

## Various strategies of multiplication: Differentials in equatives and comparatives

Mojmír Dočekal and Marcin Wągiel,  
Masaryk University

**Background** Though cardinal numerals have received a lot of attention in the semantic literature (Landman 2000, Krifka 2003 among many others), expressions such as English *twice* or *two times* are much less studied and understood (with notable exceptions such as Landman 2006, Donazzan 2012). In this paper, we bring in novel evidence from a flecional language (Czech, Cz) and an isolating language (Vietnamese, Vie). We model the meaning of such numericals based on their syntactic and semantic properties observed in different environments focusing mainly on differential constructions in equative (EQ) and comparative (COMP). Our work contributes to the research on comparatives as well as to the semantic typology since the observed data allow us to extend cross-linguistic frameworks for comparatives and degree constructions.

**Data and analysis** Cz and Vie both express multiplication via two types of quantificational adverbs: Cz *dvojnásobně* ‘doubly’ (degree numerals, DNs) and *dvakrát* ‘twice’ (event numerals, ENs); Vie below. In both languages both DNs and ENs are morphologically productive and are used in a variety of contexts as degree constructions, differentials in COMP or EQ, modification of homogeneous and count events, and quantification over Ns denoting amounts, events, and social roles. Though there are crucial differences between DNs and ENs we intend to clarify in the talk (notice, e.g., the inability of DNs to have wide scope w.r.t. to a modal verb in a context which pragmatically enforces the wide scope reading of the COMP such as (1)), in the abstract we focus on the contrast concerning their distribution in differentials in EQ and COMP. Although Cz COMP allows for differential modification by both DNs and ENs, Cz EQ is acceptable with EN differentials but not with DN differentials – (2). In contrast, Vie differentials allow for both DNs and ENs both in COMP and in EQ – (3) and (4). Furthermore, unlike standard amount quantifiers constituting differentials (see Schwarzschild 2008), the distribution of adjectival and nominal DNs within NPs is very restricted.

- (1) Pokud chceš Karlovu práci, tak musíš být ???dvojnásobně/Xdvakrát lepší.  
if want.2sg Karel’s job then must.2sg BE ???doubly/Xtwice better  
‘If you want to get Karel’s job, then you have to be two times better.’
- (2) a. Petr je **dvojnásobně/dvakrát** vyšší než Marie.  
Petr is doubly/twice taller than Marie  
‘Petr is two times taller than Marie.’  
b. Petr je ???**dvojnásobně/✓dvakrát** tak vysoký jako Marie.  
Petr is ???doubly/✓twice so tall as Marie  
‘Petr is twice as tall as Marie.’
- (3) Petr cao hơn ✓**gấp-dôi** Marie ✓**hai-lần**. (4) Petr cao ✓**gấp-dôi** Marie ✓**hai-lần**.  
Petr tall than ✓doubly Marie ✓twice Petr tall ✓doubly Marie ✓twice  
‘Petr is two times taller than Marie.’ ‘Petr is twice as tall as Marie.’

In the analysis we adopt the standard theory of COMP and EQ (von Stechow 1984, Heim 2000) – see (5). In order to account for the data we postulate the interplay of two factors: (i) we posit two semantic strategies which natural languages can employ when quantifying via multiplication: either via direct multiplication of a degree returning the multiplied value of the degree (EN:  $\lambda n \lambda d.n * d$  – we assume polymorphic multiplication, type  $\langle \langle n, d \rangle, d \rangle$ ) or semantics returning a characteristic function of degrees equal to a contextually salient degree  $g$  multiplied by  $n$  (DN:  $\lambda n \lambda d.d = n * g$ , type  $\langle n, \langle d, t \rangle \rangle$ ); (ii) we propose a semantic parametric distinction between Cz and Vie extending the frameworks of Kennedy (2007) and Beck et al. (2009). For Vie EQ we assume that comparison employs a pragmatic operation on a degree variable where the context is linguistically manipulated in such a way that the standard provides the salient degree of tallness with which the correlate’s degree is equated. On the other hand, Cz uses the explicit comparison strategy, i.e., EQ/COMP have a direct access to the degrees of the correlate and standard in the syntax. Cz EQ such as (2) can be then formalized as (6) for the DN differential (in COMP it works well, but in EQ the requirements that MAX of the correlate and standard are equal and that  $MAX_C$  equals a multiplied  $MAX_S$  lead to a contradiction ! ungrammaticality) and (7) for EN differential (the EN multiplies the standard’s degree ! no contradiction in EQ). For Vie we assume the EQ/COMP semantics is achieved through a pragmatic manipulation where the EQ/COMP compares the correlate with a salient degree provided by the standard which ultimately results in  $MAX_C = 2 * g(S)$  for both EN and DN since Vie EQ does not compare

