F]

Neither of these approaches typically deals with three-way contrasts. On the mono-valent approach, one could assume two distinct features (i.e., plural and singular) each of which contrasts with the absence of that feature. On the bi-valent approach, one could assume that the contrasting feature specification [±plural] itself contrasts with the absence of this feature. In this paper, we develop an analysis that makes more explicit the ingredients of this particular three-way contrast. Specifically, the goal of this paper is to argue that this three-way contrast reduces to two two-way contrasts, as in (4).

(4) a. singular :: plural
b. plural :: general

The remainder of this paper is organized as follows: in Section 2 we show in detail how the three-way contrast results from two two-way contrasts. For objects of morphologically transitive verbs we observe a contrast between singular and plural, but for objects of morphologically intransitive verbs we observe a contrast between general number and plural.[3] In Section 3 we develop a syntactic analysis for these two two-way contrasts. We argue that plural marking in Blackfoot can either function as a syntactic head (contrasting with its singular counterpart) or as a modifier (contrasting with general number). We discuss the semantic consequences of our analysis in Section 4, and its typological consequences in Section 5. In Section 6 we conclude.

2 Two two-way contrasts: The role of the verbal predicate

The appearance of a three-way number contrast among Blackfoot object nominals can be reduced to two two-way contrasts: a singular vs. plural contrast, on the one hand, and a general vs. plural contrast, on the other. In this section, we shall see that the two contrasts are licensed in different contexts, and in Section 3, below, we argue that they are derived in different ways. We begin by demonstrating that the number options available with different object nominals are determined by the morpho-syntactic classification of the verb. In particular we show that the distribution of the two two-way contrasts is

[3] Bliss (2013) observes that the three-way number contrast is only found with objects of verbs. This is due to the fact that the number contrast is conditioned by morpho-syntactic properties of the verbs that select and license these objects (see Sections 2 and 3 for details).

conditioned by the class of the predicate that the nominal is dependent on: objects of transitive predicates display a contrast between singular and plural number (5a), whereas arguments of intransitive predicates display general number effects (5b).

(5) a. object of **transitive** predicate: singular :: plural
b. argument of **intransitive** predicate: plural :: general

In the remainder of this section, we describe in more detail the morpho-syntax of predicate classes in Blackfoot. Like all Algonquian languages, Blackfoot classifies its verbs into four distinct classes based on the morpho-syntactic content of the final morpheme of the verb stem. The traditional Algonquianist terms for these classes and their defining properties are summarized in Table 1.

As the names of these classes and their characterization suggest, verb classification is based on two properties: (i) whether the verb is transitive or intransitive, and (ii) whether a particular argument (subject or primary object) is animate or inanimate. Both of these properties are morpho-syntactic in nature, as is evident from the fact that the classes do not always reflect the argument-structure properties of the verbs, or the semantic content of their arguments. We shall see below that morpho-syntactic intransitivity does not always align with semantic intransitivity, due to the existence of animate intransitive (AI) verbs that have a primary object. Similarly, we will see that morphologically animate nouns are a semantically mixed class, including both nouns with a human or animate referent and nouns that refer to inanimate objects, such as objects that roll, objects made of metal, some items of clothing, some berries, some plants, etc. (cf. Wiltschko & Ritter 2015 for discussion).[4] Note that for morphologically intransitive verbs, the designated argument whose animacy is specified is the subject, but for morphologically transitive verbs, the designated argument is the *primary object*. The primary object is either the direct or indirect object, and is determined as follows: if there is a semantically animate indirect object it will be the primary object; otherwise the primary object is the direct object.

All Blackfoot dyadic and triadic verbs have both transitive and intransitive variants belonging to different verb classes, and the choice among them correlates with properties of the primary object. If this object is specific and referential, the verb will be realized as morphologically transitive (TA or TI), but if it is non-specific or non-referential, the verb will be realized as morphologically intransitive (AI).[5] In other words, Blackfoot and other Algonquian languages have sets of two, three or four verbs in different classes that correspond to a single verb in English. In this paper we focus on sets of verbs that consist of an AI, TA and TI verb, as illustrated in Table 2.

Table 1: Blackfoot (Algonquian) verb classes.

