Event and degree numerals: Evidence from Czech

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In this paper, we bring in novel data concerning distribution and semantic properties of two classes of adverbs of quantification in Czech, i.e., event numerals such as *dvakrát* ('twice/two times') as opposed to degree numerals such as *dvojnásobně* ('doubly/twofold'). We explore the contrasts between the expressions in question including the interaction with comparatives and equatives as well as scope asymmetries. We propose that degree numerals target values on a provided scale and are, hence, best analyzed as predicates of degrees whereas event numerals have a more general semantics which primarily allows for quantification over individuated events, but also enables to operate on degrees.

1 Introduction

Lexicons of many natural languages distinguish between two types of adverbs involving quantification which correspond to English adverbs of quantification such as *twice* and *doubly*, see (1).[1] Surprisingly, though cardinal numerals have received a lot of attention in the semantic literature on quantification (Landman 2004, Ionin & Matushansky 2006, Hofweber 2005, and Rothstein 2012 among many others), expressions such as those in (1) remain strikingly understudied both from a descriptive and theoretical perspective (with notable exceptions of

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Bhatt & Pancheva 2007, Donazzan 2013 and Landman 2006).[2]

(1) a. twice/doubly (English)
b. deux fois/doublement (French)
c. dvaždy/vdvojne (Russian)
d. kétszer/kétszeresen (Hungarian)
e. hai-lần/gấp-đôi (Vietnamese)

The aim of this paper is to present novel data concerning the distribution and semantic properties of such expressions in Czech, exemplified in the text by (2). In recent years the meaning of different types of Slavic derived numerals attracted considerable attention (see Dočekal 2012, 2013 for Czech, Wągiel 2014, 2015 for Polish, and Khrizman 2015 for Russian), and thus the analysis of the presented data regards a broader enterprise intended to examine numeral quantification from the perspective of morphologically complex languages.

(2) a. dvakrát (Czech)
twice/two-times
b. dvojnásobně (Czech)
doubly/twofold

In the paper, we refer to Czech adverbs of quantification such as (2-a) as EVENT NUMERALS, whereas we will address expressions like (2-b) as DEGREE NUMERALS. Our goal is primarily empirical, hence we aim our attention on discussing novel data. The main focus of the article lies on constructions in which the degree argument is being manipulated, specifically on the interaction with comparatives and equatives. We claim that event numerals are best analyzed as adverbs of quantification whose semantics is general enough to allow for counting distinctive events in terms of iteration as well as operations on degree intervals. On the other hand, degree numerals are in fact degree predicates which makes their distribution more restricted.

The article is outlined in the following way. In Section 2, we discuss the distribution of Czech event and degree numerals based on the corpus study we have conducted. In Section 3, we examine the key environments in which such expressions occur. In Section 4, we focus on categorial and typal differences and we bring in additional contrasts involving event and degree numerals whereas

[2] Wągiel (to appear) proposes an analysis of Slavic adjectival multipliers similar to English *double*, however, we are not aware of any semantic treatment of adverbial expressions corresponding to English *doubly*.

Section 5 discusses properties of adjectival and nominal degree numerals. Section 6 summarizes the data and in Section 7, we propose a predicative semantics for degree numerals as well as suggest an analysis of event numerals. Section 8 concludes the paper.

2 Distribution

At first blush, in some contexts Czech numerals such as *dvakrát* ('twice/two times') and *dvojnásobně* ('doubly/twofold') appear to be synonymous:

(3) a. Petrovi se to vyplatilo **dvakrát/dvojnásobně**.
for-Petr REFL this paid-off twice/doubly
'For Petr it paid off twice.'

b. Ceny tady jsou **dvakrát/dvojnásobně** vyšší než tam.
Prices here are twice/doubly higher than there
'The prices here are two times higher than there.'

However, a more careful investigation reveals that there are multiple environments in which they are not. To determine the distribution of event and degree numerals and define properties of contexts in which they occur we have conducted a corpus study based on the Czech National Corpus (CNC).[3] The selected corpus samples contained 100 random occurrences of the event numeral *dvakrát* and the degree numeral *dvojnásobně*, which were reduced to 98 and 99 occurrences, respectively, after filtering. Figures 1 and 2 present the preferred environments in which the numerals in question appear in the samples.

The results show a significant difference in the distribution of event and degree numerals that, in our opinion, unveils the real nature of these expressions. Whereas *dvakrát* in 77% of occurrences targets event-denoting VPs as well as temporal AdvPs and PPs,[4] *dvojnásobně* tends to modify comparatives, APs, and secondary predicates as well as degree-related VPs.[5] In total, in 90% of the stud-

[3] The CNC is a representative corpus of contemporary Czech. We have selected the SYN2015 subcorpus which is the largest reference corpus of contemporary written Czech consisting of more than 100 million tokens. We searched for the lemmas: *dvakrát* and *dvojnásobně*.

[4] Following Doetjes (2007), we assume that adverbials such as *dvakrát denně* ('twice a day') and *dvakrát za týden* ('twice a week') are similar to frequency expressions in the sense that their interpretation is dependent on the time interval they introduce.

[5] Out of 30 VPs modified by *dvojnásobně* 9 were headed by deadjectival verbs, e.g., *zvětšit* ('enlarge') and *zvýšit* ('raise'), whereas 11 involved predicates inherently associated with scales including verbs operating on degrees such as *zvednout* and *vzrůst* (both 'increase'). The remaining 10 examples involved predicates such as *platit* ('pay'), *trestat* ('punish'), and *jásat*

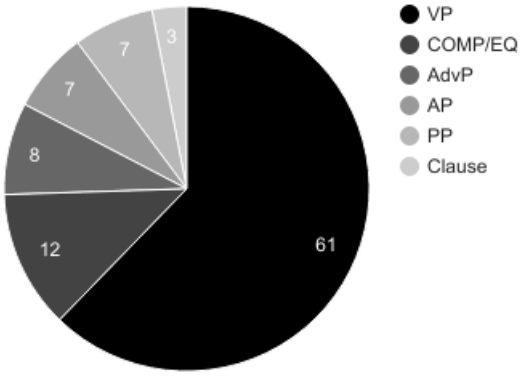


Figure 1: Distribution of *dvakrát*

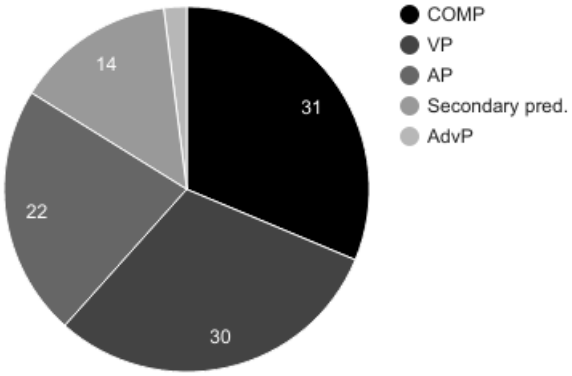


Figure 2: Distribution of *dvojnásobně*

ied cases it targets scales. The observed contrast suggests that *dvakrát* naturally favors event-denoting environments (though it can appear in comparatives and equatives) whereas *dvojnásobně* exhibits a very strong tendency to select for degree expressions.

