

Dual number and the typology of the numeral-noun construction¹

Luisa Martí
 Queen Mary University of London
 luisa.marti@qmul.ac.uk
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 Comments welcome!

In this paper I lay down the theoretical groundwork for an extension of Martí's (2020a) theory of the numeral+noun construction (e.g., English *three dogs*) to languages that draw a distinction between singular, dual and plural in their nominal domain. Martí's account hypothesizes that the number marking we see on nouns in this construction is the result of the interaction between the compositional semantics of number features, as conceived of in Harbour (2014), and of cardinal numerals, as conceived of in Scontras (2014) and others. Extending Martí's account to singular-dual-plural languages makes concrete predictions about the types of number marking we should observe on their nouns when they combine with numerals, and the question that arises is whether these are the patterns that we indeed find cross-linguistically. I argue below that the numeral+noun construction in Yimas and Hopi conforms straightforwardly to these predictions. I also discuss Imere and Ljubljana Slovenian, languages which can be shown to conform to the predictions once a proper understanding of complex numerals (in the case of Ljubljana Slovenian) and number prefixes (in the case of Imere) is in place. The consideration of Ljubljana Slovenian requires an analysis for complex numerals, aspects of which I borrow from Ionin and Matushansky (2006, 2018) and adapt to fit Martí's proposal. The analysis makes additional predictions that remain to be investigated and that are spelled out as well.

1 Introduction

Two cross-linguistically common patterns for the numeral+noun construction in languages that distinguish singular from plural on nouns are illustrated in (1)-(3). (1)-(2) illustrate one of those patterns, as realized in English, and (3) illustrates the other pattern, as realized in Turkish (Bale, Gagnon and Khanjian 2011):

- (1) English
 One {**boy** | ***boys**}
- (2) English
 Two/three/twenty-three {**boys** | ***boy**}
- (3) Turkish
 Bir/ iki/ üç/ yirmi üç {**çocuk** | ***çocuk-lar**}
 One/ two/ three/ twenty three boy.SG | boy-PL
 'One/two/three/twenty-three boy(s)'

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In the English pattern, the cardinal numeral *one* combines with a noun that is morphologically marked as singular, and other cardinal numerals combine with nouns marked for plural. In the Turkish pattern, all cardinal numerals combine with a noun that is morphologically marked for singular. Note that Turkish and other languages that instantiate this pattern do in principle inflect their nouns for plural (e.g., with the suffix *-lar*, subject to vowel harmony, in Turkish), but choose not to use the plural form of the noun in the numeral+noun construction (in both of the languages exemplified here, singular number is not realized phonologically, but nothing in what follows hinges on that).²

The morphological realization of the noun in the numeral+noun construction is usually considered a matter of number agreement, and the semantics of the construction is derived by a separate set of tools from that (see, e.g., Alexiadou 2019, Bylinina and Nouwen 2018, or Ionin and Matushansky 2006, 2018 for recent instantiations of this approach). In Martí (2020a, under review), however, a different analysis is entertained, one in which the morphological realization of grammatical number and the semantics of the construction arise from one and the same set of tools. There are reasons to think that the second approach deserves to be explored, which is what I do here. One important reason, discussed also in Martí (2020a: 4-5), is that the second approach significantly reduces the number of tools that are needed to account for the number properties of the noun in the construction. In this approach, there is no need to appeal to additional number agreement rules or principles to account for the number marking on the noun in the numeral+noun construction, since that follows already from the tools used to derive its semantics. In other words, the semantic analysis of the construction already predicts the shape that the noun should take, so appealing to any additional principles is unnecessary. It is this economical aspect of the proposal that makes it worth pursuing in principle.

The set of tools that Martí (2020a) appeals to is, in brief, as follows. First, she assumes Harbour's (2014) theory of number features. In particular, she assumes that at most three binary features can appear in NumberP, the locus of grammatical number: [\pm atomic], [\pm minimal] and [\pm additive]. These are features with a semantics that does not vary cross-linguistically and with a specific morpho-syntactic realization in different languages. Second, she follows Scontras' (2014) assumptions about the syntax and semantics of (bare) numerals, which are treated as specifiers of NumeralP that denote numbers (i.e., type $\langle n \rangle$). NumeralP itself is headed by a counting predicate CARD and bears a specific syntactic relation to NumberP, namely, it is dominated by it. With these assumptions in place, the patterns we observed above follow.³

The theoretical goal of this paper is to work out the predictions that an approach like this makes with respect to languages that, in addition to singular and plural, also distinguish dual in nouns. The extensions to the theory that I propose here entail that, generally speaking, the locus of cross-linguistic variation for the phenomenon at hand rest in two places: (a) the number feature(s) a particular language generates in NumberP, and (b) the structural relationship between NumberP and NumeralP—I will assume that, in a given language, NumberP dominates NumeralP (NumberP \gg NumeralP), as in Scontras' proposal, or the other way around (NumeralP \gg NumberP).

The theory is quite restrictive in what it predicts for singular-dual-plural languages, as explained in detail in section 3. In what I will call predicted pattern 1, shown in (4), the numeral

² It is well known that another relevant pattern is that exemplified in Western Armenian, where numerals greater than one may combine with nouns marked for singular or for plural in the numeral+noun construction, with interpretative effects (see Ionin and Matushansky 2018, Martí 2020a, Scontras 2014, Sigler 1997). Martí (2020a) shows how that pattern can be understood within the framework defended there. For reasons of space, I will not be able to consider here how the possibility of optionality interacts with the proposal I make below.

³ Martí (under review) shows that the same assumptions can explain the patterns that we find with zero as the numeral.

one combines only with a noun in the singular, the numeral two, only with a noun in the dual, and other numerals, only with the noun in the plural:

- (4) Predicted pattern 1:
One + N-**singular**
Two + N-**dual**
Other numeral + N-**plural**

Predicted pattern 2, shown in (5), is just like Predicted pattern 1 except that with numerals other and one and two, the dual form of the noun is used:

- (5) Predicted pattern 2:
One + N-**singular**
Two + N-**dual**
Other numeral + N-**dual**

On the empirical side, the goal is to find out whether there are languages that exemplify these patterns, and whether there are languages that constitute counterexamples to the predictions made by the theory. I show in section 3 that pattern 1 is straightforwardly exemplified in Yimas and Hopi.

Predicted pattern 2 might seem strange at first but can be viewed as a generalization of the Turkish pattern in that, if attested, we'd have a language that in principle marks plurality on nouns but that chooses not to use that marking in the numeral+noun construction, using other number marking instead. As far as I am aware, there is no confirmation that a language exemplifies this pattern, so it is not yet possible to know whether the theory overgenerates in this respect or not.

I have so far found two languages that are superficially problematic for the theory presented here. In Ljubljana Slovenian, complex numerals that end in one or two do not combine with a plural noun, as predicted, but with a singular or a dual one, respectively. I argue below that this language is not a real counterexample to the theory as long as the syntax and semantics of complex numerals is properly understood, an understanding that, I suggest, may borrow from Ionin and Matushansky's (2006, 2018) analysis of complex numerals. A second case to consider is Imere, which displays the following pattern despite being a singular-dual-plural language as well:

- (6) Pattern attested in Imere:
One + N-**singular**
Two + N-**plural**
Other numeral + N-**plural**

I argue that this language does not actually constitute a counterexample to the theory either. That's because the morpheme that marks dual in Imere, the noun prefix *ruu-* plausibly spells out dual number morphology *and* also material in D. Given this, we expect it not to be able to co-occur with numerals, such as the numeral two. A different number marking is then used with that numeral.

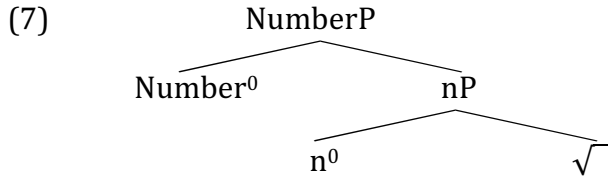
The organization of the paper is as follows. Section 2 introduces the theoretical tools from Martí (2020a). Section 3 is the theoretical core of the paper and discusses the predictions that an extension of these tools makes for singular-dual-plural systems. Section 4 presents the data from Yimas and Hopi that illustrate pattern 1. Section 5 presents the arguments that (Ljubljana) Slovenian and Imere are not counterexamples to the theory, despite appearances. Ionin and

Matushansky's (2006, 2018) proposal regarding complex numerals is discussed in detail in this section as well. Section 6 concludes.

2 Martí's (2020a) theory

This section focuses on singular-plural systems (or one-feature systems) and on Martí's account of them, based on Harbour (2014) and Scontras (2014).

Let's begin by spelling out Martí's assumptions on number features and their syntax and semantics, based on Harbour (2014). The syntax of nouns when they are not accompanied by numerals is assumed to be as in (7) (cf. Borer 2005 and many others):



Here, a nominal category nP (which results from combining a root with n^0 , a nominalizer) is the sister to the head of NumberP. The denotation of nP is assumed to contain both plural and atomic individuals (cf. Link 1983):

$$(8) \quad \llbracket \text{nP} \rrbracket = \{a, b, c, ab, ac, bc, abc\}$$

It is on such a denotation that the semantics of the number features $[\pm\text{atomic}]$, $[\pm\text{minimal}]$ and $[\pm\text{additive}]$ operate on. The semantics of the two features that will concern us here, $[\pm\text{atomic}]$ and $[\pm\text{minimal}]$, is assumed to be as follows:⁴

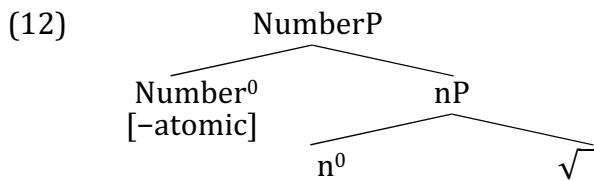
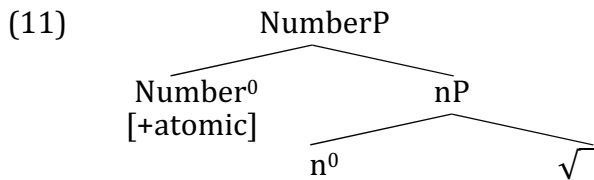
$$\begin{aligned}
 (9) \quad \llbracket +\text{atomic} \rrbracket &= \lambda P_{\langle e, t \rangle}. \lambda x_{e.} P(x) \ \& \ \text{atom}(x) \\
 \llbracket -\text{atomic} \rrbracket &= \lambda P_{\langle e, t \rangle}. \lambda x_{e.} P(x) \ \& \ \neg \text{atom}(x)
 \end{aligned}$$

$$\begin{aligned}
 (10) \quad \llbracket +\text{minimal} \rrbracket &= \lambda P_{\langle e, t \rangle}. \lambda x_{e.} P(x) \ \& \ \neg \exists y P(y) \ \& \ y \sqsubset x \\
 \llbracket -\text{minimal} \rrbracket &= \lambda P_{\langle e, t \rangle}. \lambda x_{e.} P(x) \ \& \ \exists y P(y) \ \& \ y \sqsubset x
 \end{aligned}$$

$[\pm\text{atomic}]$ is sensitive to whether something is an atom ($[+\text{atomic}]$) or not ($[-\text{atomic}]$), and $[\pm\text{minimal}]$ is sensitive to whether the set denoted by its sister contains elements with proper parts in that set ($[-\text{minimal}]$) or not ($[+\text{minimal}]$). Possible number systems are those where none of these features are available (so the language would not mark grammatical number), where just one feature is available, or where certain combinations of these features are available. Singular-plural systems may be analyzed, in principle, as either $[\pm\text{atomic}]$ or $[\pm\text{minimal}]$. Usually, unless the language makes a distinction between 1st person inclusive and 1st person exclusive in its pronominal system (see Harbour 2011), a singular-plural language is treated as a $[\pm\text{atomic}]$ system. English, for example, would be one such system, with $[+\text{atomic}]$ spelled out as null and $[-\text{atomic}]$ spelled out as $-s$:⁵

⁴ '⊂' is the proper subpart relation. Lower case variable names range over both atomic and non-atomic individuals. The third of Harbour's features, $[\pm\text{additive}]$, plays no role in singular-plural languages and is therefore not introduced here.

