The Numerals *Dva*, *Tri*, *Četyre* in the Novgorod Birch Bark Letters: A Diachronic Perspective

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Abstract: This article investigates the emergence of the cardinal numerals *dva* 'two', *tri* 'three', and *četyre* 'four' in nominal phrases in the Novgorod dialect during the 11th–15th centuries. An innovative approach presented here brings together three productive lines of inquiry—corpus analysis, historical linguistics, and diachronic generative syntax. A corpus analysis was conducted to identify 301 tokens of numeral-containing NPs and to trace the patterns of their diachronic development. The cardinal numerals 2, 3, 4 are shown to evolve from the adjectival "number" words through the process of grammaticalization, more specifically, numeralization. After the loss of dual number, the lower adjectival "number" words for 2, 3, and 4 turned into the cardinal numerals, as their lexically encoded numerosity became functionally encoded countability. The diachrony of the cardinal numerals in the Old Novgorod dialect has shown that the cognitive concepts of cardinality, individuality, and countability are inextricably connected. These concepts are grammatically encoded and subject to diachronic change. This study has demonstrated that a change in grammatical number (loss of the dual) led to the restructuring of countability and the rise of cardinal numerals.

1. Introduction[1]

Cardinal numerals in Russian provide a very interesting quandary for linguists. Specifically, the cardinal numerals 2, 3, and 4 behave syntactically differently than the cardinal numerals 5 and greater. Despite the fact that Russian is organized as a singular-plural language, this unique aspect of cardinal numerals 2, 3, and 4 is very puzzling, unless the question is examined diachronically.

Novgorod birch bark letters dating to the 11th–15th centuries provide a unique window into the historical development of the syntax and semantics of Russian nominal phrases containing the cardinal numerals *dva* 'two', *tri* 'three', and *četyre* 'four'. Unlike the literary language constrained by written conventions, the Novgorod birch bark letters represent a vernacular dialect

[1] The following abbreviations are used in this paper: SG = singular, DU = dual, PL = plural, CT = count form, MASC = masculine, FEM = feminine, NEUT = neuter, GEN = genitive.

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spoken by ordinary citizens of Novgorod of various social classes and sexes. The corpus analysis of birch bark letters conducted in this study allows us to analyze the use and occurrence of linguistic forms of the numerals 2, 3, and 4 which have not been previously analyzed.

It is well known that Russian nominal phrases modified by the cardinal numerals 2, 3, and 4 exhibit several interesting morphosyntactic properties, including a "count-form" suffix marked on the nouns in these numeral phrases. In contemporary Russian, the "count form" is expressed by the suffix *–a* on masculine and neuter nouns, while on feminine nouns it is encoded by the suffixes *-y/-i*, (1a–c). The "count-form" suffix, which looks like the marker of the genitive singular, has been analyzed in the literature in various ways: as paucal case (Mel'čuk 1985; Franks 1994, 1995; Rappaport 2002; Ionin and Matushansky 2006, 2018), as paucal number (Baylin and Nevins 2008), and as a numberless category (Pesetsky 2013). No matter the analysis, a diachronic perspective allows us to establish the historical source of the "count-form" suffix.

(1) Contemporary Russian

a. dva/tri/četyre brat-a
two/three/four brother-MASC.CT
'two/three/four brothers'

b. dva/tri/četyre sel-a
two/three/four village-NEUT.CT
'two/three/four villages'

c. dve/tri/četyre knig-i
two/three/four book-FEM.CT
'two/three/four books'

Historically, the "count-form" suffix can be traced to the Novgorod dialect of Old East Slavic, where it marked dual number on nouns quantified by the cardinal numeral 2. After the loss of dual number in the nominal inflection, the dual suffix marked on nouns in noun phrases modified by the cardinal numeral 2 was repurposed in nominal phrases containing the numerals 3 and 4, where it appeared in a new capacity as a "count-form" suffix, (2). As a result of this diachronic change, nominal phrases with the cardinal numerals 2, 3, 4 formed a special subclass of numeral expressions characterized by a "count-form" suffix.

(2) Old Novgorod dialect

a. dva/tri/četyri god-a
two/three/four year-MASC.CT
'two/three/four years'

(2) b. dŭva/tri/četyri lět-a
two/three/four year-NEUT.CT
'two/three/four years'

c. dŭvě/tri/četyri grivn-ě
two/tri/four.FEM coin-FEM.CT
'two/three/four coins'

Although the diachronic development of Russian numeral phrases has been previously addressed by Suprun (1969), Žolobov (2002, 2003, 2006), and most recently by Stepanov and Stateva (2018) and Igartua and Madariaga (2018), it poses the following key questions about the syntax and semantics of nominal phrases with the cardinal numerals 2, 3, and 4 in Russian and other Slavic languages. These questions are the focus of the present article:

1. Why did the former dual suffix spread from nominal phrases with the cardinal numeral 2 into nominal phrases with cardinal numerals 3 and 4?
2. What is "special" in the semantics of the cardinal numerals? How does the semantics of the lower cardinal numerals 2, 3, 4 differ from the semantics of the higher cardinal numerals 5 and greater?
3. What can the diachrony of the cardinal numerals in the Novgorod birch bark letters tell us about the evolution of numerals in natural languages?

In this article, I analyze the semantics and syntax of nominal phrases containing cardinal numerals 1, 2, 3, 4 using a corpus analysis of birch bark letters (11th–15th centuries). I argue that the cardinal numerals 2, 3, 4 (as well as 5 and greater) in the Old Novgorod dialect emerged as a result of the process of grammaticalization. Originally, in combination with noun phrases, the "number" words for 1, 2, 3, 4 were adjectives, while the "number" words for 5 and greater were nouns. When the dual number was lost, it triggered grammaticalization of countability, and lexically encoded numerosity of the "number words" became functionally encoded countability of the cardinal numerals.

This article is organized as follows. In §2 I discuss the key points in the diachronic development of nominal phrases containing the cardinal numerals 2, 3, 4 in the Novgorod birch bark letters. In §3 I show the results of my diachronic corpus study. In §4 I present my analysis of the diachronic changes in the syntax and semantics of nominal phrases quantified by the cardinal numerals 2, 3, 4. In §5 I draw conclusions and discuss how diachronic changes in the syntax and semantics of nominal phrases with the cardinal numerals 2, 3, 4 in the Novgorod dialect inform our understanding of the semantic and

syntactic properties of numeral-containing expressions in Russian and other Slavic languages.

2. Diachronic Development of NPs with the Cardinal Numerals 2, 3, 4

2.1. NPs with the Numerals 2, 3, 4 in the Old Novgorod Birch Bark Letters (11th–13th Centuries)

In the Novgorod dialect of the 11th–13th centuries, the syntax of nominal phrases varied according to the cardinality of the numeral (Table 1).[2] The numeral *odinŭ* 'one' required the noun to appear in the singular. The numeral *dŭva* 'two' required the noun to be in the dual, while the numerals *tri* 'three' and *četyre* 'four' required the noun to be in the plural. With the numerals *pjat'* 'five' and greater, the noun was marked in the genitive plural.

The cardinal numeral 2 in combination with noun phrases formed the so-called *dual'nyj kvantitativ* (dual quantity), called so due to the dual number marked on nouns (Žolobov 2006: 86). Dual number marking was a hallmark feature that set nominal phrases with the numeral 2 apart from nominal phrases with the cardinal numerals 3 and 4, which required nouns to be marked in the plural.

The cardinal numeral 2 behaved syntactically and morphologically as an adjective and agreed with its head noun in gender, number, and case. Zaliznjak (2004: 166) notes that "from a syntactic perspective, *odinŭ*, *dŭva*, *tri*, and *četyri* are modifiers of the counted nominal object". The cardinal numeral *dva* was marked by the suffix *-a*, an instance of agreement in the masculine or neuter gender, dual number, and the nominative or accusative case, (3a–b). The cardinal numeral *dvě* was marked by the suffix *-ě*, an instance of agreement in the feminine gender, dual number, and the nominative case, (3c).

(3) Old Novgorod dialect (12th–13th centuries)

a. два моужа
dv-a muž-a
two-MASC man-MASC.DU.ACC
'two men' (1220–40, #600)[3]

[2] I follow a set-theoretic definition of cardinality according to which cardinality is the number of members in a set. Thus, the cardinality of a numeral is the number of members it contains as a set. For example, the cardinality of the numeral 2 $|\{a,b\}|$ is 2 because this set has two members.

[3] The birch bark letters are cited by number according to the numbering system used in the database of birch bark letters (www.gramoty.ru). The numbering of birch bark letters is the same across the sources cited in this article.