In the following sections, we will examine two contexts we assume to be crucial for understanding the character of the event/degree numerals alternation as well as further contrasts and differences between those expressions.

3 Key contexts

3.1 Degrees and differentials

The first environment to be discussed is constituted by degree constructions involving comparison. Both event and degree numerals can appear in comparatives as differentials, as attested by the examples from the CNC corpus in (4).

(4) a. …je dnes až **dvojnásobně** větší nebezpečí ničivých povodní
is today even doubly bigger danger destructive floods
než před 20 lety.
than before 20 years
'…today, the danger of destructive floods is two times bigger than 20 years ago.' (CNC)

b. …a tak se dokážou **dvakrát** rychleji ohřát nebo zchladit
and thus REFL manage twice faster heat or cool-down
než běžné žehličky.
than ordinary irons
'…and thus they can heat or cool down two times faster than ordinary irons.' (CNC)

Furthermore, both event and degree numerals are unacceptable in superlatives, as (5) demonstrates.[6]

('rejoice') which arguably at least to some extent also pertain to the notion of gradability.

[6] Event numerals may appear as superlative modifiers, e.g., in the past tense. However, a sentence such as (i) has only an event reading which states that there were two occasions on which Petr was the tallest one among the compared individuals. Therefore, it seems that in such cases the event numeral modifies the whole phrase, i.e., the copula and the superlative, rather than the superlative alone.

(i) *Petr byl* ***dvakrát*** *nejvyšší.*
Petr was twice tallest

(5) a. *Petr je **dvakrát** nejvyšší.
Petr is twice tallest
b. *Petr je **dvojnásobně** nejvyšší.
Petr is doubly tallest

Nevertheless, an interesting contrast arises when we consider differentials in equatives. Though Czech event numerals are perfectly fine in such an environment, see (6), degree numerals are significantly less acceptable in equatives than in comparatives, as witnessed by the oddity of (7-b).[7] In addition, there are no attested occurrences of equatives with degree numerals in CNC.

(6) a. Petr je **dvakrát** vyšší než Marie.
Petr is twice taller than Marie
'Petr is two times taller than Marie.'
b. Petr je **dvakrát** tak vysoký jako Marie.
Petr is twice so tall as Marie
'Petr is twice as tall as Marie.'

(7) a. Petr je **dvojnásobně** vyšší než Marie.
Petr is doubly taller than Marie
'Petr is two times taller than Marie.'
b. *Petr je **dvojnásobně** tak vysoký jako Marie.
Petr is doubly so tall as Marie

This property of degree numerals corresponds to the behavior of standard differentials which, as indicated in (8), although frequently attested in comparatives, are not possible in equatives.[8]

(8) a. Petr je **o 10 cm** vyšší než Marie.
Petr is by 10 cm taller than Marie
'Petr is 10 cm taller than Marie.'
b. *Petr je **o 10 cm** tak vysoký jako Marie.
Petr is by 10 cm so tall as Marie

These data seem to suggest that though both event and degree numerals can

'Petr was the tallest twice.'

[7] A similar contrast between *twice* and *two times* in English has been observed in Gobeski (2011).

[8] As an anonymous reviewer points out it seems that (8-b) is out because equatives need to apply AP internally, before the degree variable *d* is bound, for instance by POS (e.g., Kennedy & McNally 2005).

operate on scales, they differ in that they employ distinct strategies to modify the degree they target. On the basis of the presented evidence, we assume it is plausible to hypothesize that degree numerals share core semantic properties with differentials. On the other hand, the compatibility of event numerals with equatives seems to imply that they are expressions of a very distinct type.

3.2 Count events

The second key environment to be discussed here involves VPs referring to individuated count events. Multiple examples attested in the CNC corroborate the well-known fact that event numerals can combine with VPs in order to quantify over eventualities. Interestingly, as witnessed by the ungrammaticality of (9-b), degree numerals cannot be used to count events.

(9) a. **Dvakrát** se přesvědčím, že jsou dvířka zavřená.
twice REFL I-will-ensure that are door closed
'I will make sure twice that the door is closed.' (CNC)
b. *__Dvojnásobně__ se přesvědčím, že jsou dvířka zavřená.
doubly REFL I-will-ensure that are door closed

Not surprisingly, neither event nor degree numerals modify VPs denoting homogeneous eventualities such as static states, as demonstrated in (10). As expected, no such examples were found in the CNC samples.

(10) a. *Petr **dvakrát** zná Marii.
Petr twice knows Marie
b. *Petr **dvojnásobně** zná Marii.
Petr doubly knows Marie

Another observation concerns VPs referring to values on scales. While both event and degree numerals can modify verbs such as *vzrůst* ('increase'), there is an asymmetry with respect to possible readings of sentences containing such phrases. Let us consider the contrast between (11-b) from the CNC and the corresponding example in (11-a). As indicated in the translation, (11-a) is ambiguous between the quantified-degree and the quantified-event interpretation, i.e., it is either true of a scenario when the demand increased by two times irrespective of the number of times it increased, or of a situation when there were two events of increasing the demand irrespective of the value by which the demand was increased. Crucially, (11-b) lacks the quantified-event interpretation and can only be true of a scenario in which the degree of increase was multiplied by two.

(11) a. Poptávka po dotacích vzrostla **dvakrát**.
demand after subsidies increased twice
'The demand for subsidies increased (by) twice.'
b. Poptávka po dotacích vzrostla **dvojnásobně**.
demand after subsidies increased doubly
'The demand for subsidies increased doubly.' (CNC)

The discussed observations further support the semantic nature of the event/degree numerals alternation. At this point, it seems innocuous to state that the distinction relies on the strategy the expressions in question make use of in terms of quantification. Whereas degree numerals are unable to count events and are restricted to operations on degrees, event numerals seem to employ a more general semantics which allows for quantification over both events and degrees. Further differences will be examined in the next section.

