Two kinds of modified numerals

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In this paper I argue that there are two kinds of numeral modifiers: (Class-A) those that express the comparison of a certain cardinality with the value expressed by the numeral and (Class-B) those that express a bound. The first class is exemplified by modified numerals like *more/fewer than 100*, *above/under 100*. Class-B contains among others *maximally/minimally 100*, *100 tops*, *up to 100* and *from 100 (up)*. One distinguishing feature of these last modified numerals is that they are restricted in their use in a rather specific way.

Data – For the purpose of this abstract I restrict myself to contrasting *fewer than 100* on the one hand with *maximally 100* on the other. (The reader may check that the reported intuitions are correct for the other expressions as well.) The first kind of minimal pair that suggests two distinct classes of modified numerals is in (1):

(1) John carefully counted all the chickens on his farm.

a. He found out that the total number of chickens is fewer than 100. A

b. ??He found out that the total number of chickens is maximally 100. B

(1-b) is only acceptable (yet only marginally so) if we assume John's counting was inconclusive (merely resulting in the certainty that there weren't more than 100 chickens).

Another contrast is (2). The example in (2-b) is unacceptable, or at least plainly false. This contrasts with (2-a), which is rendered coherent by a context that somehow makes a contrast with 5 relevant, as e.g. is the case if (2) is preceded by the remark that a pentagon has 5 sides. For (2-b), a similar context does not improve the example.

(2) a. A triangle has less than 5 sides. A

b. #A triangle has maximally 5 sides. B

Finally, Class-B modified numerals react in interesting ways to modals.

(3) a. John invited maximally 100 people to his party. B

b. John is allowed to invite maximally 100 people to his party. B

(3-a) is interpreted as the speaker only knowing that John didn't invite more than 100 people, but not knowing the exact number. When embedded under a weak modal as in (3-b), no such information about speaker uncertainty is conveyed and 100 is simply taken to be the upper bound on what John is allowed to invite. These data are in contrast with Class-A modified numerals. First of all, (4-a), but not (3-a) can be used if the speaker knows John invited 50 people. Second, (3-b) entails that John is allowed to invite 100 people, but (4-b) does not entail he is allowed to invite 99.[1]

(4) a. John invited less than 100 people to his party. A

b. John is allowed to invite less than 100 people to his party. A

Analysis – I assume that modified numerals combine with cardinality predicates. Class-A

[1]The following little discourse shows this: *"Bill is allowed to invite 100 people to his party. John is allowed to invite less than 100 people to his party. In fact, he may only invite 50."*

modifiers have a rather simple semantics, expressing a relation between the cardinality predicate and the numeral. ((5) glosses over some details, which are irrelevant for the purposes of this abstract. In essence, I agree with the gist of Hackl 2000.)

(5) $[\![\text{less than } 10]\!] = \lambda P_{\langle n,t\rangle}.\max_i(P(i)) < 10$

Class-B modifiers express a different kind of relation. They express that the numeral is a bound on the cardinality predicate with respect to some other property ($\mathcal{P}$ in the definition in (6)). It is clear how this works in cases like (3-b): 100 is the upperbound on the number of people John invites with respect to what is allowed. In other examples the property (or attitude) in question has to be accommodated. So, in (3-a) we would normally assume 100 to be the upperbound on how many people John invites with respect to what the speaker deems possible. This is why (2-b) is strange: there is no property/attitude that would make sense. The semantics for Class-B modified numerals generally follows the schema of that of *maximally 10* in (6). ((6) has the drawback that in some cases the universal quantifier has to be suitably restricted. The full paper discusses an alternative that is minimally different in that it uses a maximality operator as in (5)).

(6) $[\![\text{maximally } 10]\!] = \lambda P_{\langle n,t\rangle}.\forall i[\mathcal{P}(P(i)) \rightarrow i \leq 10]$

A semantics as in (6), that crucially depends on an identifiable $\mathcal{P}$ is supported by a pilot corpus study, which showed that Class-B modified numerals occur in the scope of an explicit modal overwhelmingly more often than their Class-A counterparts.

Explaining where the difference comes from – The intuitive underlying difference distinguishing class-A from class-B modifiers is that the former correspond to strict comparison ($<$ or $>$) and the latter to non-strict comparison ($\leq$ or $\geq$). The semantic differences between the two classes, I will argue, are indirectly the result of this basic difference.

First of all, notice that class-A modifiers allow (at least) two intonational patterns: (i) the numeral is focused; (ii) the modifier is focused. In the first case, class-A modified numerals turn into class-B modified numerals:

(7) a. #A triangle has less than FIVE sides.
b. A triangle has LESS than five sides.

For class B modified numerals, stressing the modifier is not an option (except maybe for meta-linguistic reasons). In an example like (7-b), the number of sides of a triangle is *contrasted* with the somehow contextually given number 5. A similar effect is impossible in an example containing a class B modifier, as in (8). This is because the non-strict comparison with 5 *includes* 5 as an option, and therefore no suitable contrast can arise.

(8) #A triangle has MAXIMALLY five sides.

The difference between the semantics in (5) and (6), I propose, is then ultimately not a distinction between the two classes of modified numerals, but a difference arising from two kinds of intonation patterns.

(Hackl 2000) – Hackl, Martin. *Comparative Quantifiers.* PhD thesis, MIT. 2000.