The Syntax of Comparative Numerals[*]
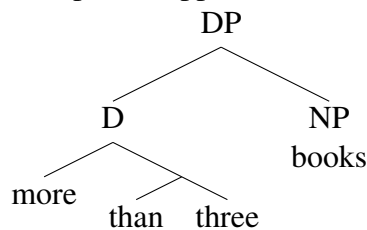

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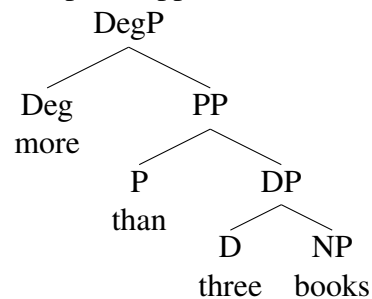### University of Chicago

1.   Introduction

In the *Complex D* approach to comparative numeral DPs (2a), *more than x*, where *x* is a numeral, is a complex (phrasal) determiner (Barwise and Cooper 1981, Keenan and Stavi 1986). This proposal is not compatible with Abney's (1987) DP Hypothesis, where determiners are heads (X^0). In this paper, I argue for a *Simple D* approach (2b), where the numeral and the NP form a constituent to the exclusion of *more than* (Bresnan 1973, Krifka 1999, Ionin and Matushansky 2006, Pancheva 2006, Geurts and Nouwen 2007).

(1)   more than three books
(2)   a. Complex D approach   b. Simple D approach

For expository purposes, I shall refer to the cardinal numeral in this construction as the *numeral*, and to the material that follows it within the construction as the *NP*. I shall also refer to strings of the form *more than*–numeral–NP simply as the *comparative numeral construction*, and to its noncomparative counterparts (e.g. *three books*) as *simple numeral DPs*.

Most of the arguments provided here are independent of the particular labels assumed in the trees above, and target the most essential difference between the two approaches: in Simple D, the numeral and the NP are sisters, and in Complex D the string *more than* and the numeral form a constituent to the exclusion of NP. In several of the languages discussed here (English, Spanish, Russian, Hebrew and Basque) different syntactic and morphophonological flags of the sisterhood relation between the numeral and the NP in simple numeral DPs are present in the corresponding comparative numeral constructions, thereby providing evidence that this sisterhood relation, undisputed in the former construction, is present in the latter as well.[1]

For the purposes of this paper, the semantic properties of the comparative numeral construction are ignored. The motivation behind this is not that these properties are irrelevant. The main reason is that proposals that assume Simple D and furthermore deal with these properties in a satisfactory way are present in the literature (Krifka 1999, Geurts and Nouwen 2007), which allows one to afford the luxury of examining the syntax of this construction without worrying whether it is compatible with its semantics. In addition, despite the wealth of literature dealing with the semantics of the construction, it contains very little discussion of its syntax. This paper is a first attempt at filling that gap.

The arguments are presented as follows. Initial justification for the Simple D approach to comparative numerals is given in Section 2 by comparing this constructions to other comparative constructions in English. The bulk of the paper is dedicated to the type of argument described above, based on class marker syncope in Spanish (Section 3), case and number in Russian numeral constructions (4), word order in Hebrew and Basque (5), and number agreement in English, Spanish, Russian, and Hebrew (6). Although this evidence argues for a Simple D analysis in these languages, Sections 5–6, also include discussion of Korean and Greek, where some of the predictions of the analysis are not borne out. Specific analyses for these languages are proposed that do not follow the details of the Simple D approach but in which the basic insight that there are no complex determiners is preserved. Before concluding, some apparent arguments for Complex D based on simple constituency tests are discussed in Section 7, where it is shown that a more careful look at the data in fact reveals that they are compatible with Simple D.

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[1] Hackl 2001 provides an analysis that is difficult to classify as belonging to Complex D or Simple D. It is not clear to me how it deals with the arguments presented here.

2.   **Standard Syntax**

Complex D makes certain problematic assumptions about comparative numerals. First, as discussed above, it uses a phrasal determiner, which is not allowed under Abney's (1987) DP Hypothesis. This is not the case in the Simple D approach: numerals, as all other determiners, are treated as D heads. A related claim is made in Ionin and Matushansky 2006, based on complex cardinal numerals (e.g. *twenty-three*).