Table 1. Numeral-containing NPs in the Novgorod dialect (11th–13th centuries)

Gender	Num 1 + NP	Num 2 + NP	Num 3, 4 + NP	Num 5 + NP
Masc	odinŭ zolotnik-e one gold.coin-SG 'one gold coin'	dva zolotnik-a two gold.coin-DU 'two gold coins'	tri, četyre zolotnik-ě three four gold.coin-PL 'three, four gold coins'	pjaťʹ zolotnik-ovŭ five gold.coin-GEN.PL 'five gold coins'
Neut	odino lět-o one year-SG 'one year'	dva lět-a two year-DU 'two years'	tri, četyre lět-a three four year-PL 'three, four years'	pjaťʹ lět-ŭ five year-GEN.PL 'five years'
Fem	odina grivn-a one coin-SG 'one coin'	dŭvě grivn-ě two coin-DU 'two coins'	tri, četyre grivn-ě three four coin-PL 'three, four coins'	pjaťʹ grivn-ŭ five coin-GEN.PL 'five coins'

(3) b. дъва лѣта
dŭv-a lĕt-a
two-NEUT year-NEUT.DU.NOM
'two years' (1160–80, #113)

c. дъвѣ дѣжѣ
dŭv-ě děž-ě
two-FEM.DU.NOM barrel-FEM.DU.NOM
'two barrels' (1120–40, #863)

Unlike the numeral 2, the numerals 3 and 4 formed the so-called *malyj kvantitativ* (small quantity), which required nouns to be marked in the plural (Žolobov 2006: 101). Like the numeral 2, the cardinal numerals 3 and 4 behaved syntactically as adjectives, exhibiting agreement with the head noun in number and case but not in gender. In the Novgorod birch bark letters, the forms of the numerals *tri* 'three' and *četyre* 'four' do not show gender distinctions, and the same form is used both with feminine and masculine nouns; cf. (4a–b) and (4c–e).[4] Despite the lack of gender agreement, there is evidence of case agreement between the cardinal numerals 3 and 4 and the head noun, (4d–e). For example, the numeral 3 is marked in the instrumental case by the suffix *-ima* in agreement with the head noun *korob'ami* in (4d). It is harder to see case agreement between the numeral 4 and its head noun since the form *četyri* is syncretic in the nominative and the accusative cases, (4e).[5]

(4) Old Novgorod dialect (12th–13th centuries)

a. три годъи
tri godŭ-i
three year-MASC.PL.NOM
'three years' (1240–60, #61)

b. три гривьнѣ
tri griv'n-ě
three coin-FEM.PL.ACC
'three coins' (1180–1200, #726)

[4] In Old East Slavic, the cardinal numerals 3 and 4 showed gender agreement. The numeral 3 had the masculine form *trije* and the non-masculine form *tri*. Likewise, the numeral 4 had two forms: *četyre* when used with masculine nouns and *četyri* when used with non-masculine ones (Žolobov 2006: 101). The gendered forms of the cardinal numerals 3 and 4 are not attested in the Novgorod birch bark letters.

[5] I did not find any other case forms of the numeral 4 besides the nominative and the accusative in the birch bark corpus.

(4) c. чотири кони
čotyri kon-i
four horse-masc.pl.nom
'four horses' (1200–20, #194)

d. трима коробьами овсаними
tr-ima korob'-ami ovsani-mi
three-inst box-fem.pl.inst oat-fem.pl.inst
'three boxes of oats' (1400–10, #540)

e. въ цетыри кѫнѣ
vŭ cetyri kun-ě
for four coin-fem.pl.acc
'for four coins' (1140–1160, #776)

During the 11th–13th centuries, dual number expressed on nouns (and pronouns) was gradually getting lost both in Old East Slavic and in the Novgorod dialect. The loss of the dual is evidenced by dual/plural syncretism of the nominal suffixes. As shown in Table 2, neuter nouns showed dual/plural number syncretism and masculine/neuter gender syncretism; feminine nouns showed dual/plural number syncretism as well, but masculine nouns had not developed this syncretism yet.

Table 2. Nominal number inflections in the Old Novgorod dialect (adapted from Zaliznjak 2004: 96)

Declension type	Number		
	Singular	Dual	Plural
o-	Neuter -o	-a	-a
o-	Masculine -e	-a	-i, -ě
a-	Feminine -a	-ě	-ě, -y

The decline of dual number triggered a diachronic shift in the nominal phrases containing the numerals 2, 3, 4. The data from the Novgorod birch bark letters show that neuter nouns were the first ones to undergo a diachronic change since their dual suffix *-a* syncretized with the plural early in the 12th century. The reason for this early dual/plural syncretism was that in

the Novgorod dialect the dual suffix *-a* was used instead of the original Old East Slavic dual suffix *-ě* (Zaliznjak 2004: 166). For example, nominal phrases such as *dŭva lěta* 'two years' and *dŭva lukna* 'two barrels' in (5–6) had the same *-a* suffix as the plural nouns not quantified by numerals, such as *lěta* 'years' in (7). Later in the 14th century, the dual suffix *-a* started being used in nominal phrases with the cardinal numerals 3 and 4, such as *3, 4 lěta* '3, 4 years'.

(5) дъва лѣта
dŭva lět-a
two year-NEUT.DU
'two years' (1180–1200, #113)

(6) в҃: лꙋ̆кна
2 lukn-a
two barrel-NEUT.DU
'two barrels' (1180–1200, #671)

(7) мънога же в[ы] лѣта
mŭnoga že vy.DAT lět-a
many EMPH you year-ACC.PL
'many years to you' (1140–60, #503)

Following neuter nouns, feminine nouns were next to undergo a diachronic change in nominal phrases with cardinal numerals 2, 3, 4. In the Novgorod dialect, the feminine nouns of *a*-declension had two possible plural suffixes: *-ě* and *-y* (Table 2). Both suffixes were possible for plural nouns without quantifying cardinal numerals. However, only the suffix *-ě* was attested in numeral phrases with the cardinal numerals 3 and 4 in the Novgorod dialect (Zaliznjak 2004: 99).[6] We observe instances of dual/plural syncretism in the inflectional suffixes of the feminine nouns quantified by the numerals 2, 3,

[6] I found four instances of the plural suffix *-y* occurring with feminine nouns with the numerals 3 and 4 (1–4). Zaliznjak (2004: 99) suggests that these instances point to the original Old East Slavic plural form *-y* and not to the form *-ě* used in the Novgorodian dialect.

(i) г҃: гривьны
3 griv'n-y
three coin-FEM.PL
'three coins' (1160–80, #710)

(ii) г҃ грины
3 grin-y
three coin-FEM.PL
'three coins' (1075–1110, #909)

4, (8–10). These data show that as early as the 12th century, feminine nouns quantified by the cardinal numerals 2, 3, 4 formed a special subclass of numeral expressions characterized by an emerging count-form suffix.

(8) в: гривьнѣ
2 grivn-ě
two coin-FEM.DU.NOM
'two coins' (1160–80, #240)

(9) г гривьнѣ
3 grivn-ě
three coin-FEM.PL.NOM
'three coins' (1160–80, #240)

(10) въ цетыри кѫнѣ
vŭ cetyri kun-ě
for four coin-FEM.PL.ACC
'for four coins' (1140–60, #776)

Masculine nouns in nominal phrases with the numerals 2, 3, 4 continued to distinguish the dual suffix *-a* from the plural suffixes *-i, -ě* and showed no dual/plural syncretism, (11–14). During the 11th–13th centuries, the dual ~ plural opposition of the masculine nouns was clearly maintained, whereas no such opposition was present in the neuter and feminine nouns.

(11) конѧ в҃ и сторова
kon'-a 2 i storov-a
horse-MASC.DU two and healthy-MASC.DU
'two healthy horses' (1120–40, #842)

(12) ч[оти]ри кон[и]
čotyri kon-i
four horse-MASC.PL
'four horses' (1200–20, #194)

(iii) трѣ грѣвоны
trě grěvon-y
three coin-FEM.PL
'three coins' (1360–80, #366)

(iv) д҃ гривьны
4 grivn-y
four coin-FEM.PL
'four coins' (1075–1110, #909)

(13) три колотокѣ
tri kolotok-ě
three headdress-MASC.PL
'three headdresses' (1100–20, #644)

(14) д҃ золотьникѣ
4 zolotnik-ě
four gold.coin-MASC.PL
'four gold coins' (1100–20, #644)

2.2. NPs with the Numerals 2, 3, 4 in the Old Novgorod Birch Bark Letters (13th–15th Centuries)

During the 13th–15th centuries, nominal phrases with the numerals 2, 3, 4 continued undergoing a grammatical change which finally transformed them into a special subclass of numeral expressions with a count-form suffix. In the 13th–15th centuries, with the continued spread of the dual/plural syncretism, neuter nouns in nominal phrases with the numerals 2, 3, and 4 became marked by the former dual suffix *-a*. Feminine nouns were consistently marked by the dual suffix *-ě* (and its allomorph *-i*). This diachronic shift ended with masculine nouns assuming the dual suffix *-a* in nominal phrases with the numerals 3 and 4. Thus, during the 13th–15th centuries, nominal phrases with the cardinal numeral 2 (*dual'nyj kvantitativ* 'dual quantity') merged with nominal phrases containing the numerals 3 and 4 (*malyj kvantitativ* 'small quantity') and formed a new subclass of numeral expressions (*novyj malyj kvantitativ* 'new small quantity'); see Table 3 on the opposite page.

Let us examine the diachronic changes in numeral phrases with neuter, feminine, and masculine nouns in more detail. In the 13th–15th centuries, neuter nouns in NPs with the numerals 2, 3, 4 were already sharing the same dual/plural suffix *-a*, thus completing a merger between NPs quantified by the numeral 2 and those quantified by the numerals 3 and 4; see (15–16).