Verb class	Characterization
Animate Intransitive (AI)	Subject must be animate
Inanimate Intransitive (II)	Subject must be inanimate
Transitive Animate (TA)	Primary object must be animate
Transitive Inanimate (TI)	Primary object must be inanimate

[4] Evidence that this is a morphological classification system can be gleaned from the fact that the form of the plural marker can reliably be used to determine the classification of nouns: animate nouns are always pluralized with the suffix *–iksi* and inanimate nouns with *–istsi*.

[5] Blackfoot imposes a strict animacy requirement on external arguments of (di)transitive verbs. Consequently, there are no (di)transitive verbs of the inanimate intransitive (II) class in this language.

Frantz (2009: 41) uses the term *para(di)transitive* for AI verbs that have a primary object, because they lack object agreement. These verbs also lack *theme marking* (also known as *direct/inverse marking*). The theme marker is a suffix that appears immediately after the verb stem and indicates the relative status of the arguments based on a language-specific person/animacy hierarchy (cf. Bliss 2005, 2013). Primary objects of morphologically transitive (TA or TI) and intransitive (AI) verbs differ in three other respects, as illustrated in (6)–(8). First, objects of morphologically transitive verbs co-occur with a demonstrative or other determiner, but objects of morphologically intransitive verbs do not. Second, objects of morphologically transitive verbs may be either singular or plural, but not general, while objects of morphologically intransitive verbs may be either plural or general, but not singular. Finally, note also that the form of a morphologically transitive verb stem is sensitive to the animacy of its primary object, but the form of a morphologically intransitive verb stem is not. The examples in (8) demonstrate that morphologically intransitive verb stems are compatible with both animate and inanimate primary objects. These differences are summarized in Table 3.

(6) Transitive Animate (TA): plural vs. singular

a. Nit-oowat-a-yi ann-iksi ni'tawaakii-iksi.
1-eat.TA-TH-3PL DEM-PL chicken-PL
'I ate those chickens.'

b. Nit-oowat-a-wa ann-wa ni'tawaakii-wa.
1-eat.TA-TH-3SG DEM-PROX.SG chicken-PROX.SG
'I ate that chicken.'

c. *Nit-oowat-a ni'tawaakii.
1-eat.TA-TH chicken
Intended: 'I ate one or more chickens.'

Table 2: Blackfoot (Algonquian) verbs for 'eat'.

Verb class	'eat'	
Animate Intransitive (AI)	*ooyi*	'eat (object)'
Transitive Animate (TA)	*oowat*	'eat animate object'
Transitive Inanimate (TI)	*oowatoo*	'eat inanimate object'

Table 3: Primary objects of morphologically transitive and intransitive verbs.

Properties of primary object	Verb classes		
	Transitive Animate	***Transitive Inanimate***	***Animate Intransitive***
Referentiality	specific & referential	specific & referential	non-specific &/or non-referential
Demonstrative	yes	yes	no
Number specification	singular or plural	singular or plural	general or plural
Noun class	animate	inanimate	animate or inanimate
Agreement trigger	yes	yes	no
Theme marking	yes	yes	no

(7) Transitive Inanimate (TI): plural vs. singular
a. Nit-oowatoo-'p-yi ann-istsi aipasstaam-istsi.
1-eat.TI-TH-3PL DEM-PL apple-PL
'I ate those apples.'
b. Nit-oowatoo-'p-wa ann-yi aipasstaam-yi.
1-eat.TI-TH-3SG DEM-SG apple-SG
'I ate that apple.'
c. *Nit-oowatoo-'p aipasstaam.
1-eat.TI-TH apple
Intended: 'I ate one or more apples.'

(8) Animate Intransitive (AI): plural vs. general number
a. Nit-ooyi aipasstaam-istsi/ni'tawaakii-iksi.
1-eat.AI apple-PL/chicken-PL
'I ate apples/chickens.'
b. Nit-ooyi aipasstaam/ni'tawaakii.
1-eat.AI apple/chicken
'I ate one or more apples/chickens.'
c. *Nit-ooyi aipasstaam-wa/ni'tawaakii-wa.
1-eat.AI apple-SG/chicken-SG
'I ate an apple/a chicken.'

