Adjectival Modification of Numerals
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1 Introduction

In English, a cardinal numeral can be preceded by an adjective and an indefinite article:

(1) [A surprising twenty students] applied for this position.

The construction is quite widespread, and we find a variety of examples in the Corpus of Contemporary American English (COCA) (Davies 2008):

(2) With a whopping 44 colors, this line has a lip hue for everyone (GoodHouseKeeping 2011)
(3) Nearly 6,000 of those deaths are attributable to plants owned by a mere eight companies. (MotherJones 2003)

The indefinite article in this construction is obligatory, conditioned by the presence of the adjective and the numeral. In their absence, the indefinite article is unacceptable:

(4) a. *Surprising twenty students applied for this position.
   b. *A twenty students applied for this position.
   c. *A surprising students applied for this position.
   d. *A students applied for this position.

Outline:
- We discuss basic syntactic and semantic properties of this construction, forming a check-list for an adequate analysis.
- We suggest a syntactic analysis and compare it to other approaches.
- We formulate a semantics for this construction.
- In a short diachronic overview, we find additional support for aspects of our analysis.
- Open issues

The goal of the talk is to develop an analysis that employs independently known mechanisms in the grammar of (English) numerals that together give rise to this peculiar construction.

2 Core Data

2.1 Syntactic Issues

Despite the presumably singular indefinite which occurs in this construction, verbal agreement is necessarily plural (we exclude measure nouns, such as mile or hour, as the data differs):
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(5) **A mere eight companies own** nearly all of mainstream media journalism. (USAToday 2007)

(6) **A reported 4,000 delegates were** among the 10,000 conventioneers gathered in Charlotte, NC, for the six-day confab. (Jet 1996)

(7) **A suffocating 92,000 fans were** in the seats for each game at the L.A. Memorial Coliseum. (Chicago 2005)

(8) Many others are from Gwinnett County, but **a surprising 12 families are** transplants from New York (Atlanta 2003)

(9) **And a staggering 17 teams are** holding opponents under 39 percent. (Denver 1997)

Likewise, the construction only allows for **plural anaphora**.

(10) A mere eight companies own nearly all of mainstream media journalism. **It has / They have** too much power.

(11) A reported 4,000 delegates were among the 10,000 conventioneers gathered in Charlotte, NC, for the six-day confab. **It was / They were** well motivated.

(12) A surprising 12 families are transplants from New York. **It has / They have** managed to settle down in their new lives.

Construction-internally, replacing the indefinite with a demonstrative, we find that **demonstratives are necessarily plural**.

(13) I just knew I had to mention **these other four actors** who were, you know, some of the best actors alive. (CNN_Morgan 2012)

(14) What's one change you'd like to see Texas make in **these final three games?** (Austin 2012)

(15) I ran up our flag in the pre-dawn dark to salute **those brave 36 senators** who voted to keep Old Glory flying over the land of the free. (Houston 1995)

The construction shows evidence for plurality both construction-internally (the demonstrative) and construction-externally (verbal agreement and plural anaphora), making the presence of a singular indefinite rather puzzling.

### 2.2 Semantic Issues

The construction is said to have **‘quantity’ and ‘quality’ readings**, the readings roughly divided between the adjectives that modify the numeral (Solt 2007; Ionin and Matushansky 2016). In the ‘quantity’ readings, the adjective, intuitively, says something about the quantity, while the ‘quality’ ones target other properties of the (group of) individuals in question.

(16) a. A mere 10 students showed up for the class. **QUANTITY**  
   b. We received a remarkable ninety applications for the position.  
   c. And a staggering 17 teams are holding opponents under 39 percent.

(17) a. He played a boring/beautiful five songs. **QUALITY**  
   b. A lucky three students got fellowships.  
   c. I opened the door and found a bedraggled four hikers on my doorstep.
The difference can be seen in inferential patterns (not) supported by these different readings (Honda 1984):

(18) a. A mere 10 students showed up for the class. QUANTITY
    \(\rightarrow\) The 10 students that showed up for the class were mere.

b. He played a boring/beautiful five songs. QUALITY
    \(\rightarrow\) The five songs that he played were boring/beautiful.