⁵ (12) gives rise to a so-called exclusive semantics for English plurals, that is, to a semantics concerned only with plural individuals. There is a long-standing debate in the literature as to whether this is the correct semantics for them, given the meaning of sentences such as *I have no children*, which are concerned both with atoms and non-atoms (otherwise the sentence would be predicted incorrectly to be true as long as the speaker has one child).



[±Minimal] can, in principle, also give rise to a singular-plural system, but, because of its relative semantics, this feature can give rise to more distinctions than [±atomic]. [±Minimal] is the feature at the heart of the pronominal paradigm of languages like Ilocano (Austronesian), shown in Table 1 (see Corbett 2000: 168, Rubino 1997: 55-6):

| | minimal | augmented |
|--------------|----------------|------------------|
| 1excl | -ko | -mi |
| 1incl | -ta | -tayo |
| 2 | -mo | -yo |
| 3 | -na | -da |

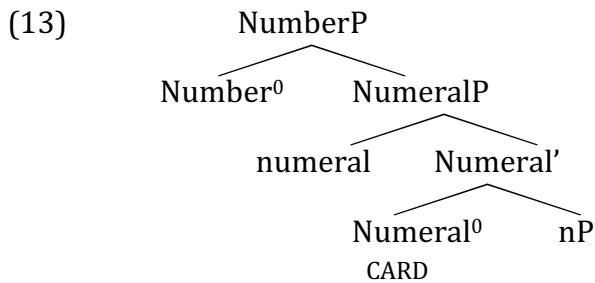
Table 1 Ilocano enclitic pronouns

[+Minimal] picks the speaker+hearer dyad (crucially not an atom) for the minimal 1st person inclusive pronoun *-ta*, giving rise to a pronoun that picks two referents (not one). That's because the speaker+hearer dyad is an element without proper parts in a set that contains speaker as well as the hearer; [-minimal] picks three or more referents (speaker+hearer+other(s)) for the 1st person inclusive augmented pronoun *-tayo*, since these all contain proper parts from the set (the speaker+hearer dyad). In the other persons, which do not include the hearer, one (for minimal pronouns) or more than one (for augmented pronouns) referents are picked. Thus, though close in their semantics, [±minimal] and [±atomic] are not the same feature.

Martí argues that this system, put together with Scontras' (2014) assumptions about numerals, predicts the English and Turkish patterns we saw in section 1⁶. Scontras assumes the following syntax:

Two main positions exist in this debate: (i) either plural nouns only have an inclusive semantics, unlike that obtained from (12), and exclusive meanings arise pragmatically (see Dvorak and Sauerland 2006, Ivlieva 2013, Krifka 1989, 1995, Lasersohn 1998, 2011, Sauerland 2003, Sauerland, Anderssen and Yatsushiro 2005, Spector 2007, Yatsushiro, Sauerland and Alexiadou 2017, Zweig 2009), or (ii) plural nouns are ambiguous between an inclusive and an exclusive semantics and their use is regulated pragmatically (see Farkas and de Swart 2010, Grimm 2012). Whereas arguments exist for and against both positions (see Kiparsky and Tonhauser 2012 for an overview), Martí (2020b) argues that only an ambiguity approach (such as (ii)) is compatible with Harbour (2014). Given that argument, and that the goal of this paper is, in part, to extend the empirical coverage of Harbour (2014), we must stick to an ambiguity approach here.

⁶ Other assumptions about the semantics or syntax of numerals might also work here. Scontras' analysis decomposes the numeral but is not too far removed from non-decompositional analyses that treat numerals as being of type $\langle\langle e, t \rangle, \langle e, t \rangle\rangle$, that is, of modifier type (see, e.g., Bale *et al.* 2011, Ionin and Matushansky 2006, 2018, Link 1983, among others). See Martí (2020a) and section 5.1.3 below for more on this.



Numeral words are generated in the specifier position (cf. Gawron 2002, Gärtner 2004, Haegeman and Guéron 1999, Jackendoff 1977, Li 1999, Selkirk 1977, Zweig 2006, a.o.) of NumeralP and have, uniformly, the semantics of numbers (of type $\langle n \rangle$; cf. Rothstein 2013, 2016, 2017, Ouwayda 2014). For example:

- (14) $\llbracket \text{one} \rrbracket = 1$
 $\llbracket \text{two} \rrbracket = 2$

The semantics of CARD is as follows:

- (15) $\llbracket \text{CARD} \rrbracket = \lambda P \lambda n \lambda x. P(x) \ \& \ \#x = n$

That is, CARD takes a property P and a numeral n and returns the set of entities that have property P and numerosity n. For the NumeralPs ‘one CARD nP’ and ‘two CARD nP’, we would obtain the following:

- (16) $\llbracket \text{one CARD nP} \rrbracket = \lambda x. \llbracket \text{nP} \rrbracket \ \& \ \#x = 1$

- (17) $\llbracket \text{two CARD nP} \rrbracket = \lambda x. \llbracket \text{nP} \rrbracket \ \& \ \#x = 2$

NumberP, the locus of number features, sits above NumeralP in this syntax. Martí proposes that Harbour’s features, such as those in (9) and (10), operate on meanings such as those in (16) to derive the grammatical number marking on the noun, as follows.

English is a $[\pm \text{atomic}]$ system, with $[\text{+atomic}]$ spelled out as null and $[\text{−atomic}]$ spelled out as $-\text{s}$. When $[\pm \text{atomic}]$ operates on NumeralP, we obtain the following results:

| Feature | Numeral | Noun morphology |
|--------------------|-----------------------------|-----------------|
| $[\text{+atomic}]$ | <i>one</i> | singular |
| $[\text{−atomic}]$ | <i>one</i> | × |
| Feature | Numeral | Noun morphology |
| $[\text{+atomic}]$ | <i>two, three, four...</i> | × |
| $[\text{−atomic}]$ | <i>two, three, four ...</i> | plural |

Table 2 $[\pm \text{Atomic}]$ with numerals

Starting with the top row of the table, when $[\text{+atomic}]$ operates on (16), it creates a new set containing those members of (16) which are atoms. All of the members of (16) are atoms, so all of them become members of the set denoted by NumberP. $[\text{+Atomic}]$ is spelled out as null in English, so, for a root like *boy*, this means that the form *boy* surfaces (*one boy*). Further material up on the tree will use the set of atomic boys differently, depending on its semantics; e.g., if an existential quantifier over individuals sits in D, an element of this set will be asserted to exist. Importantly, the derivation is not as smooth if the feature that operates on the set of boy individuals whose numerosity is 1 is $[\text{−atomic}]$, for none of them are non-atoms. Thus, NumberP

denotes the empty set in this case, and, by assumption, this makes this combination ill-formed (see Martí 2020a for more on this issue)—this is the reason why *one boys* is ungrammatical in English. All of the members of (17) have numerosity other than one (2 for *two*, 3 for *three* and so on), so [+atomic] will lead to ungrammaticality, which is the correct prediction (**two boy*, **three boy*, and so on). On the other hand, [−atomic] returns a set containing all of the non-atoms of sets like that in (17). [−Atomic] is spelled out as *−s* in English. This is why *two boys*, *three boys*, and so on are grammatical in English.⁷

Turkish is a [±minimal] system, with [+minimal] spelled out as null and [−minimal] spelled out as *−lar*. When [±minimal] operates on NumeralP, we obtain the following results:

| Feature | Numeral | Noun morphology |
|------------|---------------------------------------|-----------------|
| [+minimal] | <i>bir</i> ‘one’ | singular |
| [−minimal] | <i>bir</i> ‘one’ | × |
| Feature | Numeral | Noun morphology |
| [+minimal] | <i>iki, üç, ...</i> ‘two, three, ...’ | singular |
| [−minimal] | <i>iki, üç, ...</i> ‘two, three, ...’ | × |

Table 3 [±Minimal] with numerals

When [+minimal] operates on (16), it creates a new set containing those members of (16) which do not have proper parts in (16). All of the members of (16) lack proper parts in (16), since they are all of numerosity one, so all of them become members of the set denoted by NumberP. [+Minimal] is spelled out as null in Turkish, so, for a root like *çocuk* ‘boy’, this means that the form *cocuk* surfaces (*bir çocuk* ‘one boy’). [−Minimal] creates a new set containing those members of (16) which do have proper parts in (16)—none of them do, so the set denoted by NumberP in this case is empty, and the ungrammaticality of **bir çocuklar* follows, assuming that *−lar* spells out [−minimal] in Turkish. None of the members of (17) have proper parts in that set—hence, [+minimal], which spelled out as null in Turkish, will create a new set containing all of the members of (17), and *çocuk* ‘boy’ will co-occur with *iki* ‘two’ (and *üç* ‘three’, and so on), giving rise to *iki çocuk* ‘two boys’ (and *üç çocuk* ‘three boys’, and so on). [−Minimal] yields the empty set when combined with (17), as none of the members of that set have proper parts in it, so **iki çocuklar* (and **üç çocuklar*, and so on) is correctly predicted to be ungrammatical.⁸

As we can see, positing that English-like languages and Turkish-like languages are one-feature systems, one [±atomic], the other [±minimal], and combining that with Scontras’ syntax and semantics for numerals, explains the relevant patterns in languages that distinguish singular from plural.

The next question is what the predictions are that are made for singular-dual-plural languages, which is what we turn to in the next section.

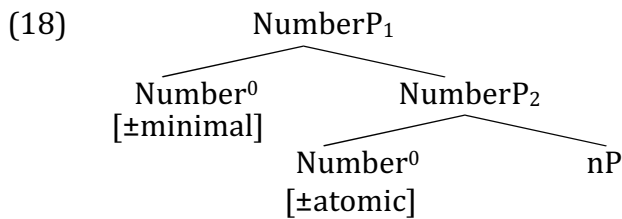
⁷ Notice that [+atomic] doesn’t change the semantics of NumeralP in case depicted in the first row of Table 2: the denotation of NumeralP in that case, in (16), is already composed of only atoms. Likewise, [−atomic] doesn’t change the semantics in (17), since (17) already contains only non-atoms. It would be wrong to conclude from this, however, that [+atomic] and [−atomic] play no role here, since [+atomic] is what blocks the ungrammatical **two/three... boy*, and [−atomic] is what blocks **one boy*. NumberP is present in the derivation of all of these examples as a matter of principle. As a matter of principle, then, [+atomic] is present in the derivation of *one boy*, and [−atomic], in the derivation of *two/three...boys*.