(15) :в҃: медвед҃на
2 medvedn-a
two bear.skin-NEUT.DU
'two bear skins' (1300–20, #65)

(16) д҃ блюда
4 bljud-a
four plate-NEUT.PL
'four plates' (1360–80, #261/262/263/264)

Table 3. Numeral-containing NPs in the Novgorod dialect (13th–15th centuries)

Gender	Num 1 + NP	Num 2, 3, 4 + NP	Num 5 + NP
Fem	odina grivn-a one coin-SG 'one coin'	dvě, tri, četyre grivn-ě (-i) two three four coin-CT 'two, three, four coins'	pjat' grivn-ŭ five coin-GEN.PL 'five coins'
Neut	odino bljud-o one plate-SG 'one plate'	dŭva, tri, četyre bljud-a two three four plate-CT 'two, three, four plates'	pjat' bljud-ŭ five plate-GEN.PL 'five plates'
Masc	odinŭ zolotnik-e one gold.coin-SG 'one gold coin'	dŭva, tri, četyre zolotnik-a two three four gold.coin-CT 'two, three, four gold coins'	pjat' zolotnik-ovŭ five gold.coin-GEN.PL 'five gold coins'

Feminine nouns in NPs with the numerals 2, 3, 4 were marked by the dual/plural suffix *-ě* as well as by the suffix *-i*. The latter was likely the result of a phonological change from /e/ to /i/ (Zaliznjak 2004: 25).[7] It is important to note that the suffixes *-ě* and *-i* appear to be in free variation even within the same document. For example, birch bark letters #278 and #521 contain both the suffixes *-ě* and *-i*, (17–21). The suffix *-i* in NPs with the cardinal numerals 2, 3, 4 is attested only in the birch bark letters of the later period dating to the 13th–15th centuries.

(17) в̄: куницѣ
2 kunic-ě
two marten-FEM.DU
'two martens' (1360–80, #278)

(18) г̄: куницѣ
3 kunic-ě
three marten-FEM.PL
'three martens' (1360–80, #278)

(19) д̄: куници
4 kunic-i
four marten-FEM.PL
'four martens' (1360–80, #278)

(20) г цетвероткѣ ржи
3 cetverotk-ě rži
three fourth-FEM.PL rye
'three fourths of rye' (1400–10, #521)

(21) г цет(ве)ретки пшеницѣ
3 cetveretk-i pšenic-ě
three fourth-FEM.PL wheat
'three fourths of wheat' (1400–10, #521)

Masculine nouns in nominal phrases quantified by the numerals 2, 3, 4 continued to resist the dual/plural syncretism until the late 14th century. The birch bark letters attest some occurrences of nominal phrases with the numeral 2 in which nouns were still marked by the dual suffix *-a*, whereas in nominal

[7] In the Novgorod birch bark letters, the sound /ě/, typically written as ѣ, is also orthographically represented by the letters *e*, *и*, ь (Zaliznjak 2004). In NPs with the cardinal numerals 2, 3, 4, the letters *e* and ь also occur on nouns as orthographic variants of the suffix *-ѣ* (*-ě*).

phrases with the numerals 3 and 4, nouns were marked by the plural suffixes *-i* and *-ě*; cf. (22–23). This evidence suggests that masculine nouns in NPs with the numerals 2, 3, 4 maintained the dual/plural opposition the longest.

(22) два ѡви⁝на
dva ovin-a
two measure-MASC.DU
'two measures' (1400–10, #23)

(23) три ру⁝блѣ
tri rubl-ě
three ruble-MASC.PL
'three rubles' (1400–10, #521)

However, during the 13th–15th centuries, masculine nouns began to show the first signs of collapse of the dual/plural opposition in NPs with the numerals 2, 3, 4. The dual suffix *-a* marking nouns in NPs with the numeral 2 began to spread into NPs with the numerals 3 and 4, (24–25). The data from the birch bark letters corpus show that instances of the merger between NPs with the numeral 2 and NPs with the numerals 3 and 4 are occasional and not consistent throughout the period of the 13th–15th centuries. However, these data show the beginning of a diachronic change in numeral phrases with masculine nouns which became widespread only at the beginning of the 17th century (Žolobov 2002: 5).

(24) г҃: рȣблѧ
3 rubl'-a
three ruble-MASC.DU/PL
'three rubles' (1300–20, #65)

(25) г҃ полосца
3 polosc-a
three rug-MASC.CT
'three rugs' (1380–1400, #263)

2.3. Summary

During the 11th–15th centuries, nominal phrases containing the numerals 2, 3, and 4 underwent significant diachronic changes. We can identify two stages in their historical development: during the 11th–13th centuries and 13th–15th centuries. As shown in Table 4 on the following page, neuter and feminine nouns underwent inflectional dual/plural syncretism during the 11th–13th

Table 4. Diachronic changes in NPs quantified by the numerals 2, 3, 4 (11th–15th centuries)

	11th–13th centuries		13th–15th centuries
Gender	**NP + Num 2**	**NP + Num 3, 4**	**NP + Num 2, 3, 4**
Neuter	lět-a year-DU	lět-a year-PL	lět-a year-CT
Feminine	grivn-ě coin-DU	grivn-ě coin-PL	grivn-ě coin-CT
Masculine	zolotnik-a gold.coin-DU	zolotnik-ě gold.coin-PL	zolotnik-a gold.coin-CT

centuries, whereas masculine nouns developed dual/plural syncretism later, during the 13th–15th centuries. As a result of these diachronic changes, NPs quantified by the numerals 2 and NPs quantified by the numerals 3 and 4 merged into a new subclass of numeral phrases characterized by the count-form suffix.

3. Corpus Study of the Birch Bark Letters (11th–15th Centuries)

3.1. Method, Design, and Results

To investigate the distribution of nominal phrases with the cardinal numerals 2, 3, 4, a corpus analysis of 879 birch bark letters was conducted via the Russian National Corpus of Birch Bark Letters (http://ruscorpora.ru/new/en/search-birch-bark.html#) and the archive of birch bark letters (www.gramoty.ru). The Russian National Corpus of Birch Bark Letters was searched to identify all tokens of feminine, masculine, and neuter nouns quantified by the numerals 2, 3, 4. A sub-corpus of the total of 301 birch bark letters containing nouns quantified by the numerals 2, 3, 4 was extracted. These 301 birch bark letter tokens make up 94.06% of the total of 320 tokens modified by all types of numerals. Tokens modified by the numerals 2, 3, 4 were categorized according to three genders (feminine, masculine, and neuter), two declension subtypes (hard/soft stems), and two time periods (11th–13th and 13th–15th centuries). The results of the diachronic corpus study are presented below.

3.2. Feminine Nouns with the Numerals 2, 3, 4

During the 11th–13th centuries, both hard- and soft-stem feminine nouns quantified by the numerals 2, 3, 4 had syncretic forms when used with the nu-

meral 2 and the numerals 3 and 4. They were marked by the dual/plural suffix *-ě*. The data show that there were only three instances of the original Old East Slavic suffix *-y* in *3 griv'n-y* (#710), *3 grin-y* (#909), and *4 grivn-y* (#909), with the majority of tokens marked by the suffix *-ě* (Table 5).

Table 5. Inflections of feminine nouns (11th–13th centuries)

Feminine noun + 2, 3, 4			
Hard stem *-a*		**Soft stem *-ja***	**Total**
-ě	-y	-ě	
82 (90.1%)	3 (3.3%)	6 (6.6%)	91

The prevalence of the suffix *-ě* over the original Old East Slavic suffix *-y* confirms that the speakers of the Novgorod dialect used an innovated and distinct suffix *-ě* to mark nouns in nominal phrases with the numerals 2, 3, 4. The availability of the innovative suffix *-ě* in the Novgorod dialect allowed feminine nouns to develop a dual/plural syncretism between NPs with the numeral 2 and those with the numerals 3 and 4.

Figure 1 illustrates that the hard-stem *-a*-nouns marked by the suffix *-ě* make up 90.1% of the total number of suffixes. Soft-stem *-ja*-nouns marked by the suffix *-ě* contribute 6.6% of the total, with the suffix *-y* representing the remaining 3.3%. Importantly, both hard-stem and soft-stem feminine nouns became syncretic not only in the dual/plural number, but also in their

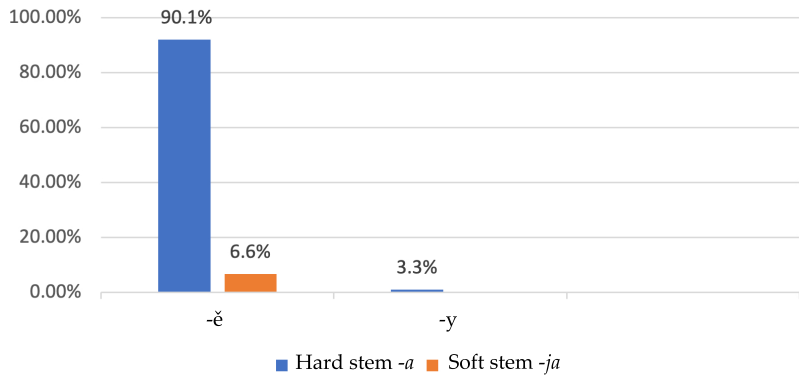


Figure 1. Feminine nouns with the numerals 2, 3, 4 (11th–13th centuries)

hard/soft declension subtypes, accounting for 98.87% of the total occurrence of the suffix *-ě*.

During the 13th–15th centuries, some hard- and soft-stem nouns were marked by the suffix *-i*, an allomorph of the dual/plural suffix *-ě* (Table 6). There is a single occurrence of the suffix *-y* on a hard-stem noun: *trě grěvon-y* (#366). Figure 2 below shows the distribution of both hard- and soft-stem nouns with the suffixes *-ě*, *-y*, and *-i*.