Some adjectives allow for both ‘quantity’ and ‘quality’ readings, like ‘remarkable’ above:

(19) We received a remarkable ninety applications for the position.
    a. 90 applications is a lot.
    b. The 90 applications that we received were remarkable.

For some adjectives, it’s hard to say whether they give rise to the 'quality' or 'quantity' reading:

(20) Today we received an additional 10 applications.
    a. 10 is an additional number of applications.
    b. The applications were additional.

There are restrictions on the adjectives that can appear in this construction. Evaluative (surprising, mere, amazing), modal (alleged, possible), and anaphoric (different, further) adjectives are acceptable, but some adjectives are not (Keenan 2013; Ionin and Matushansky 2016). These are adjectives of shape, size, color, material, origin – we call them stubbornly distributive adjectives (alluding to Schwarzschild 2011):

(21) a. ??I met a tall five people the other day.
    b. ??I bought a rectangular five tables.
    c. ??I talked to an American six students.

There is a ‘grouping effect’ in the interpretation of this construction under ‘quality’ readings. In (b), in contrast to (a), the five songs have to be sequential (Solt 2007, Ionin and Matushansky 2016):

(22) a. He played five boring songs, but in between he played one really good one.
    b. ??He played a boring five songs, but in the middle he played a really good one.

The ‘grouping effect’ is not there in ‘quantity’ readings (with ‘quantity’ adjectives):

(23) At various points during the day, a staggering 192 hikers showed up wanting to be fed.

2.3 Summing up:

- Obligatory (singular) indefinite article, adjective and numeral
- Plural verbal agreement, anaphora, and demonstratives
- ‘Quantity’ and ‘quality’ readings
- Restrictions on which adjectives can appear in the construction
- ‘Grouping effect’ under ‘quality’ readings, but not under ‘quantity’ readings
3 Syntactic Structure

3.1 The basic structure

Given the presence of the indefinite article, Jackendoff (1977) argues that the numeral is a noun and posits the following structure:

\[(24)\]

We adhere most closely to the structure of Jackendoff, adopting his intuition that the article, adjective, and numeral form a constituent to the exclusion of the noun. However, we do not treat the numeral as being of category N, but a category numeral (to be clarified).

\[(25)\]

A few notes concerning this structure:

- Following Ritter (1991, 1992) and many others, we assume the standard projection of a Num(ber)P, taking it to be the locus of number inflection in English.

- We take the numeral (with or without modification) to sit in the specifier position of NumP. Danon (2012) argues that numerals vary cross-linguistically between functioning as heads (cf., Ionin & Matushansky 2006, 2016, a.o.) and functioning as specifiers; following Jackendoff (1977) and Danon (2012), we adopt a specifier analysis of English.

- We take the D-head to be filled by a null plural indefinite in indefinite plural contexts.

Our structure immediately accounts for the apparent plurality of the construction - the D head agrees in Number with the NumP of the noun, which allows for plural verbal agreement and anaphora and predicts plural demonstratives.
3.2 The structure of NumeralP

We take the NumeralP to be syntactically complex, consisting of multiple projections.

The top projection is the locus of the indefinite article, which we take to be a semantically vacuous, “dummy” article. Its “dummy” status is further supported by the fact that it appears with plural numerals in this construction:

(26) Bypassing or tampering with power supplier meters is a growing problem, costing an estimated hundreds of billions of dollars worldwide and accounting for 10% to 40% of all energy use in various countries. (Futurist 2013)

Ionin & Matushansky (2016) analyze the difference between numerals like hundred and twenty through a process of m-merger – in both cases, there are two relevant projections, but with twenty those are merged together, whereas with hundred, they remain separated:

(27) [XP a [YP hundred]]
(28) [XP [YP ]]  
X+Y = twenty

Building on this, we assume all numerals (in English) to consist of three projections, the lowest involving the root of the numeral, the second a classifier (which allows the numeral to quantify over individuals – more on that later!), and the third, a numeral determiner, usually realized as default a(n).