Second, the complex determiner assumed in Complex D is a quantity comparative construction whose standard is the numeral (*three* in *more than three books*). This raises some issues when considering the syntax of the standard in quantity comparatives in English. Proponents of Complex D must assume that structures of the form *more than–X–NP* are possible. However, this must be allowed only when *X* is a numeral (3). No such restriction applies when the standard is postnominal (4).

(3)   a.   John bought more than three books.
       b.   *John bought more than Bill books.
       c.   *John bought more than Bill bought books.
(4)   a.   John bought more books than three.
       b.   John bought more books than Bill.
       c.   John bought more books than Bill bought.

As illustrated in these examples, postnominal standards can be DPs (*Bill* in (4b)) or clauses with a gap (*than Bill bought* in (4c)) (i.a. Hankamer 1973, Lechner 2001).[2] If, as assumed by Complex D, prenominal standards were possible, the fact that these standards are not possible in prenominal position (3b–c) is surprising. This approach must therefore stipulate restrictions on standards in prenominal position that amount to positing a special syntax for the comparative numeral construction.

On the other hand, the contrasts in (3–4) have a natural explanation under Simple D. We can simply assume that prenominal standards are not possible, which accounts for (3b–c). (3a) is grammatical because, under this approach, the standard is *three books*, i.e. it is not a prenominal standard. This type of comparative structure is independently needed for examples like the following:

(5)   John bought more than Bill.

To summarize, given independently motivated facts from English, Simple D provides a simpler account of the contrasts in (3), whereas Complex D needs to assume a special syntax for comparative numerals to account for them.

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[2] In (4a), the standard is a DP with NP ellipsis stranding numeral *three*.

3.   Class Marker Syncope in Spanish

The argument in the present section, as well as the ones to follow, is based on the claim made in Complex D that the numeral and the NP are sisters, a claim that is crucially not shared by Complex D. Several diagnostic tests for this sisterhood relation are developed based on simple numeral DPs (*three books*). When applied to comparative numeral constructions, the tests show that in several languages this sisterhood relation is present. The first argument of this type has to do with the morphophonology of class markers in Spanish.

Numeral *uno* 'one' in Spanish, like other nonverbal words in this language, contains a so-called *class marker* (Harris 1991). In the particular case of this numeral, the class marker is *-o* (*un-o*) when it agrees with a masculine noun, and *-a* (*un-a*) when it agrees with a feminine noun.[3] Like a few other determiners and adjectives, class marker *o* in *uno* is deleted when it has an over complement NP; in elliptical contexts, the class marker remains (Harris 1996):[4]

(6)   a. Juan compró {*uno/un} libro.
            Juan bought one   book
            'Juan bought one book.'
        b. Juan compró {uno/*un}.
            Juan bought one
            'Juan bought one.'

Crucially, linear adjacency between the numeral and an NP is not a sufficient condition for deletion:

(7)   Juan le regaló a {uno/*un} libros.
        Juan CL gave   to one   books
        'Juan gave someone books.'

As shown in the examples above, the NP has to be the sister of the numeral for deletion to occur. This is the case in (6a), but not in (7), where the numeral is part of a DP (an indirect object) with NP ellipsis that happens to be adjacent to a bare plural NP (a direct object).

Since the numeral and the NP are sisters in the Simple D analysis, it correctly predicts that the class marker in *uno* is deleted if it is used in a comparative numeral construction:

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[3] Note that the class marker does not encode grammatical gender directly. Rather, it encodes declension class, which is indirectly related to gender. Although most masculine nonverbs have class marker *o* and most feminines have *a*, this is not the case in a significant number of cases. See Harris 1991.

[4] Class marker *a* never deletes when attached to this numeral: *una casa/*un casa* 'one house'.

(8)   Juan compró más de   {*uno/un} libro.
       Juan bought more than one   book
       'Juan bought more than one book.'