Table 6. Inflections of feminine nouns (13th–15th centuries)

Feminine noun + 2, 3, 4					
Hard stem *-a*		**Soft stem *-ja***	**Hard stem *-a***	**Soft stem *-ja***	**Total**
-ě	-y	-ě	-i		
16	1	0	25	10	52
(30.77%)	(1.92%)	(0%)	(48.08%)	(19.23%)	

3.3. Neuter Nouns with the Numerals 2, 3, 4

Although the total number of tokens of nominal phrases with neuter nouns is rather small (eight tokens), these data suggest that neuter nouns showed a merger between NPs quantified by the numeral 2 and NPs quantified by the numerals 3 and 4. Following Zaliznjak (2004: 166), I assume that during

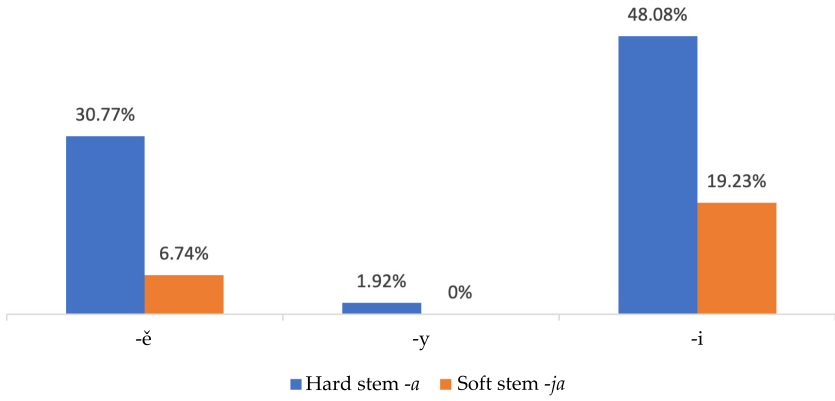


Figure 2. Feminine nouns with the numerals 2, 3, 4 (13th–15th centuries)

the 11th–13th centuries, neuter nouns quantified by the numerals 2, 3, 4 were marked by the suffix *-a* (Table 7). In the data, there were only two instances of neuter nouns occurring with the numeral 3: *3 lukn* and *3 lukon* in birch bark letter #671. Since the suffixes of these neuter nouns cannot be clearly identified, these two instances are not included in Table 7. The data from the 13th–15th centuries include only two instances of NPs with neuter nouns: *2 medvedna* (#65) and *4 bljuda* (#261). The pair *2 medvedn-a ~ 4 bljud-a* demonstrates the dual/plural syncretism of the suffix *-a*.

Table 7. Inflections of neuter nouns (1100–1300)

Neuter noun + 2		
Hard stem	**Soft stem**	**Total**
-a	-ja	
3 (75%)	1 (25%)	4

3.4. Masculine Nouns with the Numerals 2, 3, 4

During the 11th–13th centuries, the diachronic development of masculine nouns followed a different trajectory. In contrast to feminine and neuter nouns, masculine nouns quantified by the numerals 2, 3, 4 did not exhibit dual/plural syncretism but continued to distinguish between dual and plural suffixes. As Table 8 shows, 85.71% of the masculine nouns quantified by the numeral 2 were still marked by the dual suffix *-a*, distinct from the plural suffixes *-ě* and *-i*.

Table 8. Inflections of masculine nouns (11th–13th centuries)

Masculine noun + 2	**Masculine noun + 3, 4**	**Total**
-a	-ě, -i	
18 (85.71%)	13 (14.29%)	31

During the 13th–15th centuries, most masculine nouns continued to show resistance of dual/plural syncretism. The distribution of suffixes of masculine nouns and their corresponding occurrences is shown in Table 9 below.

Table 9. Inflections of masculine nouns (13th–15th centuries)

Masculine noun + 2	Masculine noun + 3, 4	Total
-a	-ě, -i, -a, -y	
8 (42.11%)	11 (57.89%)	19

As Figure 3 below illustrates, 42.11% of the masculine nouns in NPs with the numeral 2 are marked by the dual suffix *-a*, distinct from the plural suffixes *-ě* and *-i* marking masculine nouns in NPs with the numerals 3 and 4. However, some soft-stem masculine nouns, such as *rubl'* 'ruble' in *2 rubl'-a* and *3, 4 rubl'-a*, showed a tendency toward the dual/plural syncretism, but this tendency was not very strong during the 13th–15th centuries.

As the distribution of hard-stem and soft-stem masculine nouns shows, the dual and plural suffixes were still very distinct during the 13th–15th centuries (Table 10 on the opposite page). However, a detailed look at the data reveals that significant diachronic changes are already on the horizon.

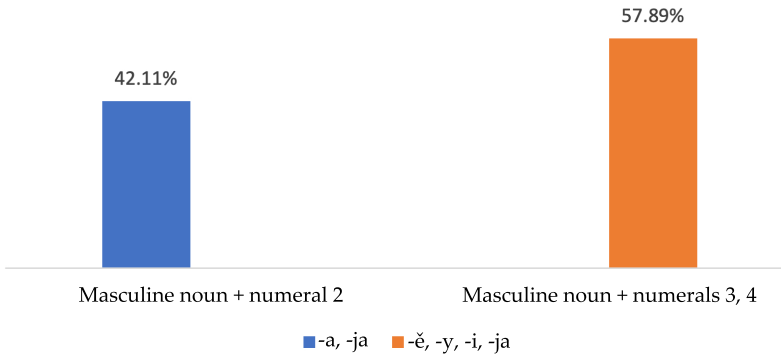


Figure 3. Masculine nouns with 2, 3, 4 (13th–15th centuries)

Table 10. Inflections of masculine nouns (13th–15th centuries)

Masculine noun + 2			**Masculine noun + 3, 4**				
Hard stem *-o*	**Soft stem *-jo***	**Total**	**Hard stem *-o***			**Soft stem *-jo***	**Total**
-a	-a		-ě	-y	-i	-a	
4 (50%)	4 (50%)	8	2 (18.18%)	1 (9.09%)	6 (54.55%)	2 (18.18%)	11

Figure 4 below illustrates a trend towards an emerging diachronic change in masculine nouns. Specifically, 18.18% of the soft-stem masculine nouns modified by the numerals 3, 4 are marked by the suffix *-a*, which is syncretic with its counterpart marking nouns quantified by the numeral 2. Although 18.18% is not statistically significant, it nevertheless marks the emergence of a new subcategory of nominal phrases with the cardinal numerals 2, 3, and 4.

3.5. Summary

The data presented in this diachronic corpus study show the gradual emergence of a new subcategory of nominal phrases containing the cardinal numerals 2, 3, 4 in the Novgorod dialect. Crucially, the emergence of these numeral phrases was possible due to the dual/plural syncretism of nominal inflections and the consequent merger between NPs quantified by the numeral 2 and NPs quantified by the numerals 3 and 4.

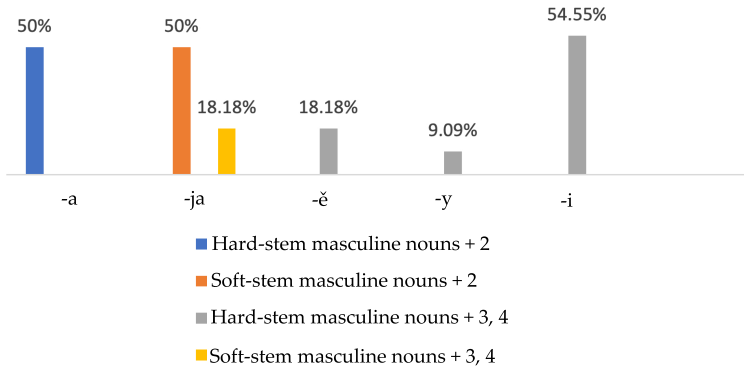


Figure 4. Masculine nouns according to the stem with 2, 3, 4 (13th–15th centuries)

4. The Syntax and Semantics of the Numerals 2, 3, 4 from a Diachronic Perspective

4.1. The Syntax and Semantics of Cardinal-Containing NPs

To understand how nominal phrases containing the numerals 2, 3, 4 emerged as a special subclass of numeral expressions, we need to look at the syntax and semantics of the cardinal-containing nominal phrases. In the analysis presented below, I show that the diachrony of nominal phrases with cardinal numerals can be explained if cardinal numerals are treated as properties in their semantics. I follow the property theory of predication and extend it to explain the semantics of cardinal numerals (Chierchia 1985; Chierchia and Turner 1988; Rothstein 2017). In the framework of property theory, I argue that both the lower (1, 2, 3, 4) and the higher (5 and greater) cardinal numerals have predicative semantics at the semantic type <e, t>, and they can also have the semantics of an individual property correlate at the semantic type <n>. When cardinal numerals appear pre-nominally, they function as prenominal modifiers at the semantic type <e, t <e, t>>. When cardinal numerals appear as bare numerals, they function as arguments at the semantic type <n>.

The property theory of the semantics of the cardinal numerals allows us to explain why Russian cardinal numerals form a cline from the more adjectival, such as the lower numerals 1, 2, 3, 4, to the more nominal numerals, such as 5 and greater. I further suggest that the syntactic behavior of Russian cardinal numerals follows from their semantics: the lower cardinal numerals 1, 2, 3, and 4 (adjectival) are mapped into the syntax as syntactic adjuncts to the NP, while the higher numerals 5 and greater (nominal) are mapped as syntactic subjects in the specifier of the NP projection.