4 More contrasts

4.1 Categorial differences

Another difference between Czech event and degree numerals concerns their derivational potential. Both classes involve morphologically complex expressions derived from a numeral root, e.g., *dv-* (corresponding to English *tw-*), by different suffixes, i.e., *-krát* and *-násobn-*.[9] However, the contrast between (12) and (13) indicates an apparent categorial asymmetry. Unlike degree numerals which employ distinct morphology to display a broad range of syntactic categories including adverbial, adjectival, and nominal forms (all derived from the same stem), event numerals are defective in the sense that they have only adverbial forms and cannot appear in syntactic contexts which are sensitive for adjectives and nominals.[10]

(12) dvakrát:

[9] In fact, *-násobn-* can be further decomposed at lest to *-násob-*, as attested in *násobit* ('multiply'), and *-n-*. For the sake of simplicity, we will ignore the morphological complexity here.

[10] It should be noted that the inability of event numerals to take adjectival and nominal morphology seems to be a Czech idiosyncrasy since, for instance, Polish allows for forms such as *dwukrotny* ('twice.A') and *dwukrotność* ('twice.N'). Similar, there is adjectival *dvukratnyj* in Russian and *dvakratni* in Slovenian. However, a detailed cross-linguistic comparison of event and degree numerals is beyond the scope of this paper and constitutes a challenge for further research.

a. Adv: pršelo dvakrát
rained twice
'it rained twice'
b. *A: [dvakrát(ní) objem nádrže]
twice.A capacity tank
c. *N: [dvakrát(ek) rychlosti]
twice.N speed

(13) dvojnásob-:

a. Adv: dvojnásobně dlouhý
doubly long
'two times longer'
b. A: dvojnásobný objem nádrže
double capacity tank
'double the capacity of a tank'
c. N: dvojnásobek ceny
double.N price
'double the price'

Although the categorial asymmetry provided in (12) and (13) may suggest that event and degree numerals are exponents of distinct semantic objects, as such it is, of course, insufficient to draw a typal distinction between the two. In the next section, we investigate such a possibility in more detail.

4.2 Typal compatibility

A further observation concerns the fact that event and degree numerals in Czech can be stacked, as witnessed by the grammaticality of examples such as (14-a). This suggests that Czech expressions of those kinds are compatible in terms of their semantic types. Moreover, the reversed order of numerals, as provided in (14-b), is not possible which further suggests different input requirements.

(14) a. Petrovi se to **třikrát dvojnásobně** vyplatilo.
for-Petr REFL this thrice doubly paid-off
'For Petr it paid off doubly three times.'
b. *Petrovi se to **dvojnásobně třikrát** vyplatilo.
for-Petr REFL this doubly thrice paid-off

Furthermore, there is solid evidence that unlike event numerals, degree numerals are anchored to a particular event. Let us consider possible interpretations of

a sentence such as (15) in which the conjoined NP in subject position denotes a plurality of entities whereas the modified VP refers to a plurality of events. As indicated in (15-a) and (15-b), the sentence can either have a distributive reading where the events of paying off doubly are distributed equally onto each of the individuals, i.e., Petr and Honza, or a collective reading in which it payed off doubly three times for Petr and Honza as a group. Moreover, a cumulative interpretation as in (15-c) is also possible. In such a scenario there was a total of three events of paying off doubly and Petr and Honza share the total gain disproportionately. Nevertheless, (15) cannot have a meaning such as the one in (15-d) or in (15-e). It is impossible to understand the sentence in such a way that the total gain corresponds to six units, similar to (15-b) or (15-c), but the total number of events is lesser or greater than three. Such cumulations are simply unaccessible which implies that degree numerals cannot outscope the event quantifier and are forced to operate on degrees within a particular event.

(15) Petrovi a Honzovi se to **třikrát dvojnásobně** vyplatilo.
for-Petr and for-Honza REFL this thrice doubly paid-off
'For Petr and Honza it paid off doubly three times.'

a. for Petr: 3 x (it-paid-off x 2)
for Honza: 3 x (it-paid-off x 2)
b. for Petr⊕Honza: 3 x (it-paid-off x 2)
c. for Petr: 2 x (it-paid-off x 2)
for Honza: 1 x (it-paid-off x 2)
d. *for Petr⊕Honza: 2 x (it-paid-off x 3)
e. *for Petr: 4 x (it-paid-off x 1)
for Honza: 1 x (it-paid-off x 2)

The data clearly demonstrate that adverbial event and degree numerals differ with respect to their semantic type and scopal properties. The following sections explore some additional semantic phenomena related to adjectival and nominal forms of degree numerals.

5 Adjectival and nominal degree numerals

5.1 Quantification over amounts and values

Let us now consider Czech adjectival degree numerals such as *dvojnásobný* ('double/two-time'). The CNC data confirm the intuition that such expressions often modify

amount nominals and nouns implicitly associated with scales like those in (16).[11] In those contexts, the degree numeral appears to multiply a contextually provided value on a particular scale. As a result, the predicates in (16) are true of a twice as high volume and a twice as high salary, respectively.

(16) a. dvojnásobný objem
double volume
'double the volume'
b. dvojnásobný plat
double salary
'double the salary'

Interestingly, adjectival degree numerals are not compatible with container nouns, as the contrast between (17-a) and (17-b) shows. This property differentiates them from basic cardinal numerals since in order to quantify over amounts determined by container nominals Czech requires cardinals to do the job, see (17-c). Czech cardinals, however, are unable to combine with amount nouns to count quantities, as witnessed by the ungrammaticality of (17-d).

(17) a. dvojnásobné množství čaje
double amount tea
'double the amount of tea'
b. *dvojnásobný hrnek čaje
double cup tea
c. dva hrnky čaje
two cups tea
'two cups of tea'
d. *dvě množství čaje
two amount tea

The data discussed above show that degree numerals and cardinals are in complementary distribution with respect to container and amount nouns. This fact suggests that the two types of expressions in question make use of distinct quantificational strategies and should be analyzed differently.

[11] In the CNC, among the 15 most frequent collocation candidates for the lemma *dvojnásobný* (1,567 occurrences in SYN2015) one can find the followings nouns: *počet* ('number'), *množství* ('amount'), *cena* ('price'), and *rychlost* ('speed').

5.2 Events and social roles

Amount nouns do not exhaust the combinatorial potential of adjectival degree numerals since they can also modify two other classes of expressions, specifically nominals referring to events, as exemplified in (18-a), as well as nominals denoting social functions such as, e.g., family roles and public capacities, see (18-b).[12] Nevertheless, the interpretation of such phrases differs from the meaning of, e.g., (16) in which the degree numeral seems to merely multiply the value indicated by the implicit degree argument of the amount nominal. For instance, (18-a) refers to a set of murdering events involving two victims in each such an event, i.e., the degree numeral seems to access an internal argument of the deverbal nominal. On the other hand, similar to what was observed in Wągiel (2015b) examples such as (18-b) denote a set of individuals that have gained a particular property two times – in this case, the property of becoming a champion.[13]

(18) a. dvojnásobná vražda
double murder
'double murder'
b. dvojnásobný mistr
double champion
'two-time champion'

Further evidence that amount noun phrases and nominals implicitly associated with scales substantially differ from nominals denoting events or social roles modified by adjectival degree numerals comes from the distribution of nominal degree numerals such as *dvojnásobek* ('double.N'). As demonstrated in (19), such nominalizations cannot take expressions referring to events or social roles as their complements though they frequently combine with amount nominals.[14]

(19) a. dvojnásobek rychlosti
double.N speed
'double the speed'

[12] The CNC collocation candidates list includes, among others, the following examples for the first class: *vražda* ('murder'), *přesilovka* ('power play'), and *radost* ('joy'), as well as *vítěz* ('winner'), *matka* ('mother'), and *účastník* ('participant') for the latter.