We interpret this cluster of properties as evidence for a syntactic difference between primary objects of morphologically transitive and intransitive verbs. In the next section, we adopt the proposal of Bliss (2013) that primary objects of transitive verbs are full arguments while primary objects of intransitive verbs are pseudo-incorporated arguments. Following Bliss, we also assume that this difference in argument status correlates with a structural difference. However, we argue that Bliss' (2013) structures fail to account for the different number contrasts in the two kinds of objects, and develop an alternative proposal which addresses this issue.[6]

3 Syntactic analysis

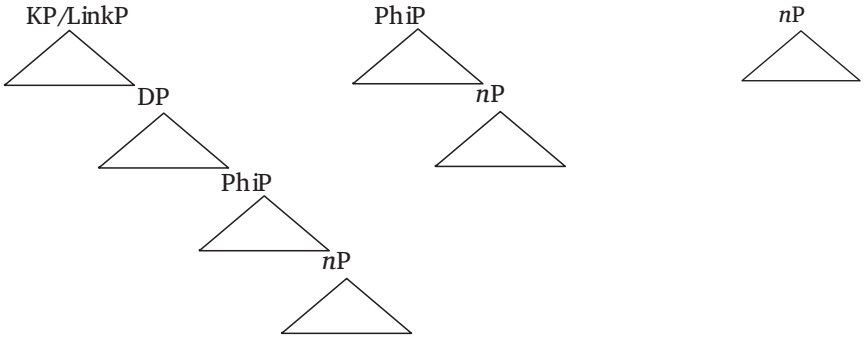
In order to account for the observed differences between the two classes of objects, Bliss (2013) argues that only objects of morphologically transitive (TA/TI) verbs are full nominals and are licensed by functional heads outside of the VP. Full nominals contain all functional categories, including PhiP, DP and KP or Link.[7] Objects of morphologically intransitive (AI) verbs, on the other hand, are *small nominals*, i.e., they lack some functional projections, and are pseudo-incorporated in the sense of Massam (2001). More

[6] For reasons of space, we omit discussion of nominals that include numerals. Based on the data we have collected, it appears that such nominals can function as the object of an AI verb only. As a reviewer points out this would be somewhat surprising if numeral licensing were only a matter of the size of the syntactic constituent. This needs further investigation. However, even the basic facts are uncertain at this point. Bliss (2013) and Weber & Matthewson (2014, 2017) report that nominal phrases that include numerals can be object of both AI and TA/TI verbs. This may be due to a difference between the speakers. Both Bliss and Weber & Matthewson consulted the same speaker – a Kainai Blackfoot woman in her 70's. Our consultants were younger speakers of the same dialect. Thus, we speculate that this point of contrast reflects a generational difference, and is the result of language change. However, exploration of this difference is beyond the scope of the present paper.

[7] Bliss (2013) assumes a version of Wiltschko's (2014) Universal Spine Hypothesis in which both nominal and verbal phrases consist of parallel sets of functional categories with the same interpretive function. LinkP is the highest category in either a nominal or verbal phrase; its function is to link the phrase into a larger structure, KP is a nominal variant of this same category. We abstract away from this distinction, as it has no consequences for the problem under consideration.

specifically, Bliss proposes that small nominals come in two varieties: she analyses bare nouns as lacking K/LinkP, DP and PhiP, but plural-marked nouns as lacking only K/LinkP and DP. The structures she proposes are schematized below:

(9) a. Full nominal b. Small nominal (PhiP) c. Small nominal (nP)



One of the distinctive properties of Blackfoot is that both singular and plural nouns are overtly marked with a suffix that indicates number and either obviation and/or animacy, as shown in Table 4.[8] *Animacy* refers to a morphological classification in Algonquian languages. *Obviation* refers to a kind of marking of discourse salience that is pervasive in these languages – morphologically animate nominals are marked as either *proximate* (discourse salient) or *obviative* (non-salient). We are not concerned here with the precise conditions that determine obviation. For discussion of obviation in Blackfoot, see Bliss (2013), and references cited therein. Bliss analyses the suffixes that mark singular number (and obviation for animate nouns) as associating with K/Link, and the suffixes that mark plural number and animacy as associating with Phi. Since only full nominals contain the category K/Link, but both full and small nominals may contain Phi, her analysis accounts for the fact that both types of nominals may be marked plural, but only full nominals may be marked singular.

Since *–wa* and *–yi* instantiate K/Link, rather than Phi, more must be said in order to account for the fact that *–wa* and *–yi* are interpreted as singular. Bliss assumes a morphological spell-out restriction that permits only one suffix per noun, with the result that the K/Link suffix is only overtly realized if Phi lacks an overt plural suffix. (See Bliss, Ritter & Wiltschko 2014 for arguments that a similar spell-out restriction is required for verbs in Blackfoot.) However, this leaves us with the following question: if some small nominals are PhiPs, why is it that

Table 4: Blackfoot nominal inflection.