Historically, Russian cardinal numerals did not belong to a single lexical category but were characterized by a lexical split: the lower numerals 1, 2, 3, 4 behaved syntactically as adjectives, while the higher numerals 5 and greater behaved syntactically as nouns. The adjectival nature of the cardinal numerals 1, 2, 3, 4 is evidenced by their agreement with the head noun in gender, number, and case, (26). The cardinal numerals *pjat'* 'five', *šest'* 'six', *sem'* 'seven', *osm'* 'eight', and *devjat'* 'nine' were count nouns belonging to the feminine *i*-declension type (Zaliznjak 2004: 113).[8] The nominal nature of the cardinal numerals 5 and greater is evidenced by the genitive plural they triggered on their nominal complement, (27). The syntactic facts about the adjectival nature of the lower numerals 1, 2, 3, 4 and the nominal nature of the higher numerals 5 and greater follow from the semantics of cardinal numerals.

[8] Zaliznjak (2004: 113) calls the numerals 5, 6, 7, 8, 9 "sčetnye suščestvitel'nye" (count nouns).

(26) на довоу иkоуноkоу
na dov-u ikounok-u
on two-DU.LOC icon-DU.LOC
'on the two icons' (1180–1200, #549)

(27) възьми оу р[а](ть)шь шьсть гривьнъ
vŭz'mi u Rat'š' š'st' griv'n-ŭ
take from Ratša six coin-GEN.PL
'Take six coins from Ratša.' (1160–80, #665)

I assume that cardinal numerals are words or phrases that denote a cardinality property (Chierchia 1985; Chierchia and Turner 1998; Rothstein 2017). This cardinality property of numerals can appear in two guises. First, cardinal numerals can denote a cardinality property at the predicative type <e, t> and can be predicated of a nominal argument. In this sense, cardinal numerals are adjectival. Second, cardinal numerals denote a cardinality property at the semantic type <n>, which itself can be an argument. In this second sense, cardinal numerals are nominals. It is Frege's (1892) original observation that properties have "two modes of presentation": on the one hand, they can be properties of arguments, while on the other, they can be arguments containing a cardinality property themselves. I will show that Frege's original observation about the dual semantic nature of properties is correct when it applies to cardinal numerals in the Old Novgorod dialect.

Let us look at the semantics of cardinal numerals as cardinality property predicates. For example, the cardinal numeral 2 will be analyzed as follows. The predicate interpretation of this cardinal numeral at the predicative type <e, t> is given in (28a–b). According to (28a), the cardinality of object x is n if the cardinality of the set of the atomic parts of x is n. Consequently, (28b) spells out the set of objects whose cardinality is 2. The denotation of the numeral 2 is given in (29). The numeral 2 at the predicative type <e, t> denotes the set of plural entities with atomic parts whose cardinality value is 2.

(28) a. $|x| = n \leftrightarrow |\{y: y \subseteq \text{ATOMIC } x\}| = n$
b. $\lambda x. |x| = 2$

(29) *two* <e, t>: $\lambda x. |x| = 2$ or $\lambda x. |\{y: y \subseteq \text{ATOMIC } x\}| = 2$

When a cardinal numeral at the predicative semantic type <e, t> composes with a noun in an NP, it functions as an intersective adjective and shifts to the predicate modifier type at <<e, t>, <e, t>>. I assume that count nouns are of type <e, t>. Singular count nouns denote sets of atoms, and plural count nouns denote the closure of the singular denotation under sum (Link 1983). For example, the interpretation of the NP *two books* proceeds in the following

way, (30). The denotation of the NP *two books* is the intersection of the denotations of the cardinal numeral *two* and the noun *books*.

(30) $[[\text{two books}]] = \lambda P\, \lambda x.P(x) \wedge |x| = 2$
$= \lambda x.\text{book}(x) \wedge |x| = 2$

Next, we will look at the semantics of cardinal numerals as individual correlates of properties. Numerals can denote an individual property correlate of the set of entities. I assume that individual property correlates are at the semantic type <n> like Chierchia's type π (Chierchia 1985; Chierchia and Turner 1988). Following Rothstein (2017), I assume that the cardinality function is a function from plural individuals into type *n*, (31). The operator $^{\cap}$ is a nominalization operator that turns predicative expressions into nominalized predicative expressions. This operator applies to a predicative interpretation at <e, t> and derives an individual property correlate. The operator $^{\cap}$ gives us an individual property-correlate interpretation, (32). Cardinal numerals at the semantic type <n> denote individuals with a particular cardinality property. Cardinal numerals at type <n> as arguments can be predicated at the semantic type <n, t>, (33).

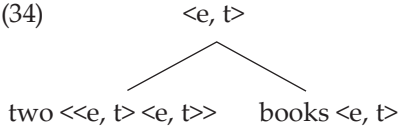
(31) $n = {}^{\cap}\lambda x.\ |x| = n$

(32) ${}^{\cap}\lambda x.\ |\{y: y \subseteq \text{ATOMIC } x\}| = 2$

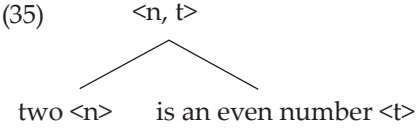
(33) Two is an even number.

Cardinal numerals denoting a cardinality property are ambiguous in their semantics between predicates and arguments. On the one hand, cardinal numerals can be interpreted as cardinality property predicates at type <e, t>, while on the other hand, they can be interpreted as individual correlate properties at type <n>. When a cardinal numeral combines with a noun in an NP, it functions as a predicate modifier at type <<e, t> <e, t>>. The semantic structure of cardinal numerals as predicate modifiers (*two books*) is given in (34). When a cardinal numeral combines with a predicate, it functions as an argument at type <n> (*two is an even number*). Cardinal numerals, as individual correlate properties, can be subjects of predication and thus function as second-order predicates at type <n, t>. The semantic structure of cardinal numerals as arguments is given in (35).

(34)

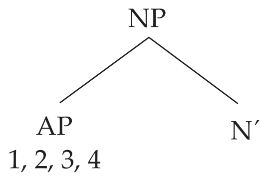


(35)

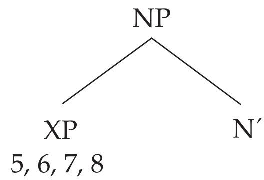


The ambiguous semantics of cardinal numerals can be easily translated into the syntax. When the semantic structures in (34–35) are mapped into the syntax, a cardinal numeral can be represented either as a syntactic adjunct or as an argument in the specifier position. The adjectival cardinal numerals 1, 2, 3, 4 are analyzed as syntactic adjuncts and have the syntactic structure as given in (36). The nominal cardinal numerals 5 and greater are analyzed as specifiers and have the syntactic structure as given in (37). The syntactic structures (36–37) show only a piece of the entire syntactic structure of cardinal-containing NPs. Their complete syntactic structure will be presented and explained in §4.2.

(36)



(37)



The evidence for treating the lower cardinal numerals 1, 2, 3, 4 as adjuncts comes from the fact that these numerals can be stacked with other adjectives within an NP, (38–39). Examples (38–39) show that the word order in which the numeral 2 appears in relation to an adjective is scrambled. In (38) the numeral 2 appears after an adjective, whereas in (39) it appears before an adjective.

(38)	шестокрї:ленаѧ	анг҃ла	:в:
	šestokrilena-ja	angl-a	2
	six-winged-MASC.DU	angel-MASC.DU	two

‘two six-winged angels’ (1180–1200, #549)

(39)	полотенеца	со	дова	цереленаѧ
	polotenec-a	so	dov-a	cerelena-ja
	towel-NEUT.DU	approximately	two-NEUT.DU	red-NEUT.DU

‘approximately two red towels’ (1200–1220, #439)

The evidence for analyzing the higher numerals 5 and greater as arguments in the specifier of the NP position comes from the fact that these numerals are assigned structural genitive case by a functional syntactic category other than the numeral itself. For example, in a cardinal-containing NP, *šest-ě koun-ŭ* (‘six-ACC coins-GEN’), the numeral 6 appears in the accusative case, while the noun appears in the genitive case, (40a). The mismatch in case assignment between the numeral and the noun shows that the noun is assigned structural genitive case not by the numeral but by the functional head (Q^0 in the QP projection).

(40) a. оу боѧна възьми шестѣ коунъ намьноую
u Bojana vŭz′mi šest-ě koun-ŭ nam′nou-ju
from Bojan take six-ACC coin-GEN.PL additional-FEM.SG.ACC
'Take six additional coins from Boyan.' (1160–80, #509)

b. осьмь высѧгла
os′m′ vysjag-l-a
eight.FEM.NOM break.away-PST-3.FEM.SG
'eight broke away' (1160–80, #724)

c. а нежѧтиници отроки били шьсть
a nežjatinici otroki bi-l-i šʹst-′
but Nežatinic's children beat-PAST-PL six-ACC
'But Nežatinic's children beat the six (of them).' (1140–1160, #855)

Bare cardinal numerals can appear as arguments in subject and object positions, (40b–c). For example, the numeral 8 is morphologically a feminine noun (*i*-declension). The bare cardinal numeral 8 is the subject of the sentence in (40b), as evidenced by the fact that the verb *vysjagla* agrees with it in the singular number, feminine gender, and 3rd person. In (40b) the subject *os′m′* is understood as a collective entity of eight individuals. In (40c) a bare cardinal numeral 6 appears in the object position and is interpreted as a collective entity of six individuals with a cardinality property (cardinality 6) defining these individuals.