⁸ There is independent evidence that [±minimal] occurs in the Turkic language family (cf. Nevskaya 2005), but search for independent evidence in Turkish in particular is still ongoing.

3 Extending the theory to singular-dual-plural systems (or two-feature systems)

Two ideas are crucial in the extension of Martí (2020a) I propose here. First, the number features that are used in Harbour (2014) to derive singular-dual-plural systems also play a role in accounting for the semantics and morphology of the noun in the numeral+noun construction in languages with such systems. Second, and more innovatively, the structural relationship between NumberP and NumeralP may vary across languages. This second idea is what allows the proposal to predict pattern 1, for which I present positive confirmation in section 4. The derivations provided in Table 4 and Table 5 below will be crucial. The assumption that the structural relationship between NumberP and NumeralP may vary cross-linguistically will require us to revisit the analysis in section 2 for singular-plural languages, which I also do here.

To account for singular-dual-plural systems, Harbour (2014; see also 2011, and Noyer 1992) assumes that a language may choose more than one feature to be generated in Number⁰. Choosing both [\pm atomic] and [\pm minimal] allows us to generate a system with the required number distinctions. The syntax for these systems is assumed to be as in (18):



This gives rise to the following possible feature combinations:

- (19)
- a. [+minimal, +atomic]
 - b. [-minimal, +atomic]
 - c. [+minimal, -atomic]
 - d. [-minimal, -atomic]

The feature combination in (19)a gives rise to a singular semantics. To see this, consider (20):

- (20) [[+minimal] [[+atomic] [[nP]]]]

[+Atomic] selects all the atoms from [[nP]]; [+minimal] then selects all of the members of that set with no proper parts in it, which results, again, in the set of atoms in [[nP]]. This is a singular semantics. (19)b leads to ill-formedness: there are no members of the set of atoms in [[nP]] with proper parts in [[nP]]. (19)c gives rise to a dual semantics, because [+minimal] selects the members of the set of non-atoms in [[nP]] which don't have proper parts in [[nP]] — these are the non-atoms of numerosity two. (19)d gives rise to an exclusive plural meaning, with [-minimal] selecting from the set of non-atoms in [[nP]] those that do have proper parts in [[nP]] — these are the non-atoms of numerosity three and above. Note that the plural semantics (19)d gives rise to is one where plural nouns are taken to be about pluralities of numerosity three and above. This seems to be correct for languages that distinguish dual from plural.^{9, 10}

⁹ There are important arguments for this decompositional treatment of the dual (cf. Nevins 2011), having to do with patterns of language change and with the acquisition of the dual. These patterns show that the dual is always dependent on the plural, which is captured in this analysis via their sharing of the feature [-atomic].

¹⁰ Harbour's (2014) argument that the theory should postulate both [\pm atomic] and [\pm minimal] is as follows. If the theory only had [\pm minimal], singular-dual-plural systems would have to be generated by repeating [\pm minimal] (e.g., the dual would arise from the feature combination [+minimal, -minimal]) (repeating [\pm minimal] is a

Predicted pattern 2 is what results from the combination of a $[\pm\text{minimal}, \pm\text{atomic}]$ with numerals. Consider Table 4:

| Feature | Numeral | Noun morphology |
|-------------------------------------|------------|-----------------|
| $[+\text{minimal}, +\text{atomic}]$ | one | singular |
| $[-\text{minimal}, +\text{atomic}]$ | one | × |
| $[+\text{minimal}, -\text{atomic}]$ | one | × |
| $[-\text{minimal}, -\text{atomic}]$ | one | × |
| Feature | Numeral | Noun morphology |
| $[+\text{minimal}, +\text{atomic}]$ | two | × |
| $[-\text{minimal}, +\text{atomic}]$ | two | × |
| $[+\text{minimal}, -\text{atomic}]$ | two | dual |
| $[-\text{minimal}, -\text{atomic}]$ | two | × |
| Feature | Numeral | Noun morphology |
| $[+\text{minimal}, +\text{atomic}]$ | three, ... | × |
| $[-\text{minimal}, +\text{atomic}]$ | three, ... | × |
| $[+\text{minimal}, -\text{atomic}]$ | three, ... | dual |
| $[-\text{minimal}, -\text{atomic}]$ | three, ... | × |

Table 4 $[\pm\text{Minimal}, \pm\text{atomic}]$ with numerals (NumberP \gg NumeralP)

The denotation of NumeralP in the case of the numeral one is the set of elements of $[[nP]]$ of numerosity one, that is, the set of atoms in $[[nP]]$. The application of first $[+\text{atomic}]$ and then $[+\text{minimal}]$ to that set still yields a set of atoms. If we assume that in a language that instantiates this setting, the feature combination $[+\text{minimal}, +\text{atomic}]$ is realized as singular morpho-phonologically, we will have singular number marking on nouns when they combine with the numeral one. Any other feature combination yields an ill-formed result with the numeral one: $[-\text{minimal}, +\text{atomic}]$ because there are no elements in a set of atoms with proper parts in the set, and $[+\text{minimal}, -\text{atomic}]$ and $[-\text{minimal}, -\text{atomic}]$ because there are no non-atoms in a set of atoms.

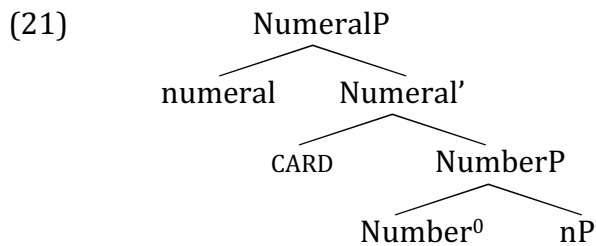
The denotation NumeralP in the case of the numeral two is the set of elements of $[[nP]]$ of numerosity two, that is, the set of dyads in $[[nP]]$. Neither the feature combination $[+\text{minimal}, +\text{atomic}]$ nor the feature combination $[-\text{minimal}, +\text{atomic}]$ can yield well-formedness when combined with such a NumeralP, since there are no atoms in its denotation (the latter, as we know, never gives rise to well-formedness). The feature combination $[+\text{minimal}, -\text{atomic}]$ does, however, because it is possible to choose the members of a set of non-atomic dyads (dyads are always non-atomic) which have no proper parts in that set—that's all of its members. Assuming that this feature combination is spelled out as dual morpho-phonologically, this gives rise to a noun with dual number marking that combines with the numeral two. The feature combination $[-\text{minimal}, -\text{atomic}]$ gives rise to ill-formedness again, since it is not possible to choose from a set of dyads elements with proper parts in it.

The reasoning we just went through for the numeral two generalizes, in fact, to all numerals greater than one. Take the case of the numeral 3. Neither the feature combination

possibility that his theory allows, in order to account for languages that distinguish minimal, unit augmented and augmented pronouns, for example). For languages with trials, though, we need a kind of repetition which, if allowed, over-generates number systems. Trial would arise from the feature combination $[+\text{minimal}, -\text{minimal}, -\text{minimal}]$ —but if a feature with the same value can repeat, you can generate non-attested number values such as quadral ($[+\text{minimal}, -\text{minimal}, -\text{minimal}, -\text{minimal}]$), pental ($[+\text{minimal}, -\text{minimal}, -\text{minimal}, -\text{minimal}, -\text{minimal}]$), etc. We can generate trials (and duals) but no quadrals, pentals, etc. if the feature combination for trial is $[+\text{minimal}, -\text{minimal}, -\text{atomic}]$ instead.

[+minimal, +atomic] nor the feature combination [−minimal, +atomic] can yield well-formedness when combined with a NumeralP that denotes a set of threesomes, since there are no atoms in its denotation. The feature combination [+minimal, −atomic] does, as before, because it is possible to choose the members of a set of non-atomic threesomes (threesomes are always non-atomic) which have no proper parts in that set—that’s all of its members. The feature combination [−minimal, −atomic] gives rise to ill-formedness, since it is not possible to choose from a set of threesomes elements with proper parts in it. Thus, all numerals greater than one are predicted to combine with dual number marking on the noun.

I do not know whether Predicted pattern 2 is attested but, without any further changes, this is all that our theory currently predicts for singular-dual-plural languages. However, as I will argue in sections 4 and 5, pattern 1 is indeed attested. It is interesting to note that just such a pattern is predicted if the hierarchical relationship between NumberP and NumeralP is allowed to change: that is, if NumeralP dominates NumberP, as in (21):



The resulting numeral+noun patterns are in Table 5:

| Numeral | Feature | Noun morphology |
|------------|---------------------|-----------------|
| one | [+minimal, +atomic] | singular |
| one | [−minimal, +atomic] | × |
| one | [+minimal, −atomic] | × |
| one | [−minimal, −atomic] | × |
| Numeral | Feature | Noun morphology |
| two | [+minimal, +atomic] | × |
| two | [−minimal, +atomic] | × |
| two | [+minimal, −atomic] | dual |
| two | [−minimal, −atomic] | × |
| Numeral | Feature | Noun morphology |
| three, ... | [+minimal, +atomic] | × |
| three, ... | [−minimal, +atomic] | × |
| three, ... | [+minimal, −atomic] | × |
| three, ... | [−minimal, −atomic] | plural |

Table 5 Numerals with [±minimal, ±atomic] (NumeralP>>NumberP)

The feature combination [+minimal, +atomic] gives us a denotation for the now-lower NumberP that is a set of atoms. NumeralP with the numeral one in its specifier will result in a well-formed set of atoms, since they are all of numerosity one. If [+minimal, +atomic] spells out with singular morphology, we then obtain a singular number marked noun in combination with the numeral one. No other numeral will work here: members of a set of atoms have no other numerosity besides one, so this feature combination will yield an ill-formed result when combined with any numeral other than one. The feature combination [−minimal, +atomic] is ill-formed on its own, as before. The feature combination [+minimal, −atomic] yields a set of dyads. Since these are elements of numerosity two, the numeral two will be able to combine

with it. No other numeral will be able to do so, since dyads have no other numerosity. If [+minimal, -atomic] spells out with dual morphology, we will obtain a dual marked noun in combination with the numeral two. Finally, the feature combination [-minimal, -atomic] will yield a set of non-atoms of numerosity greater than two. This set can combine with any numeral greater than two, but not with two or one. If this feature combination spells out as plural, we will obtain a plural marked noun in combination with all numerals greater than two.

Departing from Martí (2020a, under review) and from Scontras, we thus need to consider the possibility that the syntactic relationship between NumberP and NumeralP may vary cross-linguistically, that is, that the derivations in *both* Table 4 *and* Table 5 are allowed. If we do so, pattern 1 is a predicted pattern for singular-dual-plural languages where NumeralP dominates NumberP, and Pattern 2 is a predicted pattern for singular-dual-plural languages where NumberP dominates NumeralP. This, I contend, is the only innovation that is needed in order to extend Martí's theory of the numeral+noun construction to singular-dual-plural systems.

In developing this hypothesis further, we should look for independent evidence for the relationship between NumberP and NumeralP in particular languages. This evidence may take many forms and come from a variety of phenomena, and is a crucial part of the account that I am proposing here. My goal here, however, is, more humbly, to understand the possibilities and the limits that the theory of the numeral+noun construction under consideration affords us. I will, nevertheless, point at the numeral+noun construction with complex numerals as a possible source of independent evidence at the end of section 5.1.3.

