Directional Prepositions as Numeral Modifiers

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Modified numerals come in many varieties, such as comparatives (*more than forty*), superlatives (*at least forty*), approximatives (*almost forty*) and prepositional phrases (*between forty and fifty*, *over forty*, etc.). In recent literature, it has become clear that not all modifications of numerals are alike and that much can be learned from analysing modified numerals on a case by case basis. (See e.g. Geurts and Nouwen 2007).

Prepositional numerals are poorly studied, but an exception is Corver & Zwarts 2006. Interestingly, they suggest that only locative aspects of the meaning of prepositions play a role in modified numerals. For instance, the English preposition *over* has a directional and a locative sense, but only the latter is used in a quantifier like *over three hundred men.* I argue, however, that there exists a small class of prepositional numerals where a strictly directional interpretation of the preposition is used. I call the resulting quantified phrase a directional numeral quantifier, DNQ for short. Such quantifiers typically contain a P which completely lacks a locative sense. In English, DNQs are exemplified by *up to sixteen pages.* In many other languages the preposition involved is both a directional spatial preposition and a temporal end-point marker. Prepositions like Dutch *tot*, Hebrew *@ad* (cf. Winter 2006) and German *bis (zu)* all have a spatial, temporal and a numeral usage. (In English, *up to* cannot be applied in the temporal domain, where durative *until* is used.)

DNQs have a rather limited distribution. In this paper, I explain this on the basis of a uniform semantics for these prepositions in the spatial, temporal and numeral domain.

In Dutch, the prime example of a DNQ is the class of modified numeral quantifiers that contain the preposition *tot.* In the spatial domain, *tot* lacks a locative reading. Consequently, it depends on the expression of some sort of path.

(1) #Ik sta tot hier.
I stand TOT here.
'#I stand up to here'

(2) Ik ben tot hier gerend.
I am TOT here ran.
'I ran up to here'

A similar contrast can be found in the temporal domain.

(3) #Ik brak tot gisteren mijn been.
I broke TOT yesterday my leg.
'#I broke my leg until yesterday'

(4) Ik was tot gisteren erg boos.
I was TOT yesterday very angry.
'I was very angry until yesterday'

In the numeral domain, *tot* is subject to yet another similar constraint. DNQs are not generally allowed where other numeral quantifiers are felicitous. For instance, (5-a) is unacceptable. But the modalised version (5-b) is fine.

(5) a. ??Ik heb tot vier koekjes gegeten.
I have TOT four biscuits-DIM eaten.
'??I ate up to four biscuits'
b. Van mijn moeder, mag ik tot vier koekjes eten.
From my mother, may I TOT four biscuits-DIM eat.
'My mother allows me to eat up to four cookies'

(6) a. ??Paddy ate up to four biscuits.
b. Paddy is allowed to eat up to four biscuits.

The same contrasts occur with English *up to* (cf. (6)), German *bis zu* and Hebrew *@ad.* The parallel between the spatial, temporal and numeral function of these prepositions can be fleshed out as follows. (Here, and in what follows, I use *tot* as the generic example of all these prepositions, but use the corresponding English examples for illustration.)

(7) General semantics for *tot* (and its kin):
Let I range over intervals (spatial, temporal or other). $[\![X \text{ tot } a]\!]$ = true iff for all subintervals I of an interval that has a as its end-point X holds for I

According to (7), *Paddy played chess until midnight* means that there is a time interval leading up to midnight such that in each subinterval of that period Paddy was playing chess. For spatial use, (7) operates as follows. *Paddy ran up to the edge of the lake* means that there is a path ending on the edge of the lake such that each subpath is such that Paddy ran it. It follows straightforwardly from (7) that *tot* is incompatible with non-homogeneous predicates. Moreover, in the spatial domain, *tot* will need some expression of motion for the interval semantics to apply to.