[13] Notice that such behavior seems to be a Czech idiosyncrasy since many other languages make use of a different adjective to express such a meaning, e.g., see the English translation in (18-b).

[14] For instance, the CNC lists the following among the 15 most frequent collocation candidates for the lemma *dvojnásobek* (845 hits in SYN2015): *cena* ('price'), *částka* ('sum of money'), *počet* ('number'), and *velikost* ('quantity').

b. *dvojnásobek mistra
double.N champion
c. *dvojnásobek vraždy
double.N murder

Moreover, the asymmetry is further supported by the contrast in (20). In such examples, *je* ('is') is not used as a copula of predication, but rather it seems to establish the identity relation between the denotation of its complement and that of the subject noun phrase.[15] In (20-a), the definiendum, i.e., the modified degree noun, is associated with the definiens comprising the comparative construction. On the other hand, (20-b) and (20-c) are odd since neither *mistr* ('champion'), nor *sebevražda* ('suicide') provides a degree argument to be accessed by the degree numeral, and thus the subject NPs are not equivalent to the corresponding comparatives. In other words, since the subjects and the nominals within the matrix predicates in (20-b) and (20-c) refer to different entities, establishing of the identity relation is impossible.[16]

(20) a. **Dvojnásobná** rychlost je **dvakrát** větší rychlost.
double speed is twice bigger speed
'Double the speed means two times higher speed.'
b. #**Dvojnásobný** mistr je **dvakrát** větší mistr.
double champion is twice bigger champion
c. #**Dvojnásobná** sebevražda je **dvakrát** větší sebevražda.
double suicide is twice bigger suicide

The contrasts described above indicate that adjectival and nominal degree numerals display heterogeneous behavior in interaction with nouns implicitly associated with scales on the one hand and with event and social role nominals on the other. Possibly, the relationship between the two types of phrases is much less straightforward than it might initially seem. In this paper, however, we are primarily concerned with examples such as (16-a) and we assume that use of

[15] Note that (20-a) is ungrammatical with the Instrumental, see (i), which is commonly associated with predication.

(i) **Dvojnásobná rychlost je **dvakrát** větší rychlostí.*
double speed is twice bigger speed.instr

[16] This property seems to resemble some sort of a monotonicity constraint, as discussed in Schwarzschild (2002). However, the exact nature of this phenomenon requires further investigation.

adjectival degree numerals to be the basic one.

5.3 Predicate position

Finally, the last observation concerns the attributive and predicative use of adjectival degree numerals. In all the examples provided in the previous sections, *dvojnásobný* appears as a nominal modifier which seems to be the most natural syntactic context for such an expression. Nevertheless, it is not unusual to find *dvojnásobný* in predicate position as well, as attested in the CNC sentences in (21). In both examples, the degree numeral serves as a main predicate of a sentence and attributes a property to an amount denoting subject, i.e., *údaj* ('number') and *hodnota* ('value') respectively. For instance, in (21-a) it is predicated of the value corresponding to the body fat percentage in men in their seventies that it is twice as high relative to value for men in their twenties, i.e., it amounts to 29%. Similar, in (21-b) *dvojnásobný* functions as a predicate assigning a property to the value of saved property such that it is two times higher than the value corresponding to the damages.

(21) a. …podíl tuku v těle […] průměrný dvacátník jej
proportion fat in body […] average twenty-year-old-man it
má 14,5 %, údaj pro sedmdesátníky je **dvojnásobný**.
has 14,5% number for seventy-year-old-men is double
'…the body fat percentage […] for an average man in his twenties it is 14,5% whereas for men in their seventies the number is twice as high.' (CNC)

b. …škoda dosahuje asi 50 tisíc korun. Hodnota
damage reaches approximately 50 thousand crowns value
uchráněného majetku je **dvojnásobná**.
saved property is double
'…the damages reach approximately 50 000 CZK. The value of saved property is twice as high.' (CNC)

Sentences such those in (21) are far less frequent in the CNC than examples with adjectival degree numerals in attributive position. However, we regard their existence as an important piece of evidence revealing the predicative nature of degree numerals.

6 Data summary

Before we move on to the semantic analysis of the event/degree numerals distinction, let us briefly recapitulate our empirical findings. Table 1 summarizes the observed contrasts.[17]

Property	Event numerals	Degree numerals
Morphology	Adv	Adv/A/N
Degree	yes	**yes**
Diff. in comparatives	yes	**yes**
Diff. in superlatives	no	no
Diff. in equatives	yes	no
Modify count events	**yes**	no
Modify degree events	yes	yes
Events (N)	no	yes
Roles (N)	no	yes

Table 1: Properties of event and degree numerals

In brief, event numerals are able to target both events and degrees. They have only adverbial forms and tend to appear in eventive environments though they can also modify degree constructions including comparatives and equatives. On the other hand, degree numerals cannot scope over events and they heavily favor scalar contexts excluding equatives. Not only can they take adverbial and nominal, but also adjectival morphology and as such they can quantify over amounts, arguments of events, as well as time intervals associated with social roles specified by nominals they modify. In the next sections, we attempt to account for at least some of the puzzling differences between the two classes of expressions in question. We will propose an analysis of adverbial degree numerals and suggest possible directions of development to account for the meaning of event numerals as well as adjectival degree numerals.

[17] In bold we have emphasized the most frequent environments based on the CNC corpus study.

7 Proposal

7.1 Degree numerals

On the basis of the distributional evidence, we argue that the comparative examples introduced in Section 3.1 reveal the true nature of degree numerals. Let us now consider more closely the example in (7-a), repeated here as (22). The truth conditions of the sentence are specified informally in (22-a) and (22-b) gives an exemplary situation of which the sentence would be true.