An important question must be answered before we proceed with the more empirical part of the paper. If the hierarchical relationship between NumberP and NumeralP can vary cross-linguistically, are there new predicted patterns for the numeral+noun construction in languages that distinguish only singular from plural? Recall from section 2 that, in deriving the English-type and the Turkish-type patterns, we only considered one possible relationship between these two phrases, namely, the one where NumberP dominates NumeralP. What happens in singular-plural languages when their relationship is reversed? The answer, in short, is that no new predictions are made, but that there is now space for considering that English may be a [\pm minimal] language after all.

Consider first the possibility of [\pm atomic] in a NumberP that is dominated by NumeralP:

| Numeral | Feature | Noun morphology |
|----------|-----------|-----------------|
| one | [+atomic] | singular |
| one | [-atomic] | × |
| Numeral | Feature | Noun morphology |
| two, ... | [+atomic] | × |
| two, ... | [-atomic] | plural |

Table 6 Numerals with [\pm atomic] (NumeralP>>NumberP)

The subset of elements from $\llbracket nP \rrbracket$ which are atoms is a set of elements of numerosity one, so combination with the numeral one is well-formed and yields a set of atoms, that is, a singular semantics. Such a set of atoms cannot combine with any other numeral, since its members only have numerosity one. The subset of elements from $\llbracket nP \rrbracket$ which are non-atoms is a set of elements of numerosity greater than one, so combination with the numeral one is ill-formed, and combination with other numerals is well-formed. These predictions are as in section 1, so we can conclude that, for languages that are [\pm atomic], different assumptions about the hierarchical relationship between NumberP and NumeralP do not yield different predictions for the morphological realization of number on the noun in the numeral+noun construction. Things are different for [\pm minimal] languages. Consider Table 7:

| Numeral | Feature | Noun morphology |
|----------------|----------------|------------------------|
| one | [+minimal] | singular |
| one | [-minimal] | × |
| Numeral | Feature | Noun morphology |
| two, ... | [+minimal] | × |
| two, ... | [-minimal] | plural |

Table 7 Numerals with [\pm minimal] (NumeralP \gg NumberP)

Interestingly, the predictions do not vary from Table 6. If the feature [+minimal] applies directly to nP, it will in effect select all the atoms in \llbracket nP \rrbracket . This can combine well with the numeral one, but not with any other numeral, since atoms have numerosity one. Thus, nouns marked for singular morphologically combine with one. As for other numerals, they will only yield a well-formed result for [-minimal], since only [-minimal], when applied directly to nP, will select all and only the non-atoms in \llbracket nP \rrbracket . Nouns morphologically marked for plural will combine with numerals other than one. Again, this is the English-type pattern.

To sum up, allowing for variation in the hierarchical relationship between NumberP and NumeralP still predicts the English-type and the Turkish-type patterns for singular-plural languages—it now becomes a question of language-internal evidence (regarding the syntax of NumberP and NumeralP), and/or other considerations, whether we take English to be a [\pm atomic] or a [\pm minimal] language. The Turkish-style pattern, however, necessitates [\pm minimal] in NumberP and for NumberP to dominate NumeralP. This entails that a given singular-plural system has in principle the possibility of choosing the derivations in Table 2, Table 3, Table 6 or Table 7 for the numeral+noun construction.¹¹ As for singular-dual-plural languages, this variation plays a crucial role in predicting pattern 1 (see derivation in Table 5). Pattern 2 already follows from the syntactic assumptions made in Martí's and Scontras' work (see derivation in Table 4).

Having reviewed in this section the basic predictions of our extension of Martí's theory, we now turn to the first steps in the investigation of whether the theory's predictions are met empirically.

4 Yimas and Hopi instantiate pattern 1

The first step in that investigation is the confirmation of predicted pattern 1. I show here that Yimas and Hopi, languages with a singular-dual-plural system on nouns, exemplify predicted pattern 1 straightforwardly.

Consider first Yimas,¹² whose nouns are organized into noun classes and distinguish singular, dual and plural via suffixation (or lack thereof, in the singular of some classes), with number and class suffixes specific to each class. A few examples of nouns in this language are provided in Table 8 (Foley 1991: 91):¹³

¹¹ A reviewer asks whether the fact that, in this theory, the Turkish-style pattern has one analytical source (see Table 3), whereas the English-style pattern has three (see Table 2, Table 6 and Table 7), suggests that the English-style pattern should be more common cross-linguistically. This might indeed be taken as a prediction of the proposed theory, though one must also consider the consequences that might follow from a language choosing NumberP \gg NumeralP vs. NumeralP \gg NumberP. Depending on what evidence it is possible to find for this choice (see end of section 5.1.3 for an example), settling the issue of the commonality of one pattern over another might require more nuance.

¹² Yimas is Papuan language spoken in Papua New Guinea. All Yimas data presented here is from Foley (1991) or from Bill Foley, p.c.

¹³ Many common nouns are suppletive in that singular and plural forms have different stems (Foley 1991: 91). Nouns in Yimas also mark oblique Case, an issue ignored below.

| singular | dual | plural | translation |
|----------|----------|---------|--------------------|
| wakn | wakn-trm | wakn-tt | 'snake' (class V) |
| trŋ | trŋ-kl | trŋ-k | 'tooth' (class VI) |
| tan-m | tan-pl | tan-pat | 'bone' (class VII) |

Table 8 Some Yimas nouns and their number

Nouns agree with verbs for number (via singular, dual or plural prefixes on the verb). Thus, Yimas marks grammatical number of nouns productively and is a [\pm minimal, \pm atomic] system in Harbour's typology.

Yimas is an example of a language with predicted pattern 1. The numeral one combines with a (preceding) noun that is marked for singular ((22)), the numeral two combines with a noun marked for dual ((23)), and all other numerals combine with nouns marked for plural ((24)-(26)); no other combinations of numeral and number marking on the noun are allowed (Foley 1991: 101-2 and Bill Foley, p.c.):¹⁴

(22) **Tan-m** mpa-m
 Bone-VII.SG one-ADJ
 'One bone'

(23) **Tan-pl** p-rpal
 Bone-VII.DU VB-two
 'Two bones'

(24) **Tan-pat** p-ramnawt
 Bone-VII.PL VB-three
 'Three bones'

(25) **Tan-pat** tam mawŋkwat p-rpal
 Bone-VII.PL five other.side VB-two
 'Seven bones'

(26) **Tan-pat** namarawt munta-k-n p-rpal
 Bone-VII.PL person whole-IRR-I.SG VB-two
 'Twenty-two bones'

Notice that numerals in Yimas may display verbal or adjectival agreement markers (such as the numerals *mpam* 'one', *prpal* 'two' and *pramnawt* 'three'), may be quite complex internally (like those in (25) and (26)), and may themselves inflect for noun class and number ((26)).¹⁵ Notice also, importantly, that despite the presence of the numeral *prpal* 'two' in the formation of the numeral *tam mawŋkwat prpal* 'seven' (lit. five other side two) or *namarawt muntakn prpal* 'twenty-two' (lit. whole person two), these numerals combine with nouns in the plural, not in the dual—this issue will be discussed again in the context of Slovenian in section 4.

Hopi¹⁶ is another example of a language that displays pattern 1. Hopi has a singular-dual-plural number system on animate nouns and a small set of inanimate nouns (Hill et al. 1998:

¹⁴ Key to glosses: ACC = accusative case; ADJ = adjective agreement marker; DEM = demonstrative; DU = dual number; FEM = feminine gender; GEN = genitive case; INSTR = instrumental case; IRR = irrealis; MASC = masculine gender; NOM = nominative case; NFUT = non-future; PL = plural number; SG = singular number, VB = verbal agreement marker. Roman numerals indicate noun class.

¹⁵ Numeral number inflection may be a genuine case of agreement, or may constitute a different phenomenon, an issue I will not be able to settle here.

¹⁶ Hopi is an Uto-Aztecan language spoken in northeastern Arizona. All Hopi data presented here is from Hill *et al.* (1998) and has been corroborated by Ken Hill.

870); most inanimate nouns do not have dual or plural forms and thus do not vary for grammatical number. Nouns vary also by case, distinguishing Nominative from Accusative case. Table 9 shows some of its nouns, which, like Yimas, use suffixation (or lack thereof, for the singular) to distinguish singular, dual and plural:

| singular | dual | plural | translation |
|----------|-----------|----------|-------------|
| kawayo | kawayo-t | kawayo-m | 'horse' |
| sino | sino-t | sino-m | 'person' |
| pahaana | pahaana-t | ahaana-m | 'Anglo' |

Table 9 Some Hopi nouns and their number (nominative case forms)

It is not uncommon for languages to treat subsets of nouns differently regarding grammatical number, especially along the animate/inanimate divide we see in Hopi (see Corbett 2000: ch. 3 for discussion and examples). Thus, we can say that Hopi is a singular-

Hopi nouns in the numeral+noun construction appear in their singular form with the numeral one, as shown in (27), in their dual form with the numeral two, as in (28), and in their plural form with any other numeral, as shown in (29) and (30) for the numerals eleven and twelve, respectively; no other combinations are allowed:

- (27) Suukya **kawayo** pinto (Hill *et al.* 1998: 552)
 One.NOM horse.NOM.SG spotted.NOM.SG
 'One spotted horse'

- (28) Lööyöm **kawayo-t** (Hill *et al.* 1998: 215)
 Two.NOM horse-NOM.DU
 'Two horses'

- (29) Pakwt suukw siikya 'ytaqam **kawayo-m**¹⁷ (Hill *et al.* 1998: 382)
 Ten one.ACC plus horse-NOM.PL
 'Eleven horses'

- (30) Pakwt lööq siikya 'ytaqam **pahaana-m** (Hill *et al.* 1998: 382)
 Ten two.ACC plus Anglo-NOM.PL
 'Twelve Anglos'

Note that numerals may themselves inflect for case or even number, and that, as before, they can be internally complex, as in (29) or (30). Even then, however, the shape of the noun is not dictated by what the component parts would combine with on their own (e.g., singular for one, or dual for two, as in (27) and (28)), but by whether the numeral is greater than two—if it is, then the noun appears in its plural form. This is, in other words, an example of predicted pattern 1.

The analysis for both Yimas and Hopi is then as explained in Table 5, with NumeralP>>NumberP ((21)).

Thus, predicted pattern 1 is attested. Next I discuss two cases where neither predicted pattern 1 nor predicted pattern 2 seems to obtain, though I argue that complications in the grammar of complex numerals and determiners in the languages in question mask two further instances of predicted pattern 1.

¹⁷ The accusative form of the numeral may be used in nominative position when *siikya 'ytaqam* is used (Hill *et al.* 1998: 895). I have not been able to find a satisfactory explanation of what *siikya 'ytaqam* is, or a gloss/translation for it. I tentatively gloss it as 'plus' here. Hill *et al.* call it a modifier and say it is optional in examples with the numerals *pakwt* 'ten' and *sunat* 'twenty'.

5 Imere and Ljubljana Slovenian do conform to the predictions of the theory

In this section I discuss two additional singular-dual-plural languages, Ljubljana Slovenian and Imere. The number marking on the noun in the numeral+noun construction in these languages seems problematic from the perspective of the theory introduced in section 3. Ljubljana Slovenian conforms to pattern 1 for its lower numerals, but the empirical picture for numerals greater than one is more complex. In Imere, dual marking on the noun is never used with the numeral two and thus cannot be considered an instance of either pattern 1 or pattern 2. I argue in this section that neither language is a counterexample to the predictions of the theory once additional complications in their grammars are taken into account.