Crucial to my analysis is that *tot*-PPs modify predicates of intervals. If we view numerals as indicators of cardinality, then it is not immediately clear what such a PP applies to. I follow Hackl 2000 in assuming that raising a modified numeral creates a degree predicate. I propose a silent lift which remedies the type clash between the interval seeking *tot* and such a predicate. This lift from degree properties to interval predicates is written as Ω. (Its semantics is simply the operation that transforms sets of degrees to the intervals those degrees form when properly ordered. For completeness: $\Omega(P) = \lambda I.\forall d \in I : P(d)$. In other words, Ω connects two ways of treating sets of degrees.)

(8) a. Paddy is allowed to eat up to four biscuits.
b. [up to four [Ω [λ [allow [Paddy eats *t*-many biscuits]]]]]

This gives the corrects semantics: there is an interval leading up to four (say, [1,2,3,4]) such that for each n in that interval Paddy has the permission to eat n biscuits. For a simple sentence like *??Paddy ate up to four biscuits*, we arrive at a non-sensical meaning: the number of biscuits eaten by Paddy is one, two, three *and* four. (Some people do get one sensible interpretation for this sentence, namely that it is unclear how many biscuits Paddy ate, but that he ate no more than four. Such readings, however, once more display a weak modal element.) The analysis correctly predicts that *up to*-DNQs raised over a universal modal are infelicitous. *??Paddy is required to eat up to four biscuits* is interpreted as the non-sensical statement that the number of biscuits Paddy is required to eat is one, two, three *and* four. (Again, the interpretation might be saved by accommodating a weak epistemic modal that expresses what the speaker knows about how many biscuits Paddy is required to eat. More on this in the full paper.)

The analysis so far overgenerates, for if *up to*-DNQs can be raised over weak modals, then they should be able to take existential quantifiers in their scope too. As (9) shows, this is wrong. The analysis in (7) wrongly predicts that (9) means that for every number in $\{1, 2, 3, 4\}$ there is a child who ate that amount of biscuits.

(9) ??Some children ate up to four biscuits.

However, (9) does not come as a surprise if we compare it to the behaviour of comparatively modified numerals (*fewer/less than*). It has been observed that degree operators cannot take wide scope over nominal quantifiers. This is known as Kennedy's Generalisation: if the scope of a quantificational DP contains the trace of a degree phrase, it also contains that degree phrase itself (Heim 2000; Kennedy 1997). Hackl 2000 observes that comparatively modified numerals have readings where the comparative -er scopes over an intensional predicate. No similar readings exist where the comparative morpheme scopes over a nominal quantifier. That is, *someone ate less than four cookies* does not mean that the maximal number such that someone ate so many cookies is less than four. (In other words, it does not mean that everyone ate less than four cookies.)

In order to yield a sensible interpretation, the *up to* numeral has to move to take scope over some quantifying operator. Thus, in order to be interpretable, *up to four* in (9) will have to move over the subject quantifier. In parallel with the comparatively modified numerals, it turns out that this is impossible. So, I suggest that (10) is simply an instance of the observation captured in Kennedy's generalisation.

(10) *[tot a [Ω [λ [$\mathrm{DP_Q}$ [$\ldots t$]]]]]

The proposed analysis provides further support for a degree semantics for numeral quantifiers (Hackl 2000). Moreover, it demonstrates the cross-categorical nature of quantifiers.

References

Corver, N. and J. Zwarts (2006). Prepositional numerals. *Lingua 116*(6), 811–836.

Geurts, B. and R. Nouwen (2007). At least et al.: the semantics of scalar modifiers. *Language 83*(3), 533–559.

Hackl, M. (2000). *Comparative Quantifiers*. Ph. D. thesis, Department of Linguistics and Philosophy, Massachusetts Institute of Technology.

Heim, I. (2000). Degree operators and scope. In *Proceedings of SALT X*, Ithaca, NY. CLC Publications.

Kennedy, C. (1997). *Projecting the adjective: the syntax and semantics of gradability and comparison*. PhD. Thesis, UCSD.

Winter, Y. (2006). Closure and telicity across categories. In *Proceedings of SALT XVI*. CLC Publications.