(29)
```
NumeralP
  a
 / \
Cl   v
```

In numerals like 100, m-merger does not apply, and we find an overt dummy article:

(30) [NumeralP a [CIP CL [ 100 ]]] = a hundred

In the case of 20, m-merger does apply, hence the lack of an indefinite in the usual case:

(31) [NumeralP Numeral+CL+20 [CIP CL [ 20 ]]] = twenty

Adjectives (at least one class) sit below the numeral determiner position, and hence, block m-merger with numerals like 20 – this gives the obligatory indefinite:

(32) [NumeralP a ADJ [CIP CL [ 20 ]]] = a staggering twenty

We will be more specific as to the contribution and locus of the adjective when we turn to the semantics of the construction.

Putting our structures together, we get the following syntactic analysis of an amazing 17 teams.
For a different class of adjectives (‘mere’-class for now), the structure would be basically the same except that the adjective will occupy the same position as the CL head.

A remaining issue concerns the relation between the numeral determiner and the noun’s determiner. The data suggests that only one overt determiner is permitted per DP. Why?

There may be a phonological constraint blocking the overt expression of two determiners in one DP – Lyons (1999), for example, proposes that weak forms like a(n) must occur in an initial position in the phrase, this blocking configurations like *the a.

### 3.3 Alternatives

Ionin & Matushansky (2016) posit the following structure, taking the numeral and noun to form a constituent:
Support for this constituency comes from coordination:

(36) A surprising [78 students and 29 postdocs] applied for this position.

However, the constituency also predicts it to be possible to coordinate the adjective, numeral, and noun, to the exclusion of the article, a coordination which is, in fact, ungrammatical:

(37) *A [surprising 78 students and whopping 29 postdocs] applied for this position.

The ungrammaticality of (41) is not due to the fact that NPs, to the exclusion of articles, generally cannot be coordinated, see (42):

(38) Freeze in an airtight container or zip-top plastic freezer bag. (COCA)

Our account suffers the reverse issue: the ungrammaticality of (37) is totally expected (the numeral and noun do not form a constituent), while (36) is not. Coordination facts do not provide a convincing answer in either direction.

Problematic for Ionin & Matushansky's account is the apparent plurality of the construction – they account for the singular indefinite by analyzing the numeral as a singular noun, but this leaves the plurality unresolved.

Keenan (2013) adopts a similar structure, but assumes a silent noun GROUP in the head position of a Measure Phrase. Keenan explicitly takes GROUP to be singular, hence the indefinite.

(39)

Problematic issues for this account include:

- The plurality of the construction is unaccounted for.
• It is unclear why the numeral should be obligatory (cf. *A surprising students applied for this position).
• Positing the silent noun GROUP leads to semantic issues:

(40) An amazing 20 students applied for this position  QUANTITY

≠ An amazing group of 20 students applied for this position.

In addition, there is also Solt (2007), who adopts four structures to account for various varieties of this construction; as we will show, our analysis accomplishes the same with a single structure.

4 The Semantics

4.1 Check-list

• ‘Quality’ and ‘quantity’ interpretations
• Restrictions on the adjectives
• ‘Grouping effect’ under ‘quality’ readings
• NB: We won’t discuss the variety of this construction that is headed by measure units

4.2 Our analysis: basic assumptions

Numerals (in English) have two types of interpretation (Landman 2004, Rothstein 2016):

• A predicative type <et>
• An atomic abstract type <n>

(41) a. \[\text{three} \langle \text{et} \rangle = \lambda x. |\text{AT}(x)| = 3 \]
b. \[\text{three} \langle \text{n} \rangle = 3 \]

Presumably, <et>-numerals are the ones appearing in construction with nouns like in (a), while <n>-numerals appear (at least) in mathematical contexts, as in (b):

(42) a. Three \( <\text{et}> \) girls, four \( <\text{et}> \) boys, six \( <\text{et}> \) cats, eighteen \( <\text{et}> \) stairs
b. Six \( <\text{n}> \) is bigger than two \( <\text{n}> \).