5.1 Ljubljana Slovenian¹⁸

The numeral+noun construction for lower numerals in Ljubljana Slovenian looks like a straightforward instantiation of pattern 1, but complex numerals present a more complicated picture. I argue below there are good reasons to think that Ljubljana Slovenian is still an instantiation of pattern 1. Below I review the Slovenian data and make a proposal about its analysis that incorporates important insights from Ionin and Matushansky's (2006, 2018) proposal about complex numerals.

5.1.1 The data

Ljubljana Slovenian distinguishes singular, dual and plural on nouns (and on other categories). Table 10 shows a (partial) nominal declension paradigm for two nouns in this language (Ljubljana Slovenian has an additional gender and makes more case distinctions than shown here) (Rok Žaucer, p.c.):

| | singular | dual | plural | translation |
|-------|----------|---------------|----------|---------------|
| NOM | stol | stola | stoli | chair (masc.) |
| ACC | stol | stola | stole | |
| GEN | stola | stolov | stolov | |
| INSTR | stolom | stoloma/stoli | stoli | |
| NOM | banana | banani | banane | banana (fem.) |
| ACC | banano | banani | banane | |
| GEN | banane | banan | banan | |
| INSTR | banano | bananama | bananami | |

Table 10 Some Ljubljana Slovenian nouns

For numerals less than one, Ljubljana Slovenian follows pattern 1, as illustrated in (31)-(35) (Ljubljana Slovenian also marks case on its numerals) (Rok Žaucer, p.c.):

- (31) En **stol**
 one.NOM/ACC chair.MASC.NOM/ACC.SG
 'One chair'

¹⁸ Ljubljana Slovenian is a dialect of Slovenian spoken in and around the capital city of Ljubljana. For a language to count as a [±minimal, ±atomic] system, it must distinguish singular, dual and plural productively. The dual is being lost in certain dialects of Slovenian, but not in Ljubljana Slovenian, so it is this dialect that is discussed here. All data from Ljubljana Slovenian was provided by Rok Žaucer, p.c. For more on Slovenian more generally, see Derganc (2003), Herryty (2016), Marušič and Žaucer (to appear) and Toporišič (2000).

- (32) Dva **stola**
two.NOM/ACC chair.MASC.NOM/ACC.DU
‘Two chairs’
- (33) Trije **stoli,** tri **stole**
Three.NOM chair.MASC.NOM.PL three.ACC chair.MASC.ACC.PL
‘Three chairs’
- (34) Pet **stolov**
Five.GEN chair. MASC.GEN.PL
‘Five chairs’
- (35) Dva-in-dvajsetimi **bananami**
Two-and-two.ten.INSTR banana.FEM.INSTR.PL
‘Twenty-two bananas’

The noun appears in singular with the numeral one, in dual with the numeral two, and in plural with numerals three, five and twenty-two.¹⁹

If indeed Ljubljana Slovenian follows pattern 1, the noun should be morphologically marked for plural with any numeral greater than two. However, not all such numerals combine with a plural noun: for numerals greater than one, the noun is marked for singular if the numeral ends in one (101, 201, 301, ... 1001 and so on), and it is marked for dual if the numeral ends in two (102, 202, 301, ... 1002 and so on), as illustrated in (36) (Rok Žaucer, p.c.):²⁰

- (36) a. Sto-dve **banani**
hundred-two.ACC banana.FEM.ACC.DU
b. Sto-dvema **bananama**
hundred-two.INSTR banana.FEM.INSTR.DU
‘One hundred and two bananas’

In (36), the noun *banana* appears in the dual forms *banani* (Accusative case) or *bananama* (Instrumental case) following the numeral *sto dve/dvema* ‘one hundred and two’, not in the corresponding plural forms.

Thus, the question we need to answer is why numerals greater than one behave in this way—apart from these numerals, the rest of the Ljubljana Slovenian pattern conforms to predictions. The insight that will drive the answer I propose below is that in Ljubljana Slovenian complex numerals smaller than one, a small numeral that is added to another comes first in the word order (*en-ajst* ‘eleven, lit. one-on.ten’, *dva-najst* ‘twelve, lit. two-on.ten’, *tri-najst* ‘thirteen, lit. three-on.ten’, *ena-in-dvajset* ‘twenty-one, lit. one-and-two.ten’, etc.). On the other hand, in complex numerals greater than one, the numeral that is added comes last in the word order (*sto-en* ‘a hundred and one, lit. hundred-one’, *dva-sto-en* ‘two hundred and one, lit. two-hundred-one’, *dva-sto-dva* ‘two hundred and two, lit. two-hundred-two’, etc.). If, in both cases, it is the last numeral in the word order that determines the number marking on the noun that

¹⁹ In what is not an unusual pattern in Slavic languages (see Ionin and Matushanksy’s 2018: ch. 6), nouns in the numeral+noun construction vary their case depending on the numeral. For example, whereas the numerals one, two and three combine with nouns in Accusative case when the noun phrase appears in syntactic contexts that usually call for Accusative case (e.g., the direct object position of many transitive verbs), and in Nominative case when the noun phrase appears in syntactic contexts where usually that case is called for (e.g., the standard subject position), five combines with nouns in Genitive case even in canonical direct object and subject positions. More on this issue in section 4.1.3 below.

²⁰ This is again a common pattern in Slavic (see Ionin and Matushansky 2018: ch. 6 and references cited there).

accompanies the numeral, the pattern we have observed above follows in full, while allowing us to maintain the hypothesis that Ljubljana Slovenian is a language that exemplifies pattern 1.

In the remainder of this section, I spell out the details of the syntactic and semantic aspects of this analysis and compare it with that in Ionin and Matushansky (2006, 2018).

5.1.2 Ionin and Matushansky (2006, 2018)


In Ionin and Matushansky's approach, simple numerals (like *two* or *hundred*) are semantically of type $\langle e, t \rangle$, that is, they have the semantics of modifiers, and the nouns they combine with denote sets of atomic individuals. Consider the denotations in (37), with auxiliary definitions in (38) (for partition) and (39) (for cover) (see Ionin and Matushansky 2018: 13 and references cited there):

- (37) $\llbracket \text{two} \rrbracket = \lambda P \in D_{\langle e, t \rangle}. \lambda x \in D_e. \exists S \in D_{\langle e, t \rangle} [\Pi(S)(x) \ \& \ |S| = 2 \wedge \forall s \in S P(s)]$
 $\llbracket \text{hundred} \rrbracket = \lambda P \in D_{\langle e, t \rangle}. \lambda x \in D_e. \exists S \in D_{\langle e, t \rangle} [\Pi(S)(x) \ \& \ |S| = 100 \wedge \forall s \in S P(s)]$
- (38) $\Pi(S)(x) = 1$ iff S is a cover of x and $\forall z, y \in S [z = y \vee \neg \exists a a \leq z \wedge a \leq y]$
- (39) A set of individuals C is a cover of a plural individual x iff x is the sum of all members of C

The notion of partition in (38) ensures that there is no overlap of the cells in the partition, so that individuals are not counted twice. When a numeral like *hundred* in (37) combines with a noun N , a set of atomic individuals and thus of type $\langle e, t \rangle$, we obtain a set of plural or non-atomic individuals as in (40):

- (40) $\llbracket \text{hundred } N \rrbracket = \lambda x \in D_e. \exists S \in D_{\langle e, t \rangle} [\Pi(S)(x) \ \& \ |S| = 100 \wedge \forall s \in S \llbracket N \rrbracket(s)]$
 $= \lambda x \in D_e. x$ is a plural individual divisible into 100 non-overlapping individuals y such that their sum is x and each $y \in \llbracket N \rrbracket$

Since simple numerals have the semantics of modifiers, they are, in principle, stackable. Thus, the syntax of a noun phrase like *two hundred N*, with the multiplicative numeral *two hundred*, is as follows:

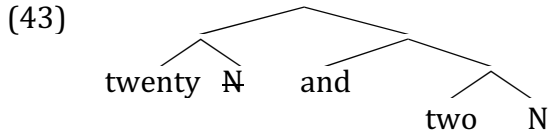
- (41) 

We then obtain the semantics in (42):

- (42) $\llbracket \text{two hundred } N \rrbracket = \lambda x \in D_e. \exists S \in D_{\langle e, t \rangle} [\Pi(S)(x) \ \& \ |S| = 2 \wedge \forall s \in S \exists S' \in D_{\langle e, t \rangle} [\Pi(S')(s) \ \& \ |S'| = 100 \wedge \forall s' \in S' \llbracket N \rrbracket(s')]]]$
 $= \lambda x \in D_e. x$ is a plural individual divisible into 2 non-overlapping individuals y such that their sum is x and each y is divisible into 100 non-overlapping individuals z such that their sum is y and $z \in \llbracket N \rrbracket$

That is, because of the semantics assumed for simplex numerals, the semantics of numerals such as *two hundred* arises straightforwardly from the compositional process.

For additive numerals, such as *twenty-two*, Ionin and Matushansky assume the coordination structure and analysis in (43) (inspired by Zweig 2006, who builds on Kayne 2003, 2007):



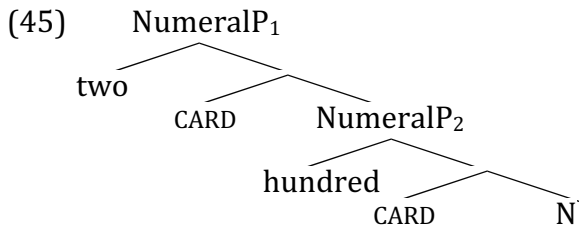
Ionin and Matushansky assume a structure with two Ns, one of which undergoes NP deletion; that is, the syntax and semantics of *twenty-two N* is just like the syntax and semantics of *twenty N and two N*. Whether a conjunction like *and* is pronounced or not in a given language, it is there for syntactic and semantic purposes. With the set-product denotation for *and* (as opposed to an intersective one) in (44) (from Heycock and Zamparelli 2005; see Ionin and Matushansky 2018: 149), the correct semantics is predicted for (43) (for ‘ \oplus ’ the sum operator):

$$(44) \quad \llbracket \text{and} \rrbracket = \lambda P_{\langle e,t \rangle} . \lambda Q_{\langle e,t \rangle} . \{x: x = y \oplus z, \text{ for } y \in P \text{ and } z \in Q\}$$

(44) takes two sets P and Q and combines their members in such a way that a new set of plural individuals, all of those that are in P are combined with all of those that are in Q, is created. (43) thus denotes a set of plural individuals each combining two-N plural individual with a twenty-N plural individual, which is a set of plural individuals each of which has numerosity 22, as desired²¹. Much empirical evidence, on the basis of case, agreement and other phenomena, across languages, is provided in Ionin and Matushansky in defense of this syntactic and semantic treatment of numerals.