degrees but rather manipulates the context. In general, we propose that DNs in COMP/EQ indirectly specify the value of a gap (see Rett 2014 for a similar analysis of quantity words), whereas ENs simply multiply the value of a degree.

- (5) a.  $\llbracket COMP \rrbracket = \lambda D' \lambda D. MAX_C(D) > MAX_S(D')$   
 b.  $\llbracket EQ \rrbracket = \lambda D' \lambda D. MAX_C(D) \geq MAX_S(D')$
- (6) a.  $\llbracket EQ \rrbracket = MAX_C(\lambda d''. \mu_{HEIGHT}(Petr)) \geq MAX_S(\lambda d'''. \mu_{HEIGHT}(Marie))$   
 b. . . . EQ prag. strengthening from  $\geq$  to  $=$  plus  $\llbracket DN \rrbracket = MAX_C(\lambda d''. \mu_{HEIGHT}(Petr)) = MAX_S(\lambda d'''. \mu_{HEIGHT}(Marie)) \wedge MAX_C = 2 * MAX_S$  ?
- (7) a.  $\llbracket EQ \rrbracket = MAX_C(\lambda d''. \mu_{HEIGHT}(Petr)) \geq MAX_S(\lambda d'''. \mu_{HEIGHT}(Marie))$   
 b. . . . prag. strengthening +  $\llbracket EN \rrbracket = MAX_C(\lambda d''. \mu_{HEIGHT}(Petr)) = 2 * MAX_S(\lambda d'''. \mu_{HEIGHT}(Marie))$

**Discussion** We propose that in general numerals such as DNs and ENs can select either the predicative *hn*, *hd*, *tii* or the degree returning *hhn*, *di*, *di* strategy (we acknowledge some idiosyncratic variation though since, e.g., German exhibits a reverse pattern of ENs/DNs in EQ differentials compared to Cz). Furthermore, our data support a more nuanced view on the semantic typology of COMP/EQ. We propose that natural languages can employ either a strategy of syntactic or pragmatic binding of a degree argument, e.g., the Cz EQ ordering is achieved by the degree argument binding since in EQ the same free relative *wh*-word as in degree questions is used (§a morphosyntactic marking of the explicit strategy). Vie allows the pragmatic binding strategy by default as there is no morphosyntactic marking of the degree manipulation, but the syntactic strategy is available as well, as witnessed by (8) where the DN modification of EQ is not possible. We account for this by positing a proper degree selecting semantics for the EQ verb *b-ng/nhu* ‘equals’ in Vie. Then, a contradiction with DNs similar to Cz EQ arises. Our claim is corroborated by the grammaticality of subcomparatives and degree questions and ungrammaticality of negative islands in Vie which points at syntactic degree manipulation in Vie. The explicit semantics for DNs and ENs allows us to test for the syntactic/pragmatic manipulation of the degree variable. Interestingly, this test seems to indicate that the implicit/explicit mode of comparison is construction specific rather than language parametrized.

- (8) Petr cao bằng/nhu Marie \*gấp-đôi  
 Petr tall equal Marie \*doubly  
 ‘Petr equals with Marie in height doubly’

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