Numerals of type \(<\text{et}>\) and nouns combine via predicate modification:

(43) \[\text{three} <\text{et}> \text{ students} = \lambda x. |\text{AT}(x)| = 3 & \text{STUDENTS}(x)\]

A silent plural indefinite determiner at the edge of ‘three students’ introduces existential closure and makes the whole DP a quantifier:

(44) \[\emptyset \text{three} <\text{et}> \text{ students} = \lambda \exists x [|\text{AT}(x)| = 3 & \text{STUDENTS}(x) & P(x)]\]

Alternatively, the D position can be occupied by demonstratives (which would be plural): ‘those three students’.

There are different analyses of the relation between \(<\text{et}>\) numerals and \(<\text{n}>\) numerals:

• Both versions are available in the lexicon
• One is derived from the other via type-shifts
  o Type-shifts are not represented syntactically
  o Type-shifts are represented syntactically

We don’t think that the choice between these options is crucial for our semantics. We will however go for the latter choice: \(<\text{et}>\) semantics of numerals is derived from the \(<\text{n}>\)-type semantics, and the shift is represented syntactically by the head that we call CL (stands for ‘classifier’ – with reference to Sudo 2016 suggesting this kind of semantics for Japanese classifiers):

\[(45) \quad [\text{three}]_{\text{et}} = [\text{CL}]( [\text{three}]_{\text{n}})\]

Let’s turn to our adjective-numeral combination. We have different stories for different classes of adjectives, although we assume basically the same syntax for all of them (unlike, for example, Solt 2007):

\[(46)\]

\[(47)\]

4.3 ‘Quantity’ adjectives

First, let’s deal with adjectives that, in our construction, modify the quantity / amount of whatever comes next.

\[(48) \quad \text{mere, scant, paltry, good, full, additional, whopping, amazing}\]
Some of these only combine with numerals (or have a different meaning when combining with nouns directly – in these cases, we assume these are homophones).

(49)  
a. mere students ≠ a small number of students (cf. a mere 10 students)  
b. good students ≠ a large number of students (cf. a good 10 students)  
c. whopping students ≠ a large number of students (cf. a whopping 10 students)

We encode this distributional restriction in terms of the semantic type of these (readings of these) adjectives. We suggest that this class of adjectives takes numbers (type <n>) as their semantic input and give properties (type <et>) as output.

The same semantic type has been sometimes argued to be seen in classifiers in classifier languages like Japanese – classifiers convert type <n> numerals into type <et> and add a bit of other meaning on top (Sudo 2016). These adjectives have the same semantic type as the CL head that we proposed above that turns <n>-numerals into <et>-numerals. We also suggest that ‘mere’ and the like occupy the same position that CL normally occupies.

(50)  
[\text{mere}]_{<n,et>} = \lambda n \lambda x. |\text{AT}(x)| = n \land n \text{ is small}

The intuition that it’s not, for example, number 3 by itself that is small in examples like ‘A mere 3 students applied for this position’ (but rather 3 is small for the number of students who applied for the position) can be incorporated into the semantics of ‘mere’ by making ‘small’ that is part of its semantics context-dependent:

(51)  
[\text{mere}]_{<n,et>} = \lambda n \lambda x. |\text{AT}(x)| = n \land n \text{ is small in } C

Then ‘mere’ combines with the numeral of type <n>:

(52)  
[\text{mere twenty}] = \lambda x. |\text{AT}(x)| = 20 \land 20 \text{ is small in } C

We suggest that the indefinite article is semantically vacuous, quite like ‘a’ in DPs in predicative positions (‘John is a doctor’), so [\text{a mere twenty}] = [\text{mere twenty}]\,]. Note that in terms of semantic type, ‘a mere 20’ is <et>, quite like ‘20’, and it combines with the noun in exactly the same way (via predicate modification):

(53)  
[a mere 20 students] = \lambda x. |\text{AT}(x)| = 20 \land 20 \text{ is small in } C \land \text{STUDENTS}(x)

The outermost determiner of the DP – the plural indefinite article – introduces existential closure and thus the whole DP ends up a quantifier:

(54)  
[\text{∅ a mere 20 students}] = \lambda P. \exists x [|\text{AT}(x)| = 20 \land 20 \text{ is small } \land \text{STUDENTS}(x) \land P(x)]