4.2. Theoretical Components of the Proposal

I propose to analyze the syntactic structure of the cardinal-containing NPs in view of their semantics. More importantly, I argue that the syntax of the cardinal-containing NPs is a direct consequence of their semantic ambiguity: on the one hand, cardinal numerals can be predicate modifiers at the semantic type <<e, t> <e, t>>, while on the other hand, they can be individual correlates of a cardinality property at the semantic type <n>. I assume that the structure of an extended nominal phrase is complex and contains three structural layers: the quantificational layer (QP), the number layer (NumP), and the countability layer (CardP). I will further argue that these three layers play a key role in the syntax of the cardinal-containing nominal phrases.

First, let us consider the quantificational layer of cardinal-containing nominal phrases. It has been established that the quantificational aspect of Russian nominal phrases is expressed via the Genitive of Quantification (Babby 1987; Franks 1995; Bailyn 2004; Pesetsky 2013). The noun in an NP is marked in the genitive case after the higher (5 and greater) numerals, negation, and existential quantifiers, (41–44). In (41) the noun *člvk-ŭ* is marked in the genitive

plural by the suffix *-ŭ* after the numeral 8. The genitive case here is structurally assigned (by the Q^0 head), and it does not change even when the higher numeral appears in oblique cases, as shown in (42), where *osm-i* is used in the dative case. The nouns are also marked in the genitive case in the presence of negation, (43). The genitive of quantification also appears on nouns in the context of a covert (or an overt) existential quantifier, (44).

(41) и҃ чл҃вкъ взѧлѣ товара на е҃
8 člvk-ŭ vzjal-ě tovar-a na 5
eight person-GEN.PL took-PERF.3.PL product-GEN.SG on five

рублевъ
rublev-ŭ
ruble-GEN.PL

'eight people took some products for five rubles' (1380–1400, #249)

(42) по осми гривъ҆въно
po osm-i grivŭvŭn-o
for eight-FEM.DAT coin-GEN.PL

'for eight coins' (1140–60, #866)

(43) аже нмъ земли не досмотритъ
aže nmŭ zeml-i ne dosmotritĭ
even 1.PL.DAT land-GEN.SG NEG see

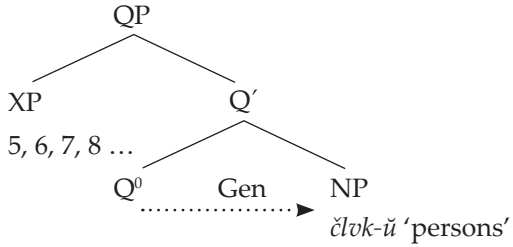
'Even we did not see after the land…' (1400–10, #933)

(44) да купи соли
da kupi sol-i
COMP buy salt-GEN.SG

'Buy some salt.' (1340–60, #354)

Syntactically, quantification is represented by the functional head Q^0 within the QP in an extended nominal projection, as given in (45) on the following page. The structure in (45) represents the sentential subject *8 člvk-ŭ* '8 persons' from example (41). The phonologically null head Q^0 assigns genitive as a structural case to its NP complement. The higher cardinal numeral occupies the specifier of QP. In example (42), the cardinal numeral *osm-i* 'eight' receives the dative case assigned by the preposition *po* 'for'; the dative case here is lexical. However, the noun *grivŭvŭn-o* 'coin-GEN' in this example receives the structural genitive case from the functional head Q^0 responsible for quantification.

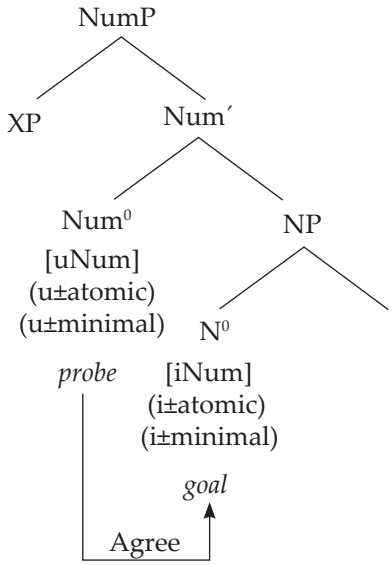
(45) Quantificational layer of a cardinal-containing NP



The next structural layer in an extended nominal projection is the number layer. I assume that a designated functional projection, the NumP, represents grammatical number of nouns (Ritter 1992). The Num^0 head hosts the syntactico-semantic number features. I further assume that number features are not primitive but compositional (Noyer 1997). Semantically, grammatical number can be represented by three number features—[±atomic], [±minimal], and [±additive]—which derive all crosslinguistically attested number systems via feature recursion (Harbour 2008, 2014). The Num^0 head is subject to crosslinguistic variation as to what number features are active or inactive in a particular language.

Consider the syntactic details of the number layer, illustrated in (46) below.

(46) Number layer of a cardinal-containing NP



In this structure, the NumP representing grammatical number sits above the NP.[9] The number head Num^0 takes the NP as its complement and hosts uninterpretable number features [uNum] (u±atomic) and (u±minimal), which are active in Old East Slavic. The nominal head N^0 has interpretable number features [i±atomic] and [i±minimal], which compose to derive the three-way number system (singular-dual-plural) of Old East Slavic. Valuation of number features ("agreement") obtains via the operation Agree (Chomsky 2005, 2008). The number head Num^0 is a probe which c-commands its goal nominal head N^0. After the feature valuation via Agree, uninterpretable number features get valued, i.e., obtain semantic content from the interpretable number features of the noun.

The compositional semantics of number features is as follows. I assume a lattice-theoretic semantic approach to number according to which number features compose with lattices in terms of superset and subset relations (Link 1983). Following Harbour (2014), I adopt the following semantic definitions of number features, (47). The [+atomic] feature partitions the lattice into atomic and non-atomic regions. The positive value of [+atomic] feature applied to a predicate P picks out atomic elements, while the negative value of this feature selects non-atomic elements. The [+minimal] feature applied to a predicate P captures sets of elements that have no proper subsets within a given region of the lattice. The [−minimal] feature picks out sets of elements with proper subsets.

(47) Definitions of number features

a. $\pm\text{atomic} = \lambda(x)\ (\neg)\ \text{atom}\ (x)$

b. $\pm\text{minimal} = \lambda P\ \lambda x\ (\neg)\ \neg\exists y\ (P\ (y)\ \wedge\ y \subset x)$

During the 11th–13th centuries, grammatical number in the Old Novgorod dialect had three values—the singular, dual, and the plural. These values are represented as feature combinations of the [±atomic] and [±minimal] number features, (48). Semantic composition of the number features proceeds as follows. The [±atomic] feature composes first, breaking up the lattice into atomic and non-atomic elements. The [±minimal] feature composes via the function application. It applies to atomic or non-atomic elements, checking for proper subsets. In the singular, the feature combination (+minimal (+atomic)) yields atoms without proper subsets, (48a). In the dual, the feature combination (+minimal (−atomic)) yields dyads without proper non-atomic subsets, (48b). In the plural, the feature combination (−minimal (−atomic)) produces non-atomic pluralities with proper non-atomic subsets, (48c).

[9] A DP layer can sit on top of the NumP to represent definiteness, but I omit it for reasons of simplicity.

(48) Grammatical number in the Old Novgorod dialect (11th–13th centuries)

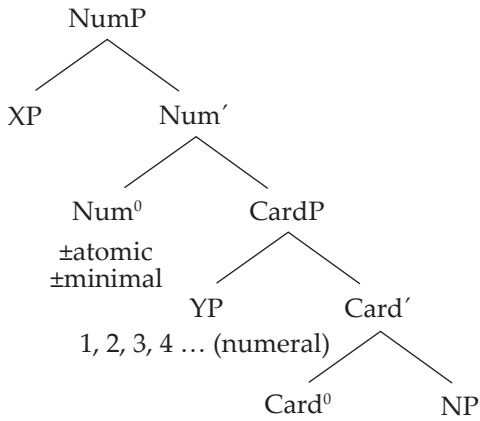
a. Singular (+minimal (+atomic))

b. Dual (+minimal (−atomic))

c. Plural (−minimal (−atomic))

I have presented two structural layers that make up the syntactic structure of cardinal-containing nominal phrases: quantification (QP) and grammatical number (NumP). The third structural layer that should be introduced into my analysis of cardinal-containing NPs is countability. The syntactic representation of countability is important for two reasons. First, the semantic notion of countability is essential to numerals, since they are words or phrases that are used to count. Second, countability must be grammatically encoded.

(49) The countability layer of a cardinal-containing NP



The syntactic structure which captures the countability layer is given in (49). I argue that countability should be represented by a designated functional projection CardP with the functional head Card⁰. CardP is positioned below NumP, and the functional head Card⁰ takes the NP as its complement. The cardinal numeral is in the specifier of the CardP position, which is similar to previous proposals (Selkirk 1977; Hurford 1987, 2003; Gawron 2002; Shlonsky 2004; Zabbal 2005; Watanabe 2010; Scontras 2013; Stepanov and Stateva 2018; Marti 2020).[10] The functional head Card⁰ contains a covert operator CARD, which denotes a two-place relation between the cardinal numeral and the

[10] The name of the functional projection hosting the cardinal numeral phrase is different in these accounts, but the position of the numeral is the same; it is in the specifier position of the NumeralP, MeasureP, or #P position.

noun phrase, (50). This operator takes a nominal predicate and returns a relation between numbers and individuals via the cardinality measure μCARD (Scontras 2013).