5.1.3 My proposal

The semantics for numerals from sections 2 and 3 is different from Ionin and Matushansky’s; in particular, we’ve taken numerals to denote numbers and to appear in the specifier position of a NumeralP. Whereas numeral stacking is possible in my approach, since CARD takes arguments of type $\langle e,t \rangle$ and the type of NumeralP is also $\langle e,t \rangle$, structures such as (45) (similar to (41), but with one NumeralP per numeral) yield the wrong semantics for multiplicative numerals. The contribution of CARD is repeated as (46) for ease of reference:



$$(46) \quad \llbracket \text{CARD} \rrbracket = \lambda P \lambda n \lambda x . P(x) \ \& \ \#x = n$$

This is because the denotation that (45) is assigned is as follows:

$$(47) \quad \begin{aligned} \llbracket \text{NumeralP}_1 \rrbracket &= \lambda x . \llbracket \text{NumeralP}_2 \rrbracket(x) \ \& \ \#x = 2 \\ &= \lambda x . \llbracket N \rrbracket(x) \ \& \ \#x = 100 \ \& \ \#x = 2 \end{aligned}$$

The numerosity of an individual cannot be both 100 and 2 at the same time.

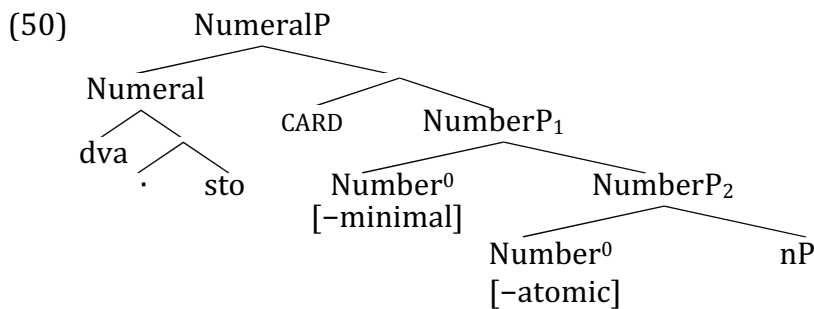
²¹ As Ionin and Matushansky (2018: 151) note, set product allows for the possibility of overlap, which incorrectly allows us to count the same individual twice, and thus include plural individuals of numerosity 101 in the denotation of (43). Ionin and Matushansky propose that the lack of overlap is pragmatic, motivated by the fact that “the whole purpose of measuring and counting is to achieve the maximal precision given the context and the speaker’s knowledge. Treating overlap as a possibility is expressly contrary to this purpose” (p. 151).

It is, however, possible to combine a compositional approach to complex numerals with the approach to numerals assumed in sections 2 and 3. Starting with multiplicative numerals, the most important assumption is the multiplicative operator \cdot in (48), of type $\langle n, \langle n, n \rangle \rangle$ (cf. Rothstein 2013: 184, Scha 1981, Ouwayda 2014, Zabbal 2005), which operates on numeral words themselves, i.e., the ones that appear in the specifier position of NumeralP:

$$(48) \quad \llbracket \cdot \rrbracket = \lambda n. \lambda m. n \cdot m$$

- (49) a. $\llbracket \text{two} \rrbracket = 2$
 b. $\llbracket \text{hundred} \rrbracket = 100$

If more than one numeral word can appear in that position (cf. Giusti 1991, 1997, Ritter 1991, Zamparelli 1995, 2002), we would have the following structure for *dva-sto N*:



The \cdot operator multiplies 100 by 2, resulting in (51) :

$$(51) \quad \llbracket \text{dva} \cdot \text{sto} \rrbracket = 200$$

The rest of the computation now proceeds as normal, producing a numeral+noun combination where the noun is marked for plural, correctly (recall Table 5). Thus, we can maintain that the meaning of *two* is unique and constant across the board (that is, as in (49)a), as long as the specifier position of NumeralP can be more complex than we assumed previously. Doing so allows us to maintain the attractive hypothesis, together with Ionin and Matushansky, that complex cardinals are derived from simple ones.²²

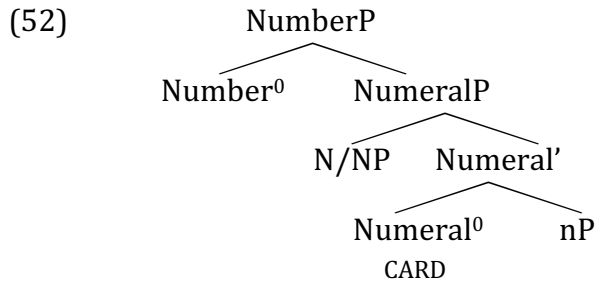
I address a number of issues that arise with this proposal for multiplicative complex numerals before moving on to my proposal for additive ones. First, an argument against the multiplicative operator in (48), based on Ionin and Matushansky's (2018: 29) criticism of Rothstein (2013, 2016, 2017), would be that positing such an operator entails the mastering of the arithmetic operation of multiplication—this could be a problematic assumption if, e.g., children can use multiplicative numerals before they master the operation of multiplication. This argument, however, does not stand closer scrutiny: there's plenty of operations and concepts used as part of the denotation of linguistic items (many set theory operations and concepts, existential and universal quantification, the notion of function, etc.) which possibly no child and only a subset of adults have a mastery of. There is no reason why the multiplicative operator in (48) should be any different.

Second, while the proposal above comes close to what Ionin and Matushansky (2018: 57) call the "single-specifier structure" (their (21)b), which is not interpretable in their semantics,

²² Much like in Ionin and Matushansky, this proposal needs to invoke additional constraints, e.g., nothing in what I have said here prevents a numeral like, say, *six-five*, meaning 'thirty-five', from being generated. My hypothesis is compatible with the kinds of additional, possibly extra-linguistic, constraints that Ionin and Matushansky (2018: 15-16) envisage.

interpretability is not an issue here, as structures such as (50) are interpretable as long as the multiplicative operator in (48) is available.

Third, and given much cross-linguistic evidence (see, e.g., Hurford 1975, Ionin and Matushansky 2018: 62-71 and references cited there), it is desirable to allow the category of numeral words to be adjectival, nominal or verbal, as Ionin and Matushansky do. However, a Scontras-compatible view of numerals need not consider them to be a special category Numeral (recall (13) and other examples above), or any category in particular, for that matter. That is, it is possible to think that the category of the items in the specifier position of NumeralP is nominal, adjectival or verbal, as in, for example, (52):



The fourth and final issue is more problematic. Ionin and Matushansky (2018: 3.1.1) also argue against the idea that several numeral words can form a syntactic unit to the exclusion of the noun/rest of the NP—such constituency is a fundamental aspect of my proposal (see (50)). They take case assignment to be a diagnostic for complementation and show that case assignment can happen both within complex numerals in some languages (i.e., from one numeral to another) and from a complex numeral to a noun in others. These patterns can be seen in Russian (we saw some evidence for this Ljubljana Slovenian above, but I use Russian here as that is what Ionin and Matushansky’s argument is based on; see pp. 51-52). In Russian, the numerals two, three and four assign what Ionin and Matushansky call ‘paucal case’ to the noun/NP; numerals higher than four assign genitive case instead:

(53) Četyre **šagá**
 four step.PAUCAL
 ‘Four steps’

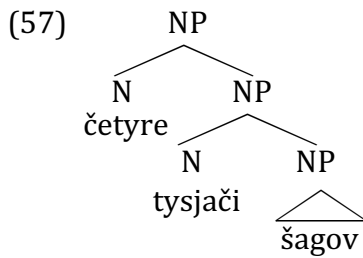
(54) Šest’ **šagov**
 six step.GEN.PL
 ‘Six steps’

With complex numerals like four thousand or five thousand, thousand appears in the paucal case in the former, but in the genitive case in the latter:

(55) Četyre tysjači **šagov**
 four thousand.PAUCAL step.GEN.PL
 ‘Four thousand steps’

(56) Pjat’ tysjač **šagov**
 five thousand.GEN.PL step.GEN.PL
 ‘Five thousand steps’

If heads, not phrases, are responsible for case assignment, as is typically assumed, the best structure for multiplicative complex numerals is, they argue, as in (57) (cf. (41)):



The proposal that numeral words form a constituent in complex multiplicative numerals, as in (50), is problematic in light of this data in that it would have to be the whole complex numeral (e.g., *četyre tysjači*) that assigns case to the accompanying noun (phrase). That's because there would be no direct relationship between *tysjači* and *šagov*. Notice that case assignment *within* the complex numeral (e.g., from *četyre* to *tysjači*) or case assignment by a *simplex* numeral (as in (53) or (54)) are not necessarily problematic in my proposal, as case in these circumstances can still be assigned by a head. But not if expressions such as *četyre tysjači* are constituents—in that instance, case assignment would have to be carried out by a phrase.

However, it may actually be necessary to allow phrases to assign case. That's because there is suggestive evidence for the constituency of numerals like *četyre tysjači*. Russian is well-known for the phenomenon of approximative inversion (see Ionin and Matushansky 2018: 118-9 and references cited there),²³ illustrated in (58) and (59) (cf. (55)):^{24, 25}

- (58) Tysjači četyre **šagov**
 thousand.PAUCAL four step.GEN.PL
 'Some four thousand steps'

- (59) **Šagov** četyre tysjači
 step.GEN.PL four thousand.PAUCAL
 'Some four thousand steps'

The linear order of *četyre* and *tysjači* can be reversed, and the noun can precede the whole numeral. In both cases, an approximative meaning arises. In addition to inversion, however, Russian also allows the insertion of an approximative word, such as *primerno* 'about', illustrated in (60):

- (60) Primerno četyre tysjači **šagov**
 About four thousand.PAUCAL step.GEN.PL
 'About four thousand steps'

Interestingly, inversion of the whole complex numeral can be combined with *primerno*, but not all possible permutations are allowed. Consider (61)-(63):

- (61) **Šagov** primerno četyre tysjači
 step.GEN.PL about four thousand.PAUCAL

²³ Ionin and Matushansky use approximative inversion to argue for a different structure for multiplicative and additive numerals, an argument which I embrace. For more on additive numerals, see below.

²⁴ Data on approximative inversion in Russian is from Masha Esipova and Natasha Korotkova, p.c.

²⁵ Example (i) is deemed ungrammatical by Ionin and Matushansky (2018: 199, their (8)c):

- (i) ***Mašin** sorok tysjač
 car.GEN.PL forty thousand.GEN.PL

My informants, however, found (59) to be grammatical, or, at most, slightly odd. They also found (59) to be worse than (i), but not ungrammatical. While it is at present unclear what's responsible for this contrast, the argument in the text still stands, as it pertains to the stark contrast between (59) and (63).

‘About four thousand steps’

- (62) **Šagov** četyre tysjači primerno
 step.GEN.PL four thousand.PAUCAL about
 ‘About four thousand steps’

- (63) ??Primerno **šagov** četyre tysjači
 about step.GEN.PL four thousand.PAUCAL

The pattern we observe here is that, if the noun precedes the complex numeral, *primerno* is possible as long as it accompanies the numeral, but impossible if it becomes stranded from it, as in (63). This is suggestive of a constituent structure whereby *primerno četyre tysjači* forms a syntactic unit, as in (64) and assumed above:

- (64)
-

If *primerno četyre tysjači* was not a constituent but had instead the cascading structure that Ionin and Matushansky envisage for multiplicative numerals, we’d have (65):²⁶

- (65)
-

But only (64) provides a straightforward explanation for the ungrammaticality of (63): in order to allow (59), Ionin and Matushansky have to allow the movement or rotation of *četyre* and *tysjači*, but then nothing prevents (63) from being generated. With a structure like (64), however, if approximative inversion involves movement of whatever is in Numeral (or of NumberP/nP), the facts above follow straightforwardly.