Note that the same meaning could be derived from an <et>-type numeral, ‘mere’ would then have type <et,et>:

(55)  
a. [\text{mere}]_{<et,et>} = \lambda P \lambda x. P(x) \land |\text{AT}(x)| \text{ is small in } C  
b. [\text{twenty}]_{<et>} = \lambda x. |\text{AT}(x)| = 20
c. ⟦mere twenty⟧ = λx. |AT(x)| = 20 & |AT(x)| is small in C

d. ⟦∅ a mere 20 students⟧ = λP. ∃x [ |AT(x)| = 20 & |AT(x)| is small & STUDENTS(x) & P(x) ]

Under this semantics of 'mere', however, nothing would prevent 'mere' under the quantity reading from combining directly with the noun ('mere students') or occurring between the numeral and the noun ('twenty mere students'). One could encode this restriction as a syntactic selection issue (and we are not saying this is not possible), but we stick to semantic selection.

4.4 ‘Quality’ adjectives

Let’s move to ‘quality’ adjectives:

(56) beautiful, boring, lucky, hungry, remarkable, bedraggled

(57) a. A lucky three students got fellowships.
    b. I opened the door and found a bedraggled four hikers on my doorstep.
    c. He played a boring/beautiful five songs.

‘Quality’ adjectives are regular adjectives of type <et> (or <et,et>):

(58) ⟦beautiful⟧ = λx. BEAUTIFUL(x)

They apply to <et> numerals, which, we suggest, are a combination of a type <n> numeral and a type-shift – in our structure, syntactically represented as a CL head (again, we assume that ‘a’ here is semantically vacuous, i.e. ‘predicative’):

(59) a. ⟦CL three⟧<et> = λx. |AT(x)| = 3
    b. ⟦a beautiful CL three⟧ = λx. |AT(x)| = 3 & BEAUTIFUL(x)
    c. ⟦a beautiful CL three pieces⟧ = λx. |AT(x)| = 3 & BEAUTIFUL(x) & PIECES(x)

Here again, under this analysis, the adjectives could modify the noun directly rather than the numeral with the same result semantically:

(60) ⟦a beautiful CL three pieces⟧ =
    ⟦CL three beautiful pieces⟧ = λx. |AT(x)| = 3 & BEAUTIFUL(x) & PIECES(x)

Recall that there is an additional interpretational effect that is associated with ‘a beautiful three pieces’ that is not there with ‘three beautiful pieces’ – the ‘grouping effect’. Importantly, the grouping effect is not observed with ‘quantity’ adjectives.

(61) a. ??He played a boring five songs, but in the middle he played a really good one.
    b. At various points during the day, a staggering 192 hikers showed up wanting to be fed.

We claim that this effect is a result of competition between two expressions that would otherwise convey the same semantics – ‘a beautiful three’ and ‘three beautiful’. As a means to resolve this competition, an enrichment of the ‘marked’ element of the competing pair
happens via grouping. We suggest that this happens at the adjective. The grouping happens via G (grouping) operator, defined as follows (following Landman, 2000):

\[
\mathcal{G} = \lambda P \lambda x. P(\uparrow x)
\]

The enrichment can be seen as a lexical or a syntactic procedure. In the latter case, G selects for adjectives and enriches them to group meanings.

An enriched meaning of ‘a beautiful three’ thus will be the following:

\[
\mathcal{G} \text{a beautiful CL three} = \lambda x. |\text{AT}(x)| = 3 \& \text{BEAUTIFUL}(\uparrow x)
\]

Then this constituent combines with the noun and a plural indefinite article:

\[
\mathcal{G} \text{a beautiful CL three} \text{ pieces} = \lambda x. |\text{AT}(x)| = 3 \& \text{BEAUTIFUL}(\uparrow x) \& \text{PIECES}(x)
\]

\[
\emptyset \mathcal{G} \text{a beautiful CL three} \text{ pieces} = \lambda P \exists x. [ |\text{AT}(x)| = 3 \& \text{BEAUTIFUL}(\uparrow x) \& \text{PIECES}(x) \& P(x) ]
\]