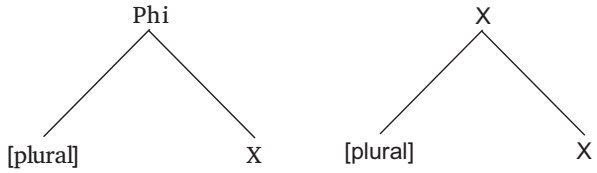
	–wa	***–yi***	***–iksi***	***–istsi***
number	singular	singular	plural	plural
obviation	proximate	(obviative)	—	—
animacy	(animate)	—	animate	inanimate
distribution	full nominals only	full nominals only	all nominals	all nominals

[8] Our speakers always appear to omit singular markers on nouns, and often appear to omit singular markers on demonstratives. Thus, a full nominal that is unmarked, or marked with a singular suffix on the demonstrative or on both the demonstrative and the noun, is interpreted as singular. Evidence that the singular markers are nonetheless there is the existence of a phonetic distinction between singular marked nouns and general unmarked nouns. This is demonstrated by Gick et al. (2012) on the basis of ultrasound experiments which show that speakers make an articulatory distinction between animate and inanimate singular nouns, even if the number markers are not audible. Thus, Gick et al. are able to show that these suffixes are still articulated despite the lack of acoustic information.

these PhiPs can be plural, but not singular? In the remainder of this section we develop an alternative analysis that attributes the lack of singular small nominals to the presence of two kinds of number features in Blackfoot. Following Bliss (2013), we assume that objects of TA/TI verbs have a more complex structure than objects of AI verbs, and that objects of TA/TI verbs always contain PhiP, whose head bears a number feature that determines whether that object is singular or plural. However, rather than assuming an optional PhiP in objects of AI verbs, we propose that in Blackfoot number marking may serve not only as a head associated with Phi, but also as a modifier which can associate lower than Phi.

We begin by motivating our hypothesis that Blackfoot has two qualitatively different number features. Our point of departure is Wiltschko's (2008) proposal that there are essentially two different kinds of formal syntactic features: *head features* and *modifying features*. A head feature determines the identity of the category it associates with. A modifying feature does not have this property. Rather, it optionally adjoins to a category whose identity is determined by a distinct head feature. This difference is schematized in (10). As shown in (10a), when [plural] is a head feature, it is associated with the functional category Phi; in contrast, as shown in (10b), when [plural] is a modifying feature, it is associated with a category whose identity is determined by some other feature.

(10) a. Head Feature b. Modifying Feature



The two types of features differ in terms of their distributional properties: a head feature is obligatory, but a modifying feature is not. According to Wiltschko (2008), English plural marking realizes a prototypical head feature. Observe that English plural nouns must bear a plural marker, even if the plural interpretation could be deduced otherwise, e.g., from a numeral like *three*, as shown in (11a). In other words, in English an unmarked noun is not compatible with a plural interpretation. When the noun is not plural-marked, as in (11b), Wiltschko argues that the noun still has to be interpreted as marked for number, and that in this case it receives a silent singular marker (Ø).

(11) a. I ate three cookie*(-s).
b. I ate a cookie-Ø.

Wiltschko interprets the contrast in (11) as evidence that an English nominal phrase is always associated with a number feature, and that the feature is interpreted as either singular or plural. She proposes that head features are bivalent, and specifically that English has a bivalent feature [±plural]. When a nominal is specified as [+plural], it is interpreted as plural, and when it is [–plural], it is interpreted as singular. As noted above, head features determine the label of the functional category they are associated with, and in particular, [± plural] associates with the category Phi.

Unlike a head feature, a modifying feature is optional and monovalent. To see this, consider the Halkomelem example in (12), in which plural marking displays different properties than in English. In (12a), the nominal *swíweles* 'boy' is not marked with a plural affix, although the numeral preceding the noun indicates that a plural interpretation is intended. And indeed, plural marking (in the form of ablaut) is optionally possible, as shown in (12b).