(50) [[CARD]] = λP λn λx. P(x) ∧ μCARD (x) = n

An important assumption that I need to make concerns the countability of nouns. To be counted by the operator CARD, the denotation of an NP must be countable. Counting presupposes individuating entities; therefore, nouns must be atomized and have the property of countability in their denotation. There are different approaches to how atomization of nouns can be achieved (Krifka 1989; 1995; Chierchia 1989, 1998, 2010; Rothstein 2010, 2017). Despite differences in the exact mechanism of atomization, these approaches agree that only atoms can be counted.

In my analysis, I follow Link's (1983) lattice-theoretic approach to mass/count-noun distinction and atomization. I assume that singular predicates have their denotation in an atomic domain and denote sets of atoms, (51a). Pluralities have their denotation in the Boolean semi-lattice and denote sets of atomic members closed under sum, (51b). In (51b) an operator * generates all the individual sums of members in the extension of the predicate.

(51) a. [[boy]] = {a, b, c} *semantically singular predicate*

b. [[*boy]] = {a, b, c, a+b, a+c, b+c, a+b+c} *semantically plural predicate*

To see how the operator CARD functions in counting individuals, let us take the cardinal-containing NP *two boys* as an example. The denotation of *two boys* is given in (52). First, the operator CARD takes the nominal predicate [NP boy] and number 2 and returns a set of individuals in P which consists of two atoms. Second, the [−atomic] number feature composes with the denotation of the cardinal-containing NP to produce a semantically (not grammatically) correct result, *two boy.* The suffix *-s* spells out the [−atomic] number feature, the plural, which is its correct grammatical number.

(52) [[[−atomic] [two CARD [NP boy]]]]
= λx. [[[NP boy]]] (x) ∧ CARD (x) = 2

4.3. Analysis of Diachronic Changes in Cardinal-Numeral-Containing NPs

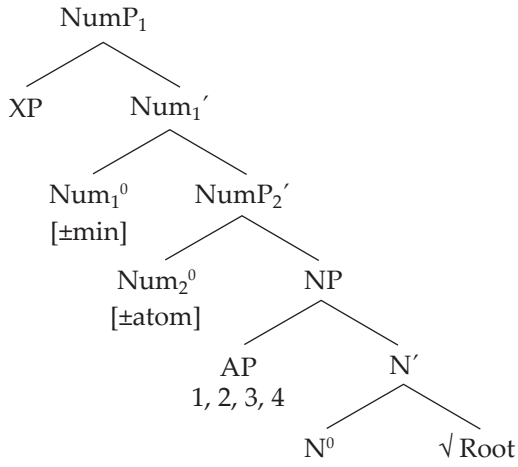
I have shown that three structural layers—quantification, number, and countability—are the essential theoretical components of my analysis of the syntax and semantics of cardinal-containing NPs. Now I turn to the analysis of the

diachronic changes in NPs containing the cardinal numerals 1, 2, 3, 4 in the Old Novgorod dialect. My main claim is that the cardinal numerals 1, 2, 3, 4 (as well as 5 and greater) underwent a syntactic reanalysis: namely, the process of numeralization (grammaticalization of countability), during which these numerals transformed from the lexical categories of adjectives and nouns into the functional category of the cardinal numerals proper. As a result of the process of numeralization, both the lower (adjectival) numerals 1, 2, 3, 4 and the higher (nominal) numerals 5 (and greater) became proper numerals with new structural properties.

The first stage (11th–13th centuries) in the diachronic development of NPs containing the cardinal numerals is represented in the syntactic structure in (53a). During this diachronic stage, the Num^0 head, responsible for grammatical number, hosted two number features, [±atomic] and [±minimal]. The [±atomic] feature is hosted in the lower $NumP_2$ since it composes first with the denotation of the NP by breaking NP denotation into atomic and non-atomic members. The [±minimal] feature is hosted in the higher $NumP_1$ since it is a function of the [±atomic] feature, which takes it and checks for minimal or non-minimal subsets.

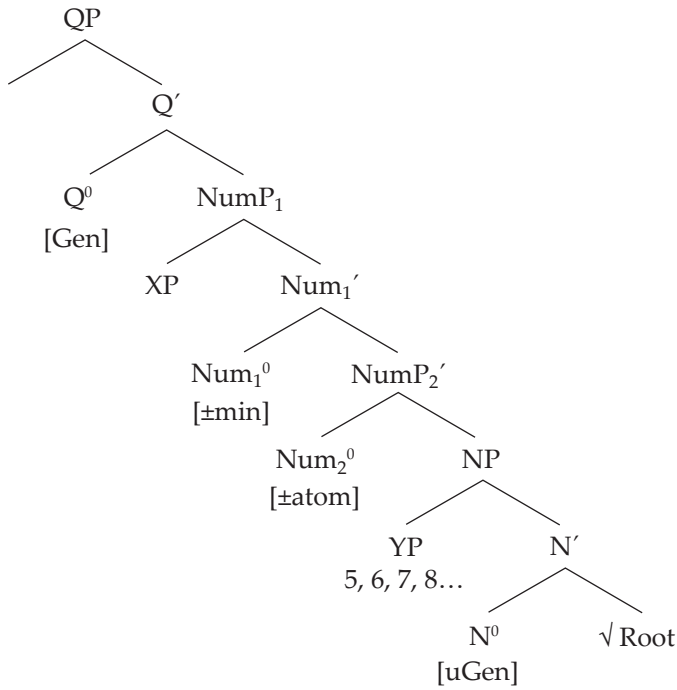
During the first stage (11th–13th centuries) of diachronic development, the lower adjectival numerals *odin* 'one', *dŭva/dŭvě* 'two', *tri* 'three', and *četyre* 'four' did not belong to the functional category of numerals proper yet; they were lexical "number" words. Recall that in Old East Slavic, as well as in the Old Novgorod dialect, the cardinal numerals 1, 2, 3, 4 behaved syntactically as adjectives, agreeing in number, gender, and case with their head noun. As shown in (53), the lower adjectival numerals 1, 2, 3, 4 were syntactic AP adjuncts to the NP.

(53) Diachronic Stage 1 (Old Novgorod dialect, 11th–13th centuries)



The syntactic structure of the higher cardinal numerals 5 and greater is given in (54) below. In this structure, the higher numerals 5 and greater are in the specifier of the NP. From this position, they move to the specifier of the QP to derive the surface word order. The quantificational head Q^0 acts as a probe with the structural genitive case feature [Gen], which values the unvalued case feature on its goal, the noun N^0. After the valuation of the genitive case feature is complete, the numeral YP moves to the specifier of the QP to satisfy the EPP feature requirement of its Q^0 head.

(54) Diachronic Stage 1 (Old Novgorod dialect, 11th–13th centuries)



Now we will turn to the compositional semantics of both higher and lower cardinal-containing NPs. Let us take *dva čeloveka* 'two persons' as an example to see how the compositional semantics delivers the correct interpretation of this cardinal-containing NP. The denotation of *dva čeloveka* proceeds as follows, represented in (55). The denotation of the NP *čelovek* 'person' is made countable in the lexicon. It has been atomized and contains sets of atoms. Thus, the cardinal numeral *dva* can easily combine with it. The cardinal numeral *dva* 'two', as a restrictive modifier at the semantic type <e, t <e, t>>, composes with the denotation of the NP predicate *čelovek* 'person' at the semantic type <e, t>. The cardinality of the numeral *dva*, which equals 2, in combination with the denotation of the NP *čelovek* delivers the correct composi-

tional result—*dva čeloveka* 'two persons', an intersective set with two atomic members.

(55) [[[+minimal [−atomic] [*dva* [NP *čelovek*]]]]] *dva čelovek-a* ('two persons')
= λx. [[[NP *čelovek*]]] (x) ∧ |x|= 2

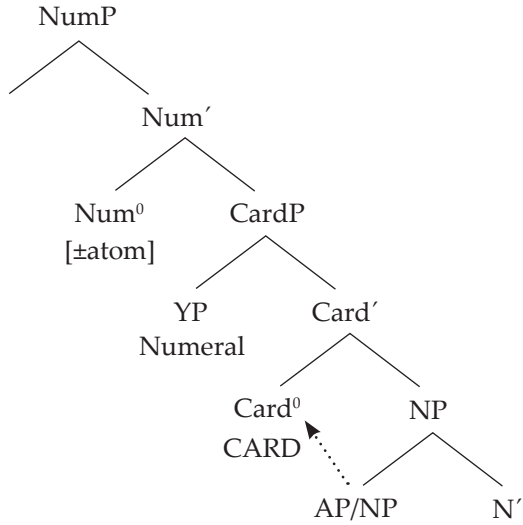
(56) [[[−minimal [−atomic] [*pjat'* [NP *čelovek*]]]]] *pjat' čelovek-ŭ* ('five persons')
= λx. [[[NP *čelovek*]]] (x) ∧ |x|= 5

Next, the number feature [−atomic] combines with the denotation of the NP *dva čeloveka* and checks for non-atomic members. Finally, the (+minimal) feature checks for the minimality of proper subsets and finds no non-atomic subsets, since the members of dyads are atomic. The dual suffix *-a* spells out the dual number on the noun *čelovek-a.* The semantic composition of an NP with the higher cardinal numeral 5, e.g., *pjat' čelovekŭ* 'five persons', proceeds in a similar way, represented in (56). The only difference is in the number specification of a plurality in a singular-dual-plural number system. A plural predicate has a (−minimal (−atomic)) number specification.