As desired, the head noun applies to the plurality of the individuals rather than to them as a group, similarly to the rest of the sentence, but the adjectival predicate applies to a group individual formed from the plurality. This is enough for the spatial / temporal etc. proximity effects to arise without affecting the external distributive properties of the overall DP. In particular, distributive adjectives can still apply to the whole DP and the sentences with this construction give rise to distributive readings of ambiguous predicates:

\[
\begin{align*}
\text{a.} & \quad \text{A lucky three students turned out to be American / very tall.} \\
\text{b.} & \quad \text{A hungry three climbers turned out to be partially bald.} \\
& \quad \text{(ok under reading ‘each of them was partially bald’)}
\end{align*}
\]

4.5 *‘Distributive’ adjectives

Recall that not all adjectives can appear in pre-numeral position, under any reading (‘quality’ or ‘quantity’):

\[
\begin{align*}
\text{a.} & \quad ??\text{I met a tall five people the other day.} \\
\text{b.} & \quad ??\text{I bought a rectangular five tables.} \\
\text{c.} & \quad ??\text{An American six students applied for this position.}
\end{align*}
\]

What prevents these adjectives from having quality readings, quite like ‘beautiful’? The resulting interpretation of (68a) would be that I met five students the other day, they were tall, and they came together / were standing close to each other. We suggest that the unavailability of these readings has to do with the (stubborn) distributivity of these adjectives (Schwarzschild 2011) – in particular, their inability to apply to groups:

\[
\text{TALL}(\uparrow x) \text{ is not defined}
\]

5 A historical perspective
We considered the emergence of this construction using the Corpus of Historical American English, COHA (Davies 2010-), which consists of more than 400 million words in 107,000 individual texts.

We found 1450 occurrences of the construction.

We checked all 1450 occurrences against the list of units from Cleave Books, A dictionary of units, to see how measure nouns influenced the rise of this construction. We also checked to what extent adjectives triggering quantity readings appear in this construction.

Observations:

- The construction is originally used only with measure nouns: (e.g., *a good ten feet*)
- The construction increases in frequency in the 20th century
- The quantity readings were first, then came the quality readings

With respect to adjectives, we see that in the 19th century, almost all examples include the quantity ones (*a good ten feet, an excellent 2256 ribbons, a paltry four shillings*), while later on quality readings become common (*an awesome 2,330 pages, an easy 20 bucks, a hard ten rounds* etc.)
Analysis:

- Adjectives occupied the position that was already syntactically there – the CL position.
- They made use of the construction that existed independently (measure noun construction).
- Being an instance of adjectival modification of numerals, this opened up space for a more general adjectival modification of numerals pattern.
- Regular adjectives enter the picture and this is how ‘quality readings’ arise.
- ‘Quality’ adjectives do not occupy the CL position but rather attach to <et>-numerals.
- ‘Quality’ readings enter into competition with regular noun modification ‘Num Adj Noun’ and this gives rise to an enriched meaning of the former.

6 Open Issue: Measure Nouns

In this talk, we were careful to avoid measure nouns. The reason for this was that, in contrast to non-measure nouns, measure nouns trigger singular agreement:

(69) A cool 68 degrees is thought to be the most conducive to sound slumber. (Cosmopolitan 2004)
(70) So in that span, a mere nine points separates the Blues from the best mark in the league. (STLouis 2014)
(71) A heightened five senses comes standard with being a were, but I firmly believe it gives you heightened instincts, too. (Bk:NightLife 2008)

Interestingly, we find the same phenomenon even when an adjective is not present. This suggests that singular agreement is related to the use of measure nouns, as opposed to the construction (contrary to Keenan 2013).

(72) 50 degrees (C) / 122 degrees (F) is just too hot.
(73) Five pounds is a lot of money. (Hudson 1999: 174, ex. 2a)
(74) Two drops deodorizes anything in your house. (Kim 2004: 65, ex. 24b)
(75) Most of us can agree that 8 million people is too many to be receiving disability payments from the government (Maekawa 2013: 430, ex. 52b)

7 References