(12) *Halkomelem* (Wiltschko 2008: 642)

a. te lhíxw swíweles
DET three boy
'the three boys'

b. te lhíxw swóweles
DET three boy.PL
'the three boys'

When a monovalent modifying [plural] feature is present the noun is interpreted as plural in number; when it is absent, the noun is interpreted as number-neutral, unless there is some other element that restricts the interpretation of the nominal, such as a numeral or another quantifier. For instance, in Halkomelem, the unmarked noun *swíweles* 'boy' can be interpreted either as singular or plural.[9] The diagnostics for head and modifying features are summarized in Table 5.

As shown in Section 2, objects of AI verbs can be realized either as plural marked nouns or as bare nouns. The data are repeated in (13). We now show that the [plural] feature on objects of AI verbs is best analyzed as a modifying feature, and that the nominal complement of AI verbs lack PhiP.

(13) a. Nit-ooyi aipasstaam-istsi.
1-eat.AI apple-PL
'I ate apples.'

b. Nit-ooyi aipasstaam.
1-eat.AI apple
'I ate [one or more than one] apple./*I ate one apple.'

The properties of the plural suffix in the context of objects of AI verbs indicate that the plural feature on these objects is a modifying feature as diagnosed by Wiltschko (2008).[10] First, with objects of AI verbs, the plural suffix *–istsi* is optional, as shown by the fact that it is not required for a plural interpretation. A plural interpretation is possible, both in the presence of a plural suffix, and in its absence. However, in the absence of the plural suffix the nominal is number neutral, i.e., it is compatible with both a singular and a plural

Table 5: Two kinds of plural features (Wiltschko 2008).

Modifying feature	**Head feature**
optional	obligatory
monovalent values [plural] vs. absence of plural feature	bivalent values [+plural] vs. [–plural]
plural vs. number neutral interpretation	plural vs. singular interpretation

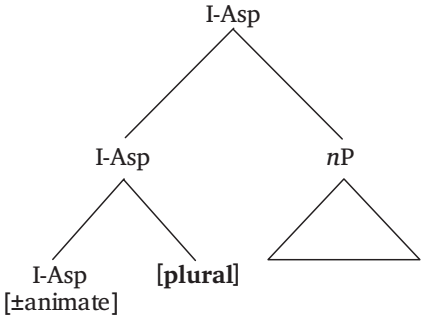
[9] Wiltschko (2008) argues that the modifying [plural] feature in Halkomelem is adjoined to a root, but speculates that there could be cross-linguistic variation in the category that the modifying [plural] feature adjoins to. We propose that Blackfoot also has an optional modifying [plural] feature, but that it is adjoined to Inner Aspect (I-Asp), rather than to the root (see the discussion below). See also Butler (2011) for additional evidence that the position of modifying features varies across languages.

[10] Blackfoot appears to be different from other Algonquian languages in this respect. For example, Mathieu (2013) shows that Ojibwe, another Algonquian language, only has a two-way contrast in number, i.e., singular vs. plural. He observes that Ojibwe bare nouns are not interpreted as number neutral, but rather as singular. Moreover, unlike in Blackfoot, Ojibwe bare nouns can appear as the object of TA and TI verbs. Taking these facts into consideration, Mathieu argues that plural suffixes in Ojibwe always instantiate a head feature, not a modifying feature.

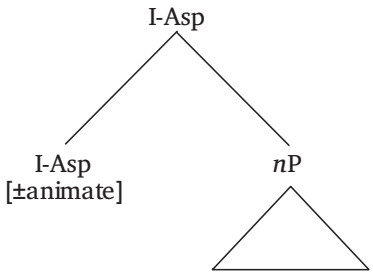
interpretation. This pattern of interpretation indicates that the plural feature on nominal objects of AI verbs cannot be a head feature. If it were a head feature, we would expect the contrast to be between singular and plural, as in English (11). In other words, the availability of a number-neutral interpretation in the absence of plural marking indicates that the category Phi is not projected. If it were, we would expect that nouns lacking an overt [+plural] affix would be PhiPs bearing a contrasting null [–plural] affix and hence be interpreted as singular.

The hypothesis that [plural] on small nominal objects of AI verbs is an optional modifying feature entails that there must be a distinct category-defining head feature. In fact, Ritter and Wiltschko (2014) develop just such an analysis. More specifically, they propose that the optional modifying [plural] feature on these small nominals is associated with I-Asp, a position which is associated with the head feature [±animate] (Wiltschko 2012). On this view, all small nominal objects of AI verbs are analyzed as instantiating nominal I-Asp – a constituent which does not include PhiP. The structures of plural and number-neutral objects of AI verbs are schematized in (14a) and (14b), respectively.