(22) Petr je **dvojnásobně** vyšší než Marie.
Petr is doubly higher than Marie
'Petr is two times taller than Marie.'

a. True in all situations where the gap between Petr's and Marie's height is equal to the height of Marie

b. $\mu_{HEIGHT}(Petr) = 180 \wedge \mu_{HEIGHT}(Marie) = 90$

Building on the observations discussed in Section 3.1, we acknowledge that degree numerals seem to behave similar to differentials in that they define the difference between compared values on a scale provided by the comparative. Nonetheless, we argue that the underlying mechanism which yields such a result is distinct. Degree numerals differ from typical differentials in that they do not determine the gap in terms of some absolute value, e.g., 10 cm as in (8-a). Instead, they provide information about the degree corresponding to a correlate in terms of the value related to a standard of comparison. For instance, in (22) the degree numeral specifies the height of the correlate, i.e., Petr, in terms of the multiplied height of the standard of comparison, i.e., Marie.

We are now ready for the first approximation. Based on the observation discussed in Section 5.3, namely that *dvojnásobný* can occur in predicate position, see (21), we propose that the primary interpretation degree numerals have is the predicative one. Furthermore, based on the morphological evidence examined in Section 4.1, we assume that Czech degree numerals are compositional. We posit that numeral roots simply refer to numbers modeled as abstract entities and as such are expressions of type n. On the other hand, the suffix *-násobn-* introduces an operation involving multiplication of a degree by a number denoted by the root. Therefore, we model degree numerals as degree predicates, i.e., expressions denoting a characteristic function of degrees (type $\langle d, t\rangle$). We posit that such a function yields the truth value True iff a selected degree d is two times higher than some contextually determined value g. The semantics for *dvojnásobný* is pro-

posed in (23-a) whereas (23-b) gives the abstracted meaning of degree numerals in general.

(23) a. $[\![\textit{dvojnásobně}]\!] = \lambda d[d = 2 \times g]$ type $\langle d, t\rangle$
b. $[\![\textit{Degree Numeral}]\!] = \lambda n \lambda d[d = n \times g]$ type $\langle n, \langle d, t\rangle\rangle$

Let us now consider how (23-a) accounts for the meaning of (21-a). The denotation of the subject NP (an expression of type d), i.e., the body fat percentage for seventy year old men, has the property of being equal to the body fat percentage for men in their twenties multiplied by two. The logical type of the degree numeral is $\langle d, t\rangle$, hence the composition of (21-a) is trivial and proceeds via the standard rule of Function Application. The predicate of degrees (type $\langle d, t\rangle$) is applied to the degree denoting subject (type d) and after the degree variable is saturated a truth value is obtained.

7.1.1 Comparatives

Before we demonstrate how the proposed semantics fits into the big picture involving comparatives and equatives, let us introduce several assumptions concerning gradability and comparison we make. First of all, we adopt the standard view and assume an ontology including degrees, i.e., objects of a primitive type d, which are ordered into scales. A scale is modeled as a triple $\langle D, >, DIM\rangle$ where D is a set of degrees, $>$ is an ordering relation on D, and DIM represents a dimension of measurement such as height or weight. Notice, however, that we embrace the interval-based approach to degrees (e.g., Kennedy 2001 and Schwarzschild & Wilkinson 2002).

Second, following Solt (2014) we assume that individuals are associated with scales via measure functions that map an entity to the unique degree on the scale corresponding to the particular dimension. For instance, the measure function μ_{HEIGHT} yields the measure of an individual with respect to the dimension of height. Thus, the semantics of a gradable adjective such as *tall* looks like (24).

(24) $[\![tall]\!] = \lambda d \lambda x[\mu_{HEIGHT}(x) \geq d]$

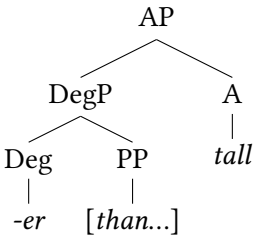
However, we slightly diverge from the standard semantics for the comparative (e.g., Von Stechow 1984, Heim 2000, and Schwarzschild 2008) in that we model the comparative marker in constructions such as (22) as involving the $\geq$ (rather than $>$) relation between maximal degrees corresponding to compared entities on a provided scale, as in (25) (see Gobeski & Morzycki 2017 for a similar treatment of *-er* in English percentage differential comparatives). What is important

is that the $\geq$ relation may be pragmatically strengthened to = unless a suitable context prevents strengthening. We will discuss this issue in more detail below.

(25) $[\![-er_{FACTOR}]\!] = \lambda D' \lambda D[\textsc{max}(D) \geq \textsc{max}(D')]$ type $\langle\langle d,t\rangle,\langle\langle d,t\rangle,t\rangle\rangle$

Furthermore, we assume the standard syntactic analysis of comparatives. In particular, we adopt the so-called small DegP view on which the comparative marker *-er* and the *than*-clause form a constituent at LF and the entire DegP serves as an argument of the gradable predicate (e.g., Heim 2000), as illustrated in (26).

(26)



Finally, following Pancheva (2006) we assume that Slavic comparatives such as (22) involve an elided clause introducing the maximal interval corresponding to a standard of comparison on a proper scale. Within such an approach, Czech clausal comparatives such as (27-a) are analyzed as in (27-b).

(27) a. Petr je vyšší než Marie.
Petr is taller than Marie
'Petr is taller than Marie.'

b. LF: [$_{IP}$ [$_{IP}$ Petr is d_1-tall] [DegP *-er*$_1$ [$_{PP}$ than [$_{CP}$ Marie is d-tall]]]]

In the assumed structure, the comparative morpheme is interpreted as an operation that takes a set of degrees and returns a function from a set of degrees to a truth value (type $\langle\langle d,t\rangle,\langle\langle d,t\rangle,t\rangle\rangle$). As discussed in detail in Pancheva (2006), such typing is incompatible with the denotation of the *than*-clause since as a free relative it is interpreted as a definite description, i.e., a degree denoting expression of type d (Heim 2000). To remedy such a type clash, some approaches (e.g., Von Stechow (1984) and Rullmann (1995)) attribute a non-trivial semantics to *than*.[18] We follow this line of analysis. In particular, we adopt Pancheva (2006)'s treatment of *than* as a partitive preposition in the domain of degrees which in clausal comparatives gets the semantics in (28).