Complex D incorrectly predicts that there is no deletion in this context, since the numeral and the NP are not sisters in this approach.[5]

4.   Case and Number in Russian Numerals

Another argument based on the Simple D claim that the numeral and the NP are sisters can be developed from certain complex facts having to do with case and number morphology in Russian. In order to understand the argument, we must first establish two relevant facts about this language. First, clausal standards in comparatives are marked with the particle *čem*, and phrasal standards with genitive case:[6]

(9)   a.   Germann   byl sil′nee čem   (byl) ego protivnik
            Germann.NOM was stronger what.INSTR (was) his adversary.NOM
            'Germann was stronger than his adversary (was).'
       b.   Germann   byl sil′nee svoego protivnika
            Germann.NOM was stronger his   adversary.GEN
            'Germann was stronger than his adversary.'

Second, numerals from two to four require that the noun heading their complement NP be marked as genitive singular whenever the entire DP is in nominative or accusative position:[7]

(10)   Vanja kupil   tri   knigi
       Vanja bought three.ACC book.GEN.SG
       'Vanja bought three books'

However, if the DP is in an oblique case position, the case and number on the noun is the expected one. For instance, it is genitive plural in genitive position:

(11)   cena trjox   knig
       price three.GEN book.GEN.PL
       'the price of three books'

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[5] Very similar facts hold in West Flemish, but I cannot incorporate them here for reasons of space. I would like to thank Liliane Haegeman for bringing these facts to my attention.

[6] The examples contain the following abbreviations: ABSolutive, ACCussative, CLassifier, DECLarative, ERGative, GENitive, INSTrumental, NOMinative, PLural, PST (past), SG (singular), TOPic.

[7] Higher numerals mark the noun as genitive plural.

Given these basic observations about Russian comparatives and numerals, consider the predictions that the two approaches to comparative numerals make about this language. In the Simple D approach, the numeral and the NP form a DP that is a phrasal standard. Thus, this DP should have genitive case in Russian, which predicts that if the numeral is between two and four, the noun in the NP is marked as genitive plural, just as in other examples of DPs in genitive position (11). Furthermore, this is independent of the syntactic position of the entire comparative numeral construction. Simple D predicts genitive plural on the noun even if the comparative numeral construction is in accusative position. This prediction is borne out:

(12)   Vanja kupil   bol′še trjox   knig
        Vanja bought more three.GEN book.GEN.PL
        'Vanja bought more than three books'

What is crucial in this argument is that Simple D predicts that the case and number morphology of the NP is determined by the numeral, since, as in simple numeral DPs, the two constituents are sisters.

Complex D makes no such prediction. The standard in this approach contains only the numeral, and therefore it predicts that the NP in Russian comparative numerals is not part of a genitive DP. Under this approach, the NP is the complement of a complex determiner, and there is no independent evidence that would tell us what morphological case and number requirements this complex determiner would impose on the noun when the DP (i.e. the comparative numeral construction) is in nominative or accusative position. Thus, the generalization would have to be stipulated as part of the analysis of the comparative numeral construction.

5.   Word Order: Hebrew, Basque and Korean

The relation between the numeral and the NP can also be diagnosed by the effect that it has on word order in Hebrew and Basque. In these languages, the linear order of the numeral with respect to the NP is somewhat idiosyncratic in simple numeral DPs. These idiosyncrasies can be used as diagnostic tools for the sisterhood relation between the numeral and the NP, which when applied to complex numeral constructions, provides further evidence for the presence of the same sisterhood relation in the latter construction.

In Hebrew, numeral *exad* 'one' follows its sister NP in simple numeral DPs, whereas higher numerals precede it:

(13)   a. Dani kana   sefer exad
            Dani bought book one
            'Dani bought one book.'

      b.   Dani kana   shney sfarim
           Dani bought two   books
           'Dani bought two books.'

These simple numeral DPs can be converted into comparative numerals by simply prefixing *yoter mi-* 'more than':

(14)   a.   Dani kana   yoter mi-   sefer exad
           Dani bought more from- book one
           'Dani bought more than one book.'
      b.   Dani kana   yoter mi-   shney sfarim
           Dani bought more from- two   books
           'Dani bought more than two books.'

This paradigm provides two separate arguments for Simple D. First, the differences in word order among numerals are replicated in comparative numerals. Since these differences are the result of the local relation between the numeral and the NP in simple numerals, their presence in comparative numerals provides an argument for Simple D, which posits the same local relation in the two constructions, and against Complex D, which does not.