(14) a. Plural



b. Number Neutral



Summarizing the results of this section, we have argued that objects of TA/TI verbs are full nominals, and that they include PhiP, a functional category whose head is specified for a bivalent number feature [±plural]. Consequently, full nominals are specified as either singular or plural number. In contrast, objects of AI verbs are small nominals. In Blackfoot, small nominals are I-AspPs, a category whose head is obligatorily specified for a bivalent class feature [±animate], and optionally modified by a monovalent number feature [plural]. When the optional [plural] feature is present, a small nominal is interpreted as plural and when it is absent the small nominal is number neutral.

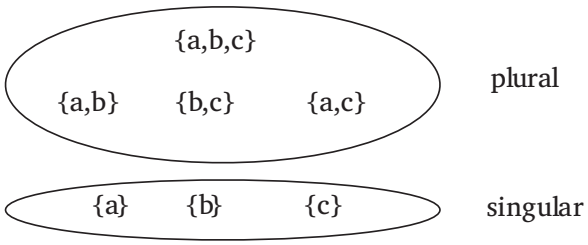
Given that plural features occur in two different head positions one might expect that a single noun could have two plural markers. This is not possible, as a double plural would be semantically vacuous: a head feature that specifies a value for plural receives no additional information from a modifying plural feature.

4 Semantic consequences

In this section we turn to the question of the semantic content of the two plural markers we have identified in Blackfoot. Relevant in this context is Rullmann & You's (2006) analysis of number in languages like English with only a singular-plural opposition and languages like Mandarin with only a general-plural opposition. Here we suggest that their analysis can also be applied to languages like Blackfoot, which have both types of opposition, but in different contexts. This is a desirable result given that there appears to be no difference in interpretation between the two kinds of plural in Blackfoot.

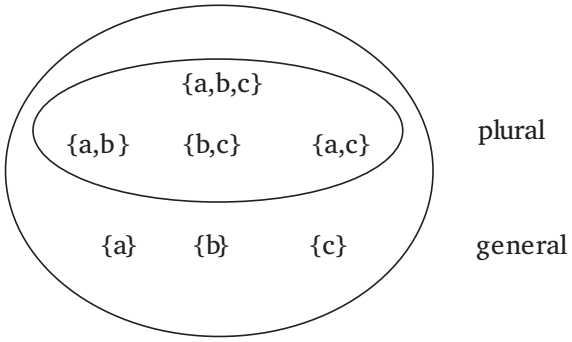
Rullmann & You (2006) follow Link's (1983) general approach to the semantics of number, in which the domain consists of an atomic join semi-lattice. The atoms in this lattice represent singular entities (e.g., *Alex*), and their (non-atomic) sums represent plural entities (a.k.a. pluralities; e.g., *Alex and Bob*). A singular count noun denotes a set of atoms, and the corresponding plural noun denotes the set of all pluralities that can be constructed from those atoms, as schematized in (15).

(15) Denotation of singular :: plural opposition (*English*)



A noun with general number (such as bare nouns in Mandarin and many other languages) denotes a set containing both atoms and all their sums, and is best translated into English as 'one or more Ns'. According to Rullmann & You, in languages with a general-plural opposition, the denotation of the plural noun is a subset of the denotation of the bare (general) noun, as shown in (16).

(16) Denotation of general :: plural opposition (*Mandarin*)



Within this general framework, the proposal about Blackfoot we have put forward in this paper can be implemented formally as follows. As in Schwarzschild (1996), Chierchia (1998), and Rullmann & You (2006), we model entities (type *e*) as non-empty sets. Singular entities (atoms) are singleton sets (e.g., {a}) and plurals entities (sums) are non-singleton sets (e.g., {a,b}). Sum formation corresponds to set-theoretic union (e.g., the sum of {a} and {b} is {a}∪{b} = {a,b}). Common nouns are of type $<e,t>$ and denote (the characteristic function of) sets of entities.

In Blackfoot (and perhaps in all languages), noun roots have general number, that is, they denote sets that include both atoms and their sums. The denotations of Blackfoot noun roots are therefore closed under union (sum-formation); that is, for any (atoms or sums) x and y, if $x \in [\![N]\!]$ and $y \in [\![N]\!]$, then also $x \cup y \in [\![N]\!]$.