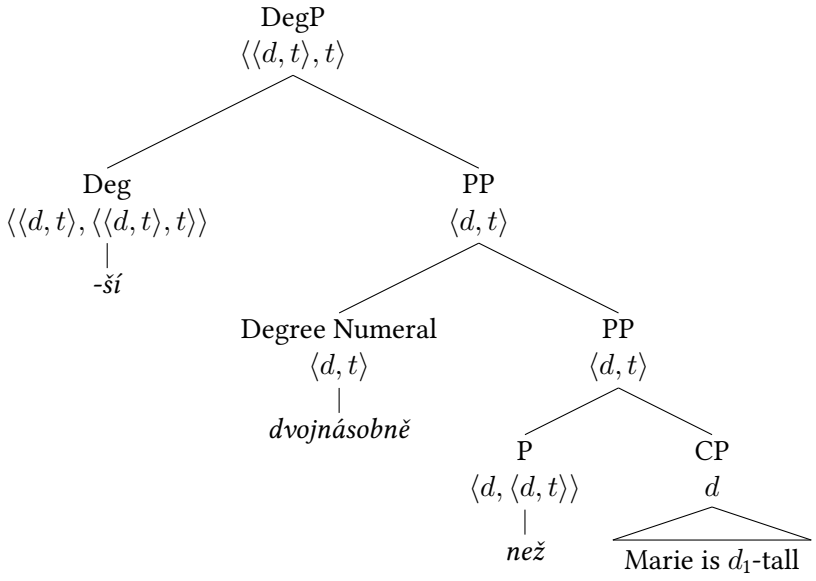
[18] This contrasts with the standard view assuming that *than* is semantically vacuous (e.g., Heim 2000, Kennedy 2001, and Schwarzschild & Wilkinson 2002).

(28) $[\![than]\!] = \lambda d' \lambda d[d \text{ is part of } d']$ type $\langle d, \langle d, t\rangle\rangle$

In prose, *than* takes a denotation of a free relative clause, i.e., a degree d, and yields a set of degrees which d is member of. For instance, if the standard of comparison in (27-a), i.e., Marie, corresponded to, e.g., 170 cm, then the entire *than*-clause would denote a set of degrees in the interval between 0 and 170 on the scale of height calibrated in centimeters. In terms of semantic types, the result of *than* being applied to the standard of comparison is an expression of type $\langle d, t\rangle$ which can serve as the first argument of the comparative morpheme. We assume that the same mechanism applies to the Czech preposition *než* ('than').

With all the ingredients in place, let us now consider how the pieces fit together. Assuming that Heim & Kratzer (1998)'s rule of Predicate Modification applies also to degree predicates, the adopted analysis creates a plausible attachment site for degree numerals. Since they are expressions of type $\langle d, t\rangle$, we propose that they can modify the PP node resulting in a syntactically more complex argument for Deg, as illustrated in the tree in (29). Crucially, the derived expression is also of type $\langle d, t\rangle$ which is suitable for the interpretation by the comparative morpheme.

(29)



The composition proceeds as follows. The proposition *než* takes the maximal interval to which Marie is tall as its input and yields a set of degrees which are part of that interval. Subsequently, the degree numeral combines with the PP

via Predicate Modification, and thus multiplies each member of the set by two. The output is a set of intervals that are two times bigger than the intervals corresponding to Marie's height and can serve as the first argument of the comparative morpheme *-ší*. The comparative morpheme applies the maximization operation MAX which picks the degree, i.e., the maximal interval, to which Marie is tall multiplied by two. As a result, the whole sentence is true iff the degree on a scale of height corresponding to the correlate, i.e., Petr, is equal or exceeds the value corresponding to Marie, as stated in the truth-conditions in (30-a). However, this is not the way one would normally understand a sentence such as (22). In order to account for that deficiency, we propose that (30-a) gets strengthened to (30-b), i.e., the $\geq$ relation is replaced by =, which finally gives rise to an expedient result. We assume that the pragmatic enrichment results from a scalar implicature, a consequence of the competition between *dvojnásobně* and higher degree numerals similar to what has been proposed in the neo-Gricean theories of cardinals (e.g., Horn 1972).

(30) a. $[\![(22)]\!] = \text{MAX}(\lambda d.\mu_{HEIGHT}(Petr) \geq d) \geq \text{MAX}(\lambda d'.d' = 2 \times \mu_{HEIGHT}(Marie))$
b. $\rightsquigarrow [\![(22)]\!] = \text{MAX}(\lambda d.\mu_{HEIGHT}(Petr) \geq d) = \text{MAX}(\lambda d'.d' = 2 \times \mu_{HEIGHT}(Marie))$

On the other hand, in a sentence such as (31-a) where *aspoň* ('at least') prevents from the pragmatic inference the unstrengthened meaning unearths and we obtain the *at least* interpretation given in (30-a). The lack of pragmatic enrichment in examples such as those in (31) is parallel to well-studied cases like *more than three boys* where the modified numeral never gives rise to a scalar implicature (see, e.g., Krifka 1999 and Schulz & Van Rooij 2006). Another observation concerns the disappearance of scalar implicatures in downward-entailing contexts as in (31-b). Unlike (22), (31-b) deos not suggest that Petr's height cannot correspond to Marie's height multiplied by three or more. We regard it as an argument for the competition account resulting in the strengthening of (30-a) to (30-b).

(31) a. Petr je **aspoň dvojnásobně** vyšší než Marie.
Petr is at-least doubly taller than Marie
'Petr is at least two times taller than Marie.'
b. Petr **není dvojnásobně** vyšší než Marie.
Petr isn't doubly taller than Marie
'Petr is not two times taller than Marie.'

The developed account seems to deliver desirable results. Not only have we provided an explanation of the semantic composition of degree numerals within the

structure of the DegP but also we have proposed a plausible analysis of how comparatives modified by factor phrases involving degree numerals are being interpreted.

7.1.2 Equatives

So far we have demonstrated how our proposal accounts for the interaction between degree numerals and comparatives. Let us now turn to one of the main puzzles of the paper, namely the incompatibility of degree numerals with equatives, as witnessed by the ungrammaticality of (7-b) repeated here as (32).

(32) *Petr je **dvojnásobně** tak vysoký jako Marie.
Petr is doubly so tall as Marie

We assume that similar to comparatives equative sentences involve a CP with elided material. However, unlike comparatives equatives lack an element such as *than* which would shift the type of a free relative of degrees to $\langle d, t\rangle$. Therefore, are at LF an equative sentences such as (33-a) gets the structure in (33-b) where the DegP takes the CP as its argument directly (see Gobeski & Morzycki 2017 for a similar analysis of equatives).

(33) a. Petr je tak vysoký jako Marie.
Petr is so tall as Marie
'Petr is as tall as Marie.'
b. LF: [$_{IP}$ [$_{IP}$ Petr is d_1-tall] [$_{DegP}$ as... as$_1$ [$_{CP}$ Marie is d-tall]]]

Additional evidence suggesting that the proposed analysis is on the right track comes from the morpho-syntax of Slavic equatives. In Czech, the equative contains only the *wh*-element *jako* ('as; literally: how') and the non-obligatory demonstrative pronoun *tak* ('so; literally: like this') which precedes the adjective. Unlike in the comparative, there is no preposition or complementizer.