     Second, in order to maintain a Complex D analysis in Hebrew, one would need to posit a discontinuous constituent for comparative numerals containing *exad* 'one'. As seen clearly in (14a), *yoter mi-* 'more than' and *exad* are not linearly adjacent, but Complex D claims that they form a constituent to the exclusion of the NP. One could, of course, propose a discontinuous constituent for cases like this one, but that would seem to be too far of a departure from standard assumptions about syntax, taking into account that the word order facts follow without stipulation from the Simple D approach.

     Basque comparative numerals provide parallel arguments for Simple D. Since it is a (mostly) head-final language, the linear order in quantity comparatives is standard–standard marker *baino*–NP–degree word *gehiago*:

(15)   Jonek   Patxik   baino liburu gehiago   irakurri du.
         Jon.ERG Patxi.ERG than   book more.ABS read   has
         'John has read more books than Patxi.'

Furthermore, numeral *bat* 'one' follows the NP in simple numerals, whereas numerals *hiru* 'three' and higher precede it:[8]

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[8] Numeral *bi* 'two' can precede or follow the NP, depending on the dialect. The data reported here are in Standard Basque, and, as far as I know, there is no relevant dialectal variation.

(16) a. Liburu bat   erosi   dut.
          book   one.ABS bought I.have
          'I have bought one book.'
      b. Hiru liburu   erosi   dut.
          three book.ABS bought I.have
          'I have bought three books.'

Given these background facts, the following Basque comparative numeral examples replicate the word order argument discussed above for Hebrew:

(17) a. Liburu bat   baino gehiago   erosi   dut.
          book   one.ABS than   more.ABS bought I.have
          'I have bought more than one book.'
      b. Hiru liburu   baino gehiago   erosi   dut.
          three book.ABS than   more.ABS bought I.have
          'I have bought more than three books.'

As in simple numerals, *bat* 'one' follows the NP, and other numerals precede it. As was the case in Hebrew, this parallel provides an argument for Simple D. Furthermore, comparative numerals with *hiru* 'three' and higher would require a discontinuous complex determiner in Complex D: as shown in (17b), *hiru* and *baino gehiago* 'than more' are not adjacent.

Surprisingly, the same type of paradigm shows that the Simple D analysis is not possible for Korean.[9] In this language, numerals are always associated with a classifier, whose form depends on the noun they are associated with:

(18) Cheli-nun sey-kwen-uy chayk-ul sa-ss-ta
      Cheli-TOP three-CL-GEN book-ACC buy-PST-DECL
      'Cheli bought three books.'

Furthermore, as can be seen in the above example, the numeral–classifier constituent is marked as genitive (*-uy*) when modifying an NP, and, like other genitive modifiers, it precedes the NP. Consider next the comparative numeral counterpart of the above example:

(19) Cheli-nun sey-kwen-isang-uy   chayk-ul sa-ss-ta
      Cheli-TOP three-CL-more.than-GEN book-ACC buy-PST-DECL
      'Cheli bought more than three books.'

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[9] Rajesh Bhatt (personal communication) has brought to my attention that similar facts hold in Hindi. I have not been able to fully explore the consequences of this for my analysis.

Crucially, the comparative numeral is formed by attaching *-isang* 'more.than' directly to the numeral–classifier constituent (and inside the case marker). These linear order facts strongly suggest that the equivalent of English *more than*–numeral is a constituent in Korean, which provides an argument against a Simple D analysis of comparative numerals in this language.

Nevertheless, the facts are compatible with the more general claim defended in this paper, namely, that complex (phrasal) determiners do not exist. As evidenced by the fact that the numeral–classifier constituent is case-marked even in simple numerals (18), this constituent is a nominal phrasal constituent (a DP or NP), and presumably, attaching *-isang* 'more.than' to it to form a comparative numeral (19) does not change this fact. What is crucial is that this constituent does not behave as a determiner. A complete analysis requires discussion of questions that go beyond the purposes of this paper, but I would like to tentatively propose the following structure for (18) and other comparative numerals, which accounts for all the facts discussed above:[10]

(20)   [[$_{NP}$ [$_{NP}$ sey-kwen] -isang   ] -uy   chayk] -ul
       [[$_{NP}$ [$_{NP}$ three-CL   ] -more.than] -GEN book   ] -ACC

Thus, the facts point to an analysis of Korean comparative numerals that does not involve positing complex determiners. What the Korean data reveal is that Simple D is the correct analysis only for languages in which numerals are determiners. This is expected given the basic theoretical motivation behind the approach, namely that there are no complex determiners.