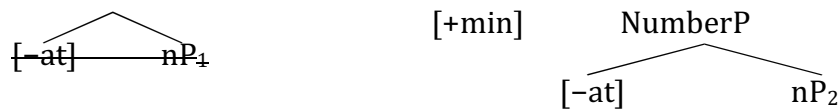
Crucially, if this is the case, then case assignment to nouns by numerals have to be effected, at least sometimes, by phrases, not just heads—e.g., *šagov* will need to be assigned case by (*primerno*) *četyre tysjači*. This means that the only remaining argument of Ionin and Matushansky against the constituency of multiplicative numerals does not stand.²⁷

Moving on now to additive numerals, an enriched version of structures such as those in (43) is necessary. Consider (66), for (36)a, following Ionin and Matushansky quite closely:

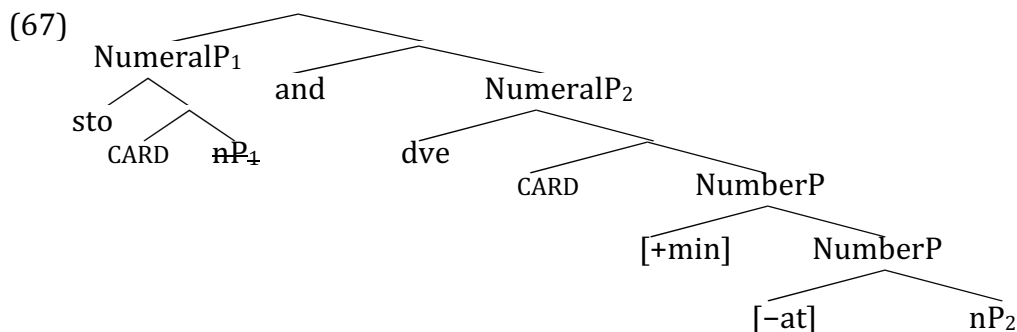
- (66)
-

²⁶ It’s clear from the semantics that *primerno* cannot attach just to *četyre*: the approximation is to 4,000, not to 4.

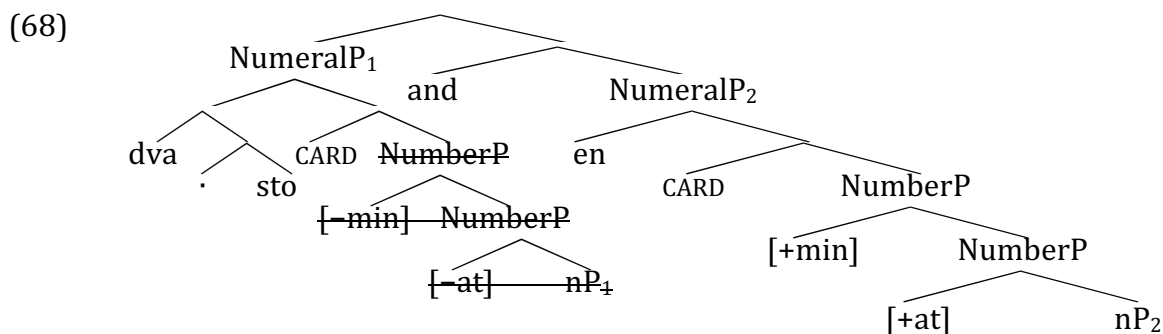
²⁷ An issue that remains to be addressed is the grammatical number of the noun in examples such as (53). The special case we see in this example raises complex questions that I am not prepared to address here (for more on this issue, see, e.g., Franks 1994).



In this structure, two NumeralPs are generated, one for each of *sto* and *dve*. Ionin and Matushansky's *and* in (44) is used. Both numeral words project a NumeralP here because the ellipsis envisaged by Ionin and Matushansky is noun ellipsis (recall (43)), so space for two nouns is needed. Ellipsis then proceeds to delete nP_1 and the two NumberPs above it, producing (36)a, with dual marking on the noun because that is the number marking of the surviving noun in (66). Such an analysis requires noun ellipsis to occur even when the elided material is not fully identical to its antecedent, obviating the different Number features of nP_1 and nP_2 .²⁸ If this is not desired, one may assume the alternative in (67), where nP_1 is generated without any NumberP, and where noun ellipsis occurs in the context of a fully identical antecedent:



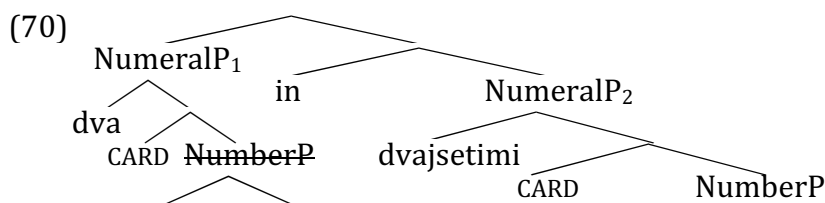
It is easy to account for complex numerals that mix the multiplicative and the additive strategies, such as *dva-sto-en* 'two hundred and one', as in (68) (if we choose (66) for *sto-dve*):



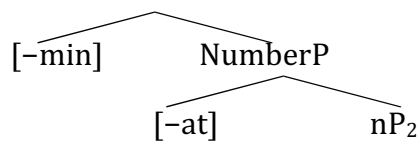
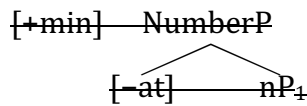
(68) correctly predicts (69):

- (69) *Dva-sto-en* **banana**
 two-hundred-one.NOM banana.FEM.NOM.SG
 'Two hundred and one bananas'

Complex numerals smaller than one are all additive in Ljubljana Slovenian. (35) receives the analysis in (70). (70) correctly predicts that the noun in (35) will take the plural form:



²⁸ Eliding nouns which are not fully identical to their antecedents isn't in itself a problem, as it is very common cross-linguistically, e.g., *I have one cat and you have two cats*. Thanks to Klaus Abels for discussion of this point.



The analysis of Ljubljana Slovenian complex numerals proposed here maintains the spirit of the decompositional approach to numerals from Ionin and Matushansky's work while at the same time integrating the approach to numerals and grammatical number from sections 2 and 3. Ljubljana Slovenian is indeed an example of predicted pattern 1, but the syntax and semantics of its complex numerals is such that those above 100 that end in 1 or 2 take the singular or dual form of the noun, respectively.

A final question before closing this section pertains not so much to Slovenian, but to some of the other languages we saw earlier: if the analysis of (69) is as in (68), why are **two hundred and one banana* or **twenty one banana* ungrammatical in English—that is, why must the noun there be in its plural form? Likewise, why is the noun in the Yimas example in (26), repeated here, not in the dual form if the complex numeral *namarawt muntakn prpal* 'twenty-two' contains the numeral *prpal* 'two'?

- (71) *Yimas*
Tan-pat namarawt munta-k-n p-rpal
 Bone-VII.PL person whole-IRR-I.SG VB-two
 'Twenty-two bones'

And why is the noun in the Hopi example in (30), also repeated here, not in the dual form if the complex numeral *pakwt lööq siikya 'ytaqam* 'twelve' contains the numeral *lööq* 'two'?

- (72) *Hopi*
 Pakwt lööq siikya 'ytaqam **pahaana-m** (Hill *et al.* 1998: 382)
 Ten two.ACC plus Anglo-NOM.PL
 'Twelve Anglos'

To understand why combinations such as **two hundred and one banana* or **twenty one banana* are ungrammatical in English, consider the structure of English *twenty one N* in (73) (cf. (43)):

- (73)
-

Recall that Martí hypothesizes that English is a [\pm atomic] language with NumberP \gg NumeralP (Table 2). Importantly, with additive numerals this means that NumberP is above the coordination structure hypothesized by Ionin and Matushansky. Crucially, [-atomic], but not [+atomic], yields a grammatical result in (73), since the denotation of the constituent the number feature operates on is a set of individuals each of which is of numerosity 21—that is, a set of non-atoms. And [-atomic] gives rise to a plural-marked noun, which correctly predicts the number marking on the noun with this and any other complex numeral in English. That in English additive numerals always take plural-marked nouns might be taken as evidence that (73), and, thus, the system in Table 2, is the correct analysis for English (as opposed to that in Table 6, where NumeralP dominates NumberP). In other words, number marking of nouns with complex numerals is a potential source of independent evidence for the relationship that is

taken to hold between NumeralP and NumberP in a particular language, a relationship that is taken by the theory proposed here to potentially vary from one language to another and for which there is a need of language-particular evidence.

In other cases, such as Yimas and Hopi, it is possible that complex numerals are syntactically decomposed in a way not too dissimilar to the way they are decomposed in Ljubljana Slovenian, but noun ellipsis targets a different site; that is, the correct analysis of (71) might be *tanpat namarawt muntakn ~~tanpl~~ prpal*, where it is the dual marked noun that is elided. And there will most likely be other particularities in a given language that might interfere here.

Thus, all in all, it is possible to maintain the Ljubljana Slovenian indeed instantiates predicted pattern 1. It has been possible to do that and incorporate important aspects of the analysis of complex numerals in Ionin and Matushansky (2006, 2018). While the nouns numerals combine with are not taken by default to be sets of atomic individuals in my approach, the only aspect of their analysis that required modification was the analysis of multiplicative numerals, where a \cdot operator and a different constituent structure was found to be necessary.²⁹

5.2 Imere³⁰

In Imere, dual marking on nouns doesn't appear at all in the numeral+noun construction: all numerals greater than one, including the numeral two, combine with nouns marked for plural. This is neither pattern 1 nor pattern 2. In this section I argue that in Imere the dual marker is not just the spell out of the number feature combination [+minimal, –atomic], that marker also spells out D. As such, we do not expect it to be able to combine with numerals. Thus, Imere is, despite appearances, argued to instantiate pattern 1 in what follows.

Imere is a language that displays a singular-dual-plural system on its non-pronominals, as shown in Table 11 (Clark 1975, 1998, 2002/2011, Martí 2019):

| singular | dual | plural | translation |
|----------|-----------|---------|-------------|
| te-sea | ruu-sea | a-sea | chair |
| te-manu | ruu-manu | a-manu | bird |
| te-soa | ruu-soa | a-soa | friend |
| te-ngata | ruu-ngata | a-ngata | snake |

Table 11 Some Imere nouns and their number

Imere uses prefixes on nouns to express grammatical number. These prefixes attach to nouns that belong to the native vocabulary, though not all native nouns can take them. Verbs display subject agreement prefixes that are sensitive to the grammatical number on the noun in subject position.³¹

Regarding the numeral+noun construction, the facts in Imere are as follows (data from my own fieldwork):

(74) **Te-sea** ee-tasi

²⁹ In several Arabic dialects, up to the numeral ten the pattern is as in Predicted Pattern 1, but numerals eleven and higher combine with singular-marked nouns (see Hurford 2001: 10757, Ouwayda 2014, Zabbal 2005). More work is needed to understand whether this pattern is problematic for the theory presented here.