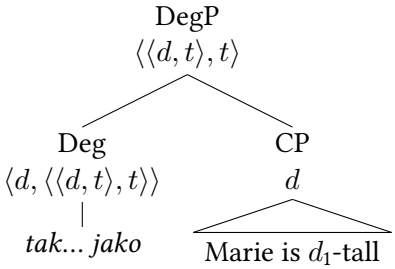
The final assumption concerns the denotation of the equative marker. We follow the standard view that the meaning of *as... as* differs from the semantics of the comparative morpheme. However, we argue that it is not the case that the only difference between the two lies in employing the = or $\geq$ relation instead of $>$, as often assumed (e.g., Rett 2014a). On contrary, we propose that unlike *-er* which requires a set of degrees as its first argument, see (25), *as... as* yields a function from sets of degrees to truth values for a particular degree (type $\langle d, \langle\langle d, t\rangle, t\rangle\rangle$), see (34). In other words, the equative operates on the maximal interval associated with a standard of comparison rather than on a set of degrees.

This seems intuitively correct since equative constructions appear to evaluate values with respect to a particular degree rather than to a set of intervals. We assume the same applies to Czech *tak... jako*.

(34) $[\![as... as]\!] = \lambda d \lambda D[\textsc{max}(D) \geq d]$ type $\langle d, \langle \langle d, t \rangle, t \rangle \rangle$

Given the components discussed above, the reason why degree numerals are incompatible with equatives is simply because of type mismatch. Consider the structure of the DegP illustrated in (35). Since the equative does not involve the node of type $\langle d, t \rangle$ but rather the CP of type d, the degree numeral cannot combine with any expression within the DegP via Predicate Modification. In principle, Function Application would still be applicable. Nevertheless, if a definite description denoted by the CP saturated the degree variable, the resulting expression could not combine with the equative marker. In any case, the derivation of (7-b) would necessarily crash.

(35)



At this point, we consider the main puzzle of the paper solved. The (in)compatibility of degree numerals with comparatives and equatives is essentially type-driven. Degree numerals are of type $\langle d, t \rangle$, and thus in comparatives they modify the *than*-clause of the same type. On the other hand, since there is no such node available in equatives, degree numerals cannot find a plausible attachment site which leads to type mismatch and unacceptability of sentences such as (7-b). In Section 7.2.2, we will demonstrate that event numerals, unlike degree numerals, can appear in both comparatives and equatives due to the fact that they are of a different semantic type. However, before we move to *dvakrát*, let us briefly discuss adjectival degree numerals such as *dvojnásobný*.

7.1.3 Adjectival degree numerals

So far, the proposed semantics for degree numerals seems to work well. However, it is insufficient to account for the data which involve adjectival *dvojnásobný*

modifying event and social role nominals, as discussed in Section 5.2. Inspired by Rett (2014b)'s M-Op$_e$ and M-Op$_d$ operators, we propose that the analysis of degree numerals can be extended by adopting operations which introduce mappings between entities, events, degrees, and time intervals.

In general, quantified noun phrases exhibit an individual/degree polysemy (Rett 2014b). This is also true for Czech NPs modified by cardinal numerals. (36-a) has an individual reading on which five individuated portions (or sorts) of beer were such that they were top-fermented. On the other hand, (36-b) refers to the amount of beer rather than to particular entities (or sorts).

(36) a. Pět piv bylo svrchně kvašených.
five beers was top fermented
'Five beers were top-fermented.'
b. Pět piv bylo pro Karla dost/Karlovi stačilo.
five beers was for Karel enough/for-Karel was-enough
'For Karel, five beers were enough.'

For degree numerals, we assume that the degree interpretation is the basic one, as in (37) where adjectival *dvojnásobný* modifies the amount nominal *plat* ('salary') in order to multiply the relevant degree.[19] Apart from the data already introduced in favor of such a claim, further evidence comes from the fact that degree numerals can target gradable nouns such as *idiot* (see Morzycki 2009), as indicated in (38) which is an attested example from the CNC. The second clausal conjunct means that the speaker attributes to themselves the level of idiocy which is twice as high as the contextually relevant value. It is the internal degree argument of the predicate *idiot* that is targeted by the degree numeral.

(37) **Dvojnásobný** plat Karlovi stačil.
double salary for-Karel was-enough
'For Karel, double salary was enough.'

(38) Bratr Čuchraj je idiot a lhář a já **dvojnásobný** idiot…
brother Čuchraj is idiot and liar and I double idiot
'Frater Čuchraj is an idiot and a liar and I am a double idiot…' (CNC)

Similar, in the case of modified measure nouns such as *dvojnásobný objem* ('double volume'), see (16-a), we assume that the degree numeral quantifies over the

[19] We assume that the composition involves at least the following steps: (i) modification of the amount noun (type $\langle d, t\rangle$) by the degree numeral via Predicate Modification and then (ii) type-shifting of the entire phrase to the type d via the ι operation.

degree though it does not supply the dimension μ. The relevant dimension seems to be always provided by the modified predicate. For instance, in (39-a) it is the adjective that feeds the adverbial degree numeral with the dimension of size. Likewise, in (39-b) and (39-c) the measure noun and the gradable noun supply the dimensions of length and idiocy, respectively.

(39) a. dvojnásobně velký
doubly big
'twice as big'
b. dvojnásobná délka
double length
'double the length'
c. dvojnásobný idiot
double idiot
'double idiot'

In the discussed examples, the degree numeral simply multiplies values on a proper scale, hence it seems that the proposed degree semantics can be extended straightforwardly to capture such cases. We assume that the core of the analysis of *dvojnásobně* given in (23) would carry over to examples such as (39). In such examples, the degree numeral predicates of a degree supplied by the adjective, measure noun, or gradable noun, compared to a contextually supplied value in comparatives. However, due to lack of space we have to postpone a thorough implementation. Instead, in the next section we will try to suggest a way of dealing with the data that pose a more serious challenge.

7.1.4 Events and social role interpretations

In order to account for examples such *dvojnásobná vražda* ('double murder') and *dvojnásobný mistr* ('two-time champion'), see (18), we assume mappings between events and entities on the one hand and entities and times on the other. Let us start with proposing a treatment for the social role interpretation. In such cases there is no internal degree argument the degree numeral could target. Therefore, in order to approach, e.g., (18-b), we adopt the notion of time trace function (e.g., Krifka 1989 and Lasersohn 1995). A standard time trace function is an operation which maps an event to its running time, i.e., the smallest time at which it occurs. For our purposes, however, this is insufficient since in order to explain the behavior of phrases such as (18-b) we need to relate events with entities. Therefore, we assume a mapping of a property *P*, in this case: the property of being a champion,

to its running time, i.e., the time of being a champion. Consequently, the degree numeral counts the introduced running times which results in the predicate true of entities that repetitively gained the property of being a champion.