6.   Number Agreement

Number agreement in English and other languages also confirms the predictions of Simple D. In simple numeral DPs, the noun heading the NP is singular if the numeral is *one*, but plural if the numeral is higher:

(21)   a.   John bought one book/*books.
       b.   John bought two books/*book.

Attaching *more than* to form comparative numerals does not alter these facts:

(22)   a.   John bought more than one book/*books.
       b.   John bought more than two books/*book.

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[10] Note that case markers in Korean are phrase-level affixes that attach to NP/DP (Yoon 2005).

The correlation also holds in Spanish (6a, 8) and in Hebrew (13–14).[11]

This correlation is straightforward in Simple D, but not in Complex D, since in the former approach the syntactic relation between the numeral and the NP is identical in both constructions.[12] Note, furthermore, that in the case of *more than one* (22a), Complex D posits what seems to be a plural determiner, which should trigger plural agreement on the noun, contrary to fact. Thus, the number agreement facts in these languages provide a further argument for Simple D.

However, the agreement facts are different in Greek. Although, as expected, numeral *ena* 'one' is singular, the corresponding comparative numeral triggers plural number on the noun:

(23)   o   Janis agorase parapano apo ena vivlia
        the Janis bought more   than one book.PL
        'Janis bought more than one book.'

Complex D clearly makes the correct prediction in this case.

Given the evidence in favor of Simple D, this can hardly be seen as a knock-down argument against this approach. At this moment, I can think of three possible ways of dealing with Greek comparative numerals. First, it might be that this simply reflects parametric variation: Complex D is the right analysis for Greek, but Simple D is right for the other languages. Although it would be hard to argue against this proposal, it is in clear contradiction to the basic motivation behind the approach taken in this paper; it would amount to giving up the claim that complex determiners do not exist. A more promising approach would posit the following structure for comparative numeral constructions for all the languages

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[11] The Spanish examples contain singular *un* 'one'. The following are relevant examples with a plural numeral:

(i)   Juan compró (más de)   dos {libros/ *libro}.
        Juan bought (more than) two {books/   book}

Basque has no DP-internal agreement, which makes it irrelevant for this argument. The Russian number agreement facts with numerals higher than one are too idiosyncratic to make them relevant (see Section 4), but numeral *one* does confirm the correlation. The following are relevant examples of numeral expressions in nominative position:

(ii)   odna   kniga   / bolše odnoj   knigi
        one.NOM book.NOM.SG / more one.GEN book.GEN.SG

[12] The Complex D approach could assume a theory of agreement that would derive the facts in comparative numerals, but there is in principle no reason to assume that the NP should agree with a numeral embedded inside a complex determiner. Since no specific proposal along these lines is available, discussion of this type of analysis would be too speculative.

involved:[13]

(24) $[_{DegP}$ [more $[_{PP}$ than $[_{DP}$ numeral NP1]]] NP2]

This structure is identical to the one posited in (2b), except for the presence of two NP positions instead of just one: NP1 in the same position as in (2b), and NP2, a copy of NP1 (identical except for number, as discussed below) in a higher position. Furthermore, the analysis needs to be supplemented with a condition to the effect that one of the two NPs must undergo ellipsis, with the choice of NP1 vs. NP2 ellipsis left to parametric variation. Specifically, Greek elides NP1, while other languages elide NP2. In the specific case where the numeral is *one*, the structure would be the following:

(25) $[_{DegP}$ [more than one book$_{NP1}$] books$_{NP2}$]

NP1, being sister to *one*, is singular, while NP2, being sister to *more than one*, is plural. In Greek, NP1 is elided, leaving the plural NP2 overt, and in other languages NP2 is elided, leaving the singular NP1 overt.

This proposal is compatible with the motivations behind Simple D, and it makes certain interesting predictions. In particular, it predicts that there should be languages that are just like Spanish, Hebrew, Basque or Russian except in the behavior of comparative numerals. For instance, it predicts that a language like Spanish is possible where the class marker on the numeral is deleted in simple numerals, but in which ellipsis of NP1 instead of NP2 results in no deletion of the class marker in comparative numerals (see Section 3).