The second stage (13th–15th centuries) in the diachronic development of the cardinal-numeral-containing NPs is represented by the syntactic structure in (57). In this syntactic structure, an extended nominal projection consists of three structural layers: the QP (quantification), the NumP (grammatical number), and the CardP (countability), which takes an NP predicate as its complement.[11] In line with research on grammaticalization (Longobardi 2001; Roberts and Roussou 2003; van Gelderen 2011), I argue that lexical adjectives 1, 2, 3, 4 and nouns 5 and greater undergo the process of numeralization, during which their lexically encoded countability is grammaticalized via a new functional head, Card^0. As a result of reanalysis/recategorization, former "number" words have emerged as proper cardinal numerals (reanalysis is shown via a dotted arrow in (57) on the opposite page).

[11] In the structure in (57), the QP is not shown for reasons of space.

(57) Diachronic Stage 2 (Old Novgorod dialect, 13th–15th centuries)



I will start with the NumP projection responsible for the representation of the grammatical number. The functional Num⁰ head of this projection hosts only one feature [±atomic], because during this diachronic stage, the [±minimal] number feature becomes obsolete due to the loss of dual number. During the 13th–15th centuries, dual number, as a marked and unstable grammatical category, was gradually getting lost, until it was no longer part of the grammatical number system (see Noyer 1997; Harbour 2011; Nevins 2011; Slobodchikoff 2019 on the markedness of dual number).

As a result of the loss of the dual, a three-value number system (singular-dual-plural) was reduced to two values—singular and plural. Recall that dual number was represented by the combination of the (+minimal (−atomic)) features, whereas the plural had the (−minimal (−atomic)) feature specification in the earlier period ((58) repeated from (48)).

(58) Grammatical number in the Old Novgorod dialect (11th–13th centuries)

a. Singular (+minimal (+atomic))

b. Dual (+minimal (−atomic))

c. Plural (−minimal (−atomic))

Due to the dual/plural syncretism (sharing of the [−atomic] feature), Old Novgorod speakers were not getting enough evidence to keep the [±minimal] feature active in the grammar to distinguish the dual from the plural. Thus, the number feature [±minimal] was no longer used by speakers, leaving only

the [±atomic] number feature active in the grammar of the Old Novgorod dialect, (59). The [±atomic] number feature, which splits members of a set into atomic (singularities) and non-atomic members (pluralities), was used at this stage to represent singular and plural grammatical number, (60).

(59) (±minimal) → 0

(60) Grammatical number in the Old Novgorod dialect (13th–15th centuries)

a. Singular (+atomic)

b. Plural (−atomic)

I attribute the emergence of cardinal numerals as a distinct grammatical category to the grammaticalization (Longobardi 2001; Roberts and Roussou 2003; van Gelderen 2011) of countability. I propose that a functional projection CardP with the $Card^0$ head hosting a measure operator μCARD (adopted from Scontras 2013) is a new structural layer that was needed to accommodate the loss of dual number and grammaticalize the linguistic notion of countability in the grammar of the Old Novgorod dialect. CARD is a cardinality predicate that creates cardinal numerals. The denotation of the operator CARD is given in (61) (repeated from (50)). This operator creates a two-place relation between the cardinality *n* of a numeral and the denotation of an NP. Thus, counting is done via a covert functional operator CARD.

(61) $[[CARD]] = \lambda P\, \lambda n\, \lambda x.\ P(x) \wedge \mu CARD\ (x) = n$

At Diachronic Stage 1, the "number" words for 1, 2, 3, 4 were lexical categories—adjectives and nouns—whereas at Diachronic Stage 2, "number" words were reanalyzed as a functional category of numerals represented by a designated functional projection CardP.

4.4. Summary

The diachronic analysis presented above shows that the emergence of cardinal numerals in the Old Novgorod dialect is an instance of grammaticalization/numeralization, during which adjectival 1, 2, 3, 4 and nominal 5 and greater were grammaticalized as cardinal numerals. The grammatical category of cardinal numerals has emerged due to the reanalysis by speakers of both number features and grammatical categories. Specifically, the [±minimal] number feature, which distinguished the dual from the plural, was dropped, (62). Originally, "number" words, the adjectival 1, 2, 3, 4, and nominal 5 and greater, were reanalyzed as cardinal numerals counted via the functional head $CARD^0$, (63).

(62) Historical reanalysis of number features
[±minimal] → 0

(63) Historical reanalysis of lexical categories as functional
AP/NP lexical "number" words > functional CARD^0

5. Conclusion

This article was inspired by the puzzle of nominal phrases with the cardinal numerals *dva* 'two', *tri* 'three', and *četyre* 'four' in the Old Novgorod dialect and their occurrence in the birch bark letters dating to the 11th–15th centuries. In this article, I have investigated the reasons for and mechanisms of the emergence and diachronic development of these cardinal numerals. A detailed and systematic diachronic corpus analysis of 879 birch bark letters was conducted to identify a sub-corpus of 301 birch bark letters containing nominal phrases with the cardinal numerals 2, 3, and 4.

The main claim of my analysis of the semantics and syntax of cardinal-containing nominal phrases is that the cardinal numerals 2, 3, 4 (as well as 5 and greater) in the Old Novgorod dialect emerged as a result of the process of grammaticalization. Originally, in combination with noun phrases, the "number" words for 1, 2, 3, 4 were adjectives, while the "number" words for 5 and greater were nouns. When the dual number was lost in Old East Slavic, it triggered grammaticalization of countability, and the lexically encoded numerosity of "number words" became functionally encoded countability represented by a new grammatical class of cardinal numerals.

Now I will briefly revisit the theoretical questions which are the focus of this article:

1. Why did the former dual suffix spread from nominal phrases with the cardinal numeral 2 into nominal phrases with cardinal numerals 3 and 4?
2. What is "special" in the semantics of the cardinal numerals? How does the semantics of the lower cardinal numerals (2, 3, 4) differ from the semantics of the higher cardinal numerals (5 and greater)?
3. What can the diachrony of the cardinal numerals in the Novgorod birch bark letters tell us about the evolution of numerals in natural languages?

The answer to the first question was confirmed by the results of my diachronic corpus study. The data have shown that the spread of the dual suffix was triggered by the loss of dual number and was due to the dual/plural number syncretism. Since both the dual and the plural shared the [−atomic] number

feature, the dual suffix, originally used to mark nouns combining with the numeral 2, was repurposed in NPs modified by the numerals 3 and 4. In the new system, following the loss of the dual, the former dual suffix marked grammatical number, i.e., non-atomic elements, and the former "number" words for 3 and 4 became numerals supplying cardinality and counting non-atomic nouns.

The second question required a deeper look into the semantics of the cardinal numerals. I have shown that cardinal numerals are semantically ambiguous, which makes them, in this sense, "special". The lower cardinal numerals 1, 2, 3, 4, as well as the higher numerals 5 and greater, have predicative semantics at the semantic type <e, t> and can function as modifiers at the semantic type < e, t < e, t >> when they appear pre-nominally in combination with NPs. Bare cardinal numerals are of the semantic type <n>, which allows them to function as arguments in a sentence. The semantic ambiguity of the cardinal numerals makes it possible for us to understand why they can function syntactically as attributive adjectives as well as arguments.

Russian cardinal numerals form a cline from adjectival lower numerals (1, 2, 3, 4) to nominal (5 and greater). Historically, the lower numerals *odin* 'one', *dva/dve* 'two', *tri* 'three', and *četyre* 'four' behaved like adjectives in that they agreed in number, case, and gender with the noun they modified. The higher numerals *pjat'* 'five', *šest'* 'six', *sem'* 'seven', *osm'* 'eight', *devjat'* 'nine', *desjat'* 'ten', and greater were count nouns of the *i*-feminine declension type; they behaved like regular nouns in that they triggered genitive case on the noun in combination with noun phrases. The lexical split between the adjectival 1, 2, 3, 4 and nominal 5-and-greater cardinal numerals might be the result of Proto-Slavic inheriting the Proto-Indo-European quaternary system of counting (the first four fingers of the hand were more salient and different from the thumb; Winter 1992). The answer to the question about the lexical split of the cardinal numerals in Russian requires further inquiry and research.[12]

The diachrony of cardinal numerals in the Old Novgorod dialect has shown that the cognitive concepts of cardinality, individuality, and countability are inextricably connected. Since these cognitive notions are grammaticalized in language and represented by grammatical number and numerals, we would expect that a change in one of these categories would provoke a change in another category. The case of cardinal numerals in the Old Novgorod dialect has shown that a change in grammatical number (loss of the dual) led to the restructuring of countability and the rise of cardinal numerals.

[12] Ionin and Matushansky (2018: 162) note that Russian cardinal numerals are "neither fully nominal nor fully adjectival" and exhibit a more fine-grained behavior.

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