Adjunction of the [plural] feature restricts the noun denotation to the sums and eliminates the atoms. There are two ways in which this can be implemented formally. One option is to treat the [plural] feature as a *function* of type $<<e,t>,<e,t>>$, which has been the usual approach in the formal-semantic literature on number. Concretely, the

feature [plural] would denote a function which takes a set of entities and maps it onto the subset containing only its non-atomic members. This function is defined in (17).[11]

(17) Denotation of [plural] as an expression of type $<<e,t>,<e,t>>$ (FA analysis)
$[\![\text{[plural]}]\!] = \lambda X . X - At$
where At is the set of all atoms in D_e.

In this analysis, the feature combines with the noun (or *n*P) to which it is adjoined by means of Function Application (FA; cf. Heim & Kratzer 1998).

There is, however, a simpler analysis, at least for the Blackfoot data under consideration. If the [plural] feature combines with the noun by means of Heim & Kratzer's operation of Predicate Modification (PM) instead of FA, we can treat it as an expression of type $<e,t>$ (the same type as the noun), which denotes the set of all non-atomic entities, as in (18).

(18) Denotation of [plural] as an expression of type $<e,t>$ (PM analysis)
$[\![\text{[plural]}]\!] = D_e - At$

Combining the adjoined [plural] feature with the noun via PM in effect means forming the intersection of the noun denotation with the set of non-atoms, which yields the same result as in the FA analysis.

If [plural] is a monovalent modifying feature (i.e., in objects of AI verbs), both the FA and the PM analysis yield the opposition between general and plural number depicted in (16). In the absence of the [plural] feature, the noun (both the root and its *n*P projection) will denote a set containing atoms as well as their sums (e.g., {{a}, {b}, {c}, {a,b}, {a,c}, {b,c}, {a,b,c}}), whereas when the [plural] feature is adjoined, the resulting denotation will include only the sums (e.g., {{a,b}, {a,c}, {b,c}, {a,b,c}}). However, things are complicated somewhat by the fact that, for syntactic reasons, we argued in Section 3 that the [plural] feature is not adjoined to the *n*P itself, but to the [±animate] feature in I-Asp, as shown in (14a). This complication can be solved more easily, and elegantly, under the PM analysis than in the FA analysis. We will simply assume that the feature [±animate] is also of type $<e,t>$, with [+animate] denoting the set of all entities that count as animate in Blackfoot, and [–animate] denoting the complement of that set (i.e., all non-animate entities).[12] The [plural] and [±animate] features are then combined via PM, forming the intersection of their respective denotations, which in turn is intersected (again via PM) with the denotation of the *n*P.[13]

What about objects of TA or TI verbs, which have a bivalent head feature [±plural]? Again, it's easier to deal with this if we assume the PM analysis. We will treat the minus

[11] Rullmann & You's (2006) semantics for the plural marker is slightly more complicated in that it first closes the noun denotation under union, as in (i).

(i) $[\![\text{[plural]}]\!] = \lambda X . {}^*X - At$

Here the * operator denotes closure under union, i.e., $^*X = \{x \in X \mid \exists y, z \in X [x = y \cup z]\}$. For Blackfoot, including the * operator in the definition of the plural feature will not make any difference because the denotation of Blackfoot noun roots is, by hypothesis, already closed under union (i.e., for any noun root N, $^*[\![N]\!] = [\![N]\!]$). However, adding the * as in (i) has the advantage that the same semantics for the plural feature will be applicable to languages where (uninflected) nouns denote sets containing only atoms. But for the sake of simplicity, we will use definition (17) without the * in the main text.

[12] This semantic analysis of animacy is challenged by the mismatches mentioned in Section 2: recall that morphologically animate nouns belong to two subclasses – those that are also semantically animate, and those that are semantically inanimate, e.g., *áínaka'si* 'wagon' and *apssi* 'white buffalo berry'. We note that similar problems commonly arise in languages with masculine, feminine (and neuter) gender features, and leave this issue for future research.

[13] Under the FA analysis, where the features denote functions of type $<<e,t>,<e,t>>$, a solution can also be devised, but it is more complex, involving *composition* of the functions denoted by the two features.