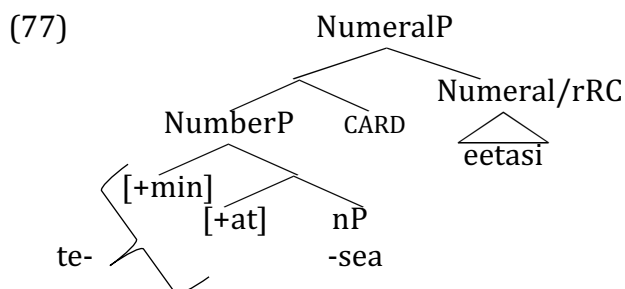
³⁰ Imere is a Polynesian language spoken in Vanuatu. Early work on the language includes Clark (1975, 1998, 2002/2011). All Imere data not attributed to a source is from my own fieldwork. Spelling follows Clark (1975, 1998, 2002/2011), with some modifications from van Urk (2018). The letter *j* corresponds to [tʃ], *k* is variably realized as [k] or [ɣ] intervocalically, *m̃* and *p̃* are labio-velars.

³¹ Clark (1975, 1998, 2002/2011) proposes that Imere makes more number distinctions, including what look like paucals or greater plurals. However, I have not been able to attest the presence of paucals or greater plurals in Imere. Speculatively, it may be that in a previous stage of the language the grammatical number system was more complex than a singular-dual-plural system.

- | | | |
|------|-------------------|-------------------------|
| | SG-chair | 3SG.NFUT-one |
| | 'One chair' | |
| (75) | a. Ruu-sea | (^{??} ee-rua) |
| | DU-chair | 3SG.NFUT-two |
| | b. A-sea | ee-rua |
| | PL-chair | 3SG.NFUT-two |
| | 'Two chairs' | |
| (76) | A-sea | ee-toru |
| | PL-chair | 3SG.NFUT-three |
| | 'Three chairs' | |

All other numerals use the plural prefix on the noun.³² That is, the numeral *eetasi* 'one' combines with nouns that necessarily bear the prefix *te-* ((74)), which indicates singular number; numerals greater than one necessarily combine with nouns that bear the plural prefix *a-* ((76)); curiously, the numeral *eerua* 'two' is incompatible with dual number marking on the noun ((75)a) and plural marking must be used there too ((75)b). This is an unexpected pattern from the perspective of the theory in section 3.

Before proceeding with the argument, it's important to notice that (non-borrowed) numerals in Imere, as shown in (74)-(75), is that they take verbal morphology (compare *ee-tasi* with *roo-tasi* 'one', with the future marker *roo-*; Clark 2002/2011: 684). This state of affairs is not unheard of cross-linguistically, as discussed earlier in section 4.1 (Ionin and Matushansky 2018: 69-71). I will follow Ionin and Matushansky in assuming that Imere (non-borrowed) numerals project reduced relative clauses/participles, an analysis that is supported by the fact that regular relative clauses in Imere are postnominal (Clark 2002/2011: 686). Thus, *te-sea eetasi* 'one chair, lit. SG-chair be.one' would be analyzed as what in English could perhaps be rendered with 'chair [which is one]'. Its structure would be as follows ('rRC' stands for 'reduced relative clause'; I do not explore here what the internal structure of that relative clause would be):



Proceeding now with the argument that Imere is not a counterexample to the theory presented in section 3, the status of the dual prefix *ruu-* and of the plural or singular prefixes is not equal in this language. While it is feasible to analyze *te-* and *a-* as the spell out of number features only, as Martí (2019) does, there is evidence that *ruu-* spells out not only dual number morphology, but is also a determiner. Its status as determiner, I suggest, prevents it from combining with the numeral *eerua* 'two' ((75)a). A first indication that *ruu-* is set apart from *te-* and *a-* in Imere is that, whereas there are (morphophonological) constraints on which nouns

³² For numerals greater than 9 or 10, English borrowings are used and the English pattern for the noun, that is, plural number marking, is followed.

can take *te-* and *a-*, with some nouns taking neither, other nouns taking one prefix, and yet others taking both, all (native) nouns can take *ruu-*. Table 12 illustrates this phenomenon (data from my own fieldwork):

| singular | dual | plural | translation |
|----------|--------------|----------|-------------|
| te-fine | ruu-fafine | fafine | woman |
| tangata | ruu-taangata | taangata | man |
| funumui | ruu-funumui | funumui | girl |
| loto | ruu-loto | loto | car |
| te-kori | ruu-kori | kori | dog |

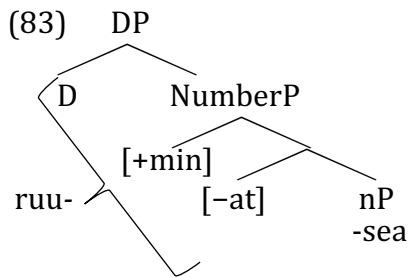
Table 12 Some Imere nouns and their number

An argument that, in addition, *ruu-* is actually a determiner, and not just a number prefix, is that, whereas *te-* and *a-* are compatible with demonstratives and quantifiers, *ruu-* isn't. Consider the examples in (78)-(82) (data from my own fieldwork):

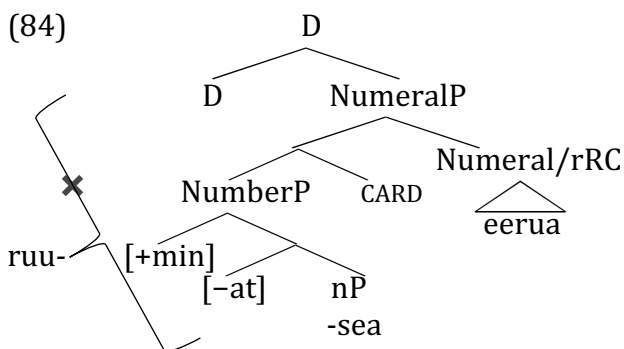
- (78) **Te-fare** ʔoulapa-raa
 SG-house big-DEM
 'That big house'
- (79) **A-fare** ʔwoulapa-raa
 PL-house big-DEM
 'Those big houses'
- (80) a. **A-ngata** toope
 PL-snake many
 'Many snakes'
 b. ***Ruu-ngata** toope
 DU-snake many
- (81) a. **A-ngata** eewji
 PL-snake all/every
 'All (the) snakes'
 b. ***Ruu-ngata** eeweji
 DU-snake all/every
- (82) a. **A-ngata** afaru
 PL-snake some
 'Some snakes'
 b. ***Ruu-ngata** afaru
 DU-snake some

Consider that there is nothing in principle wrong with quantifying over twosomes: it is possible to talk about many, all, or some pairs of snakes—that is, the impossibility of (80)b, (81)b, and (82)b cannot be blamed on a semantic ill-formedness. The ungrammaticality of these examples can be understood if *ruu-* sits in D, in addition to spelling out number morphology, on the assumption that demonstrative *-raa* and quantifiers such as *toope* 'many', *eeweji* 'all/every' or *afaru* 'some' also occupy this position.³³ The syntax that we can thus assume for *ruu-* is as follows:

³³ Demonstratives and quantifiers are incompatible with the definite article in other languages: **this/that/these/those the, *the this/that/these/those, *every/many the, *the every/many*. *Many/all/some of the* is possible in English, but the presence of *of* is indicative of a more complex structure (*all* might not be a quantifier



The explanation I propose for ??*ruu-sea eerua* ((75)a) is that, if it is true that *ruu-* is a determiner and also spells out number features in NumberP, D and NumberP must be close enough to each other in the structure; that is, an intervening (c-commanding) NumeralP would disrupt that close relationship, as shown in (84):³⁴



A question that arises in this analysis is how the numeral two can combine with a plural-marked noun in a singular-dual-plural system. I would like to consider here the possibility that plural forms in Imere are ambiguous between an exclusive semantics (the one we've been assuming all along) and an inclusive semantics, which can be observed in (85) and (86) (data from my own fieldwork):

- (85) Au seia kee **a-ngata.**
 I see not PL-snake
 'I didn't see any snakes'/'I didn't see the snakes'

- (86) A: Lekina **a-tama?**
 exist PL-child
 'Do you have children?'
 B: Ai, eetasi
 yes 3SG.NFUT-one
 'Yes, one'

If *angata* 'snakes' or *atama* 'children' couldn't be understood inclusively, that is, pertaining to one or more snakes/children, (85) would be true if I had seen one snake, and (86)A would be a question about pluralities of children, and thus not answerable as in (86)B, contrary to fact. In Martí (2020b), I analyse inclusive plurals as lacking NumberP altogether—the absence of

in English anyway, see Brisson 2003, among others). In languages such as Spanish, noun phrases such as *el chico ese* 'that boy (pejorative), lit. the boy that' are possible, but only if the demonstrative appears phrase-finally, which is plausibly indicative of a different structure (cf. Brugè 2002).

³⁴ An alternative analysis might be that *ruu-* is actually the spell out of both the numeral *eerua* and [+minimal, -atomic]. I will not pursue this possibility further here.

NumberP translates into plural morphology in languages that have inclusive plurals (see also footnote 5). That is, the analysis of inclusive and exclusive plurality is one of ambiguity: exclusive plurals are analysed just as we have done so far (see section 2), and inclusive plurals have an inclusive semantics and lack NumberP³⁵. If the latter possibility is available in a language, as it is in Imere, then plural-marked nouns can combine with the numeral two, a possibility that is exploited by Imere *eerua* because, as I've argued above, nouns marked with *ruu-* cannot combine with it for syntactic reasons (*eetasi* 'one' is not allowed to make use of this possibility, **angata eetasi*, because *te-* is available, so *a-* is blocked).

6 Conclusion

In this paper I have explored some of the implications for the combination of Harbour's number feature theory with Scontras' approach to numerals in languages that distinguish singular, dual and plural number on nouns. I have hypothesized that the syntactic relation between NumberP, where number features reside, and NumeralP, where numerals reside, might vary from one language to another. The theory that results from these assumptions leads to a very restricted set of predictions regarding the number marking on nouns in the numeral+noun construction.

I argued that both Yimas and Hopi constitute straightforward confirmation that predicted pattern 1 is attested. I also argued that Ljubljana Slovenian and Imere instantiate the same pattern, but additional grammatical properties of their complex numerals and the grammar of D make that confirmation more difficult to establish.

I showed that Ljubljana Slovenian conforms to predicted pattern 1, even when complex numerals greater than one are taken into account, once their complex syntax and semantics are properly understood, something that became possible once certain ideas in Ionin and Matushansky (2006, 2018) about the semantics and composition of numerals were adapted for our purposes. Imere duals also seemed to pose a problem initially but I argued that the dual prefix *ruu-* can reasonably be taken to be the spell out of an article in addition to spelling out number morphology, which would prevent it from combination with the numeral two, for which case plural-marked nouns are used.

Much remains to be explored. To begin with, it is at present unknown to me whether there are any languages in which dual-marked nouns combine with numerals greater than two (predicted pattern 2), but this possibility is predicted by the theory presented here. Certain assumptions that were necessary to make, such as the variable syntactic relation between NumberP and NumeralP, remain to be justified empirically. But the most important underlying issue here is that, descriptively, we know little about what is possible and what is impossible in the numeral+noun construction in languages with duals, despite the efforts of Plank (1995). I hope that the mostly theoretical exploration I have undertaken in this paper will at least serve to motivate us to fill this important empirical gap in our knowledge.

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³⁵ Recall footnote 5.

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