I have so far found no languages that fit this description. I therefore propose the following more conservative approach that only makes predictions about number in Greek and other languages. The prediction that *more than one* triggers singular agreement on the noun is based on the assumption that the number morpheme (Nb) attaches directly to the noun (or the NP) in both simple and comparative numerals. Let us assume that this is true for English, Spanish, Russian, Hebrew and Basque, which derives the number agreement facts discussed above. However, we can assume that the number morpheme attaches at a higher point in the structure in Greek comparative numerals, in particular, higher than everything else in the construction:

(26) $[_{DegP}$ [parapano apo ena NP] Nb]
        $[_{DegP}$ [more   than one NP] Nb]

It is plausible to assume that in this structure, Nb is plural, since it is not in a configuration to agree with singular *ena*. This derives the Greek number agreement facts in (23).

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[13] See Kennedy 1999 for justification of the syntax of comparatives underlying this analysis.

Needless to say, this is a highly tentative approach, and it should be confirmed by other number agreement facts in Greek DPs. I leave this as a question in need of further research.

7.   Nonarguments for Complex D

The two approaches to comparative numerals compared here posit clearly different constituent structures for the construction, and it should be possible to find arguments for one or the other approach with simple constituency tests. Two such tests are examined here (based on movement and coordination) that seem to favor the constituency proposed in Complex D, at least for English. A more careful look at the data, however, shows that they are compatible with Simple D as well.

The first constituency test is based on the assumption that only sentence strings that are constituents can undergo movement. In particular, phrasal standards can be wh-moved in English (stranding *than*; Hankamer 1973)

(27)   Who did John read more books than?

In Simple D, the string numeral–NP is a phrasal standard, but this is not true in Complex D. The latter approach thus correctly predicts that this string cannot undergo wh-movement:

(28)   *How many books did John read more than?

However, this rests on the assumption that all phrasal standards can undergo movement. This assumption is false. In particular, phrasal standards that are very similar to the one posited in Simple D cannot be wh-moved:

(29)   *How many feet is John taller than?

The fact that comparative constructions block extraction of amount expressions such as *how many feet* strongly suggests that they are inner islands (i.a. Ross 1984, Fox and Hackl 2006). If that is the case, then the fact that movement of numeral–NP in comparative numerals is not possible has an explanation that is compatible with Simple D. Even if an inner island explanation turns out not to be correct, the fact that not all phrasal standards can be extracted is sufficient to call into question the validity of (28) as a constituency test.

The second constituency test rests on the assumption that only constituents can be coordinated. The string *more than*–numeral is a constituent in Complex D, but not in Simple D. The string can be coordinated, as predicted by Complex D:

(30)   John read more than three but fewer than seven books.

However, as is well-known, using coordination as a constituency test is not a straightforward matter, due to the fact that constructions such as Right Node Raising (RNR) at least apparently allow for nonconstituent coordination. In fact, (30) can be analyzed as an example of RNR parallel to the following:

(31)   Mary thinks that Bill bought more than three, but Sue claims that he bought more than five, books.

This is clearly a case of RNR; it is definitely not a case of coordination of the string *more than*–numeral. Thus, an RNR parse of (30) cannot be excluded, which makes this not a valid constituent test in this case.

To summarize this section, although apparently straightforward constituency tests seem to favor the Complex D approach to comparative numerals, other facts reveal that, at least in these cases, the data do not in fact test for constituency in the way originally assumed. Therefore, the data are compatible with Simple D as well.

8.   Conclusion

The Simple D approach provides a better account of comparative numeral constructions than the Complex D approach, as revealed by arguments based on diverse syntactic and morphophonological properties of the construction in different languages. To the extent that the arguments are sound, these are also arguments for the basic assumption underlying the approach, namely that there are no complex determiners. This is confirmed even in languages like Korean, where Simple D does not provide a suitable analysis, but only because numerals in this language are not determiners and therefore the claim that complex determiners do not exist is irrelevant. The greatest challenge to the proposal comes from number agreement facts in Greek. Two alternative analyses compatible with the general approach are given in Section 6; both make interesting predictions, a matter that I have left for future work.

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