(–) value of the feature as denoting the *complement* operation (relative to D_e), whereas the plus (+) value is the identity function (or semantically vacuous). This yields the following denotations of [+plural] and [–plural]:

(19) a. $[\![[+\text{plural}]]\!] = [\![[\text{plural}]]\!] = D_e - At$
b. $[\![[-\text{plural}]]\!] = D_e - [\![[\text{plural}]]\!] = At$

Combining the noun (*n*P) with [+plural] via PM yields a set of non-atoms (e.g., {{a,b}, {a, c}, {b,c}, {a,b,c}}), whereas combining it with [–plural] yields a set of atoms (e.g., {{a}, {b}, {c}}. This gives us the opposition between singular and plural depicted in (15).[14]

In sum, we have shown that the apparent three-way contrast in number marking reduces to two two-way contrasts. In the context of transitive predicates we have a singular vs. plural contrast but in the context of intransitive predicates the contrast is between plural and general number. Crucially, the denotation of general number includes the denotation for plural. What is interesting is that the same plural marker (animate *–iksi* or inanimate *–istsi*) is used regardless of whether it contrasts with singular or general number. This is consistent with Rullmann & You's (2006) finding that plural marking has the same denotation no matter whether it contrasts with singular or with general.[15]

5 Typological consequences

Languages with a singular-plural opposition are extremely common; languages with a general-plural opposition are less common, but include a sizeable number of genetically and areally distinct examples. For example, Haspelmath (2013) lists 133 languages with obligatory plural marking on all nouns but only 55 languages with optional plural marking on all nouns. The attested options in his survey are in fact much more varied: Haspelmath (2013) also lists 20 languages with optional plural marking – but only on nouns that denote humans, and 15 languages with obligatory plural marking on nouns that denote humans and optional plural marking on nouns that denote inanimate objects. This last group would appear to be another type of language with both a singular-plural opposition and a general-plural one, with the choice determined by the lexical semantics of the noun, rather than the classification of the verb. Languages like Blackfoot with number marking on all nouns that is obligatory in some contexts and optional in others appear to be extremely rare.

According to the analysis we have developed here, this apparent three-way contrast in Blackfoot reduces to the unusual juxtaposition of two distinct systems, which are themselves attested elsewhere. This still leaves the question as to why this constellation of facts would be so rare. We speculate that this constellation comes about only when several properties conspire. And it is precisely these properties that conspire to produce this constellation that are typologically rare for independent reasons. Specifically, Blackfoot has an overt marker for singular as well as plural number. The existence of a singular marker means that the contrast between singular and general number will be morphologically marked.

In sum, while the surface three-way contrast in Blackfoot number marking is typologically rare, we have shown here that this three-way contrast reduces to two two- way contrasts

[14] The FA analysis could also be made to handle this, but again this would be more technically complicated.
[15] Rullmann & You (2006) note that in Mandarin singular and general number differ with respect to scope possibilities, discourse anaphora and scalar implicatures. For example, Mandarin bare nouns with general number can only have narrow scope. Weber & Matthewson (2014, 2017) have shown that this is also the case for Blackfoot. An exploration of these other properties of general number is beyond the scope of this paper.

which are typologically common. It is the co-occurrence of both these systems which is typologically rare because they depend on other typologically rare properties.

6 Conclusion

In this paper, we discussed the issues surrounding the existence of a three-way number contrast in Blackfoot. We argued that this contrast reduces to two two-way contrasts that are conditioned by the embedding predicates. This is summarized below.

(20) Surface three-way contrast:
singular :: plural :: general

(21) Underlying two-way contrasts:
a. object of transitive predicate: singular :: plural
b. argument of intransitive predicate: plural :: general

In terms of the semantics, we have adopted Rullmann & You's (2006) proposal according to which the semantic properties of plural marking are identical no matter whether it contrasts with singular or with general number. This is consistent with the fact that the plural marker used in Blackfoot is identical in both cases. What remains to be seen is whether all three-way contrasts attested in the languages of the world are amenable to a similar analysis.

Abbreviations

1 = first person, 3 = third person, AI = intransitive animate, DEM = demonstrative, FA = Function Application, II = intransitive inanimate, I-ASP = Inner Aspect, PL = plural, PM = Predicate Modification, PROX = proximate, SG = singular, TA = transitive animate, TH = theme marker, TI = transitive inanimate

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Competing Interests

The authors have no competing interests to declare.

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