The proposed approach predicts that the time reading can only be obtained for nominals denoting properties which are constrained in time, i.e., either lower-bound, as in the case of *champion*, or bilaterally bound in the case of, e.g., *president*. In other words, adjectival degree numerals are only possible with nominals denoting a property which can be felicitously associated with fluctuation within the dimension of time (see Wągiel 2015b). For this reason, the phrases in (40-b) constitute weird expressions.

(40) a. dvojnásobný mistr
double champion
'two-time champion'
b. #dvojnásobný Čech/člověk/pes
two-time Czech-person/human/dog

However, the interpretation of modified deverbal nominals such as *dvojnásobná vražda* ('double murder'), see (18-a), cannot be explained in terms of time trace function. In this case, we assume a mapping between properties of events and entities related to those events as themes, i.e., such a function for a particular event would return its themes. As a result, in (18-a) the two victims reading is obtained.

7.2 Event numerals

Our proposal concerning event numerals builds on the classification developed by Doetjes (2007) who on the basis of French data draws a distinction between two classes of adverbs of quantification, namely degree expressions such as *a lot* and frequency adverbs such as *often*. According to that proposal, the division follows from the fact that the first involve degree modification whereas the latter quantify over times.

7.2.1 Frequency and scope

Prima facie, event numerals seem to be similar to frequency adverbs since they both imply iteration and, unlike degree expressions, can scope over indefinites. The data in (41) illustrate the distinction between frequency and degree adverbs in Czech. Since a similar contrast regards event and degree numerals, as demon-

strated in (42), it might seem appealing to simply claim that they are representatives of the corresponding classes.

(41) a. Petr **často** kupoval nějaké pivo.
Petr twice bought.ipfv some beer
'Petr often bought some beer.'
b. *Petr **hodně** kupoval nějaké pivo.
Petr a-lot bought.ipfv some beer

(42) a. Petr **dvakrát** koupil nějaké pivo.
Petr twice bought.pfv some beer
'Petr bought some beer twice.'
b. *Petr **dvojnásobně** koupil nějaké pivo.
Petr doubly bought.pfv some beer

According to Von Fintel (1994), frequency adverbs including event numerals can be analyzed as expressions which quantify over situations and contain a hidden domain anaphor. Following Doetjes (2007) in assuming an abstract restrictor *times*, it is possible to analyze event numerals as in (43). The example in (42-a) would then be interpreted as (44) which is true of two buying events in which Petr is the agent and beer is the theme of that event.

(43) *dvakrát*: 2 [$_{restriction}$ times][$_{nuclear\ scope}$ VP/IP]

(44) $\exists ex[\mu(e) = 2 \wedge Buy(e) \wedge \theta_1(e) = Petr \wedge \theta_2(e) = x \wedge Beer(x)]$

However, as Doetjes (2007) herself observes, there is a scopal asymmetry between expressions such as *often* and event numerals, specifically frequency adverbs can have a relational reading whereas event numerals cannot. For instance, in (45) the frequency adverb *často* ('often') can be interpreted either as having a wide or a narrow scope relative to *když* ('when'). The relational reading in (45-a) could be paraphrased as *Often when he was in Budapest, Karel visited Gellért.* On the other hand, the non-relational reading in (45-b) would be interpreted along the lines *Whenever he was in Budapest, Karel often visited Gellért.* Crucially, (46) has only the interpretation in (46-b) and cannot mean something like *Twice when he was in Budapest, Karel visited Gellért.*

(45) Když byl Karel v Budapešti, tak byl **často** v Gellértu.
when was Karel in Budapest then he-was often in Gellért
'When Karel was in Budapest, he often visited Gellért.'
a. often > when

b. when > often

(46) Když byl Karel v Budapešti, tak byl **dvakrát** v Gellértu.
when was Karel in Budapest then he-was twice in Gellért
'When Karel was in Budapest, he visited Gellért twice.'

a. #twice > when
b. when > twice

Doetjes (2007) attributes the lack of relational reading to the incompatibility of event numerals with the stative interpretation. However, event numerals differ significantly from frequency adverbs in yet another respect, i.e., they are compatible with comparatives and equatives and can access internal arguments of degree verbs, as discussed in Section 3.1 and 3.2. On the other hand, frequency adverbs cannot target scales of degrees. Neither (47-a), nor (47-b) can mean that the height of Petr exceeds the height of Marie multiple times. The only possible reading would be that there are many happenings in which Petr is taller or as tall as Marie which is a very strange interpretation. Similar, (48) can only mean that there were multiple events leading to increase of the demand, i.e., the degree reading is unavailable.

(47) a. #Petr je **často** vyšší než Marie.
Petr is often taller than Marie
b. #Petr je **často** tak vysoký jako Marie.
Petr is often so tall as Marie.

(48) Poptávka po dotacích rostla **často**.
demand after subsidies increased.ipfv often
'The demand for subsidies increased often.'

In light of the discussed data, we argue that the assumption that event numerals simply quantify over times (which implies iteration) is insufficient to explain all the observed contrasts. Instead, we propose that there is a scale of adverbs of quantification with respect to how wide scope they can take, see Table 2. In particular, degree adverbs including degree numerals have the narrowest scope, event numerals rank in the middle since they can scope over indefinites, and finally frequency adverbs can have the widest scope resulting in the possibility of relational readings but cannot access internal arguments of degree predicates. There starts to appear a promising correlation, specifically the scope of an expression seems to correspond to its sortal polymorphicity. At this point, we can only speculate on what the cause and what the consequence is, and hence we remain

agnostic with respect to the nature of the relationship in question. Nevertheless, we intend to investigate this issue in a future work.

Property	Degree adverbs	Event numerals	Frequency adverbs
Access degrees	yes	yes	no
Scope over indefinites	no	yes	yes
Relational readings	no	no	yes

Table 2: Properties of event and degree numerals

We propose that the semantics of event numerals is more general than that of frequency and degree adverbs. Essentially, we assume that they are basically able to target totally ordered sets of an unspecified type. Since non-stative eventualities comprise time scales which share core properties with degree scales, event numerals are, thus, able to modify both events involving duration and degree expressions such as comparatives and equatives. On the other hand, frequency expressions such as *often* can operate only on a specified scale, i.e., a time scale, whereas degree adverbs including degree numerals target a scale of degrees.

7.2.2 Comparatives and equatives

Finally, let us discuss how event numerals differ from degree numerals in equatives. Consider the examples in (49), repeated here as (49). We propose that in equatives event numerals do not measure the gap between the degrees associated with the standard of comparison and the correlate as standard differentials. Instead, they multiply the degree associated with the standard.

(49) a. Petr je **dvakrát** vyšší než Marie.
Petr is twice taller than Marie
'Petr is two times taller than Marie.'
b. Petr je **dvakrát** tak vysoký jako Marie.
Petr is twice so tall as Marie
'Petr is twice as tall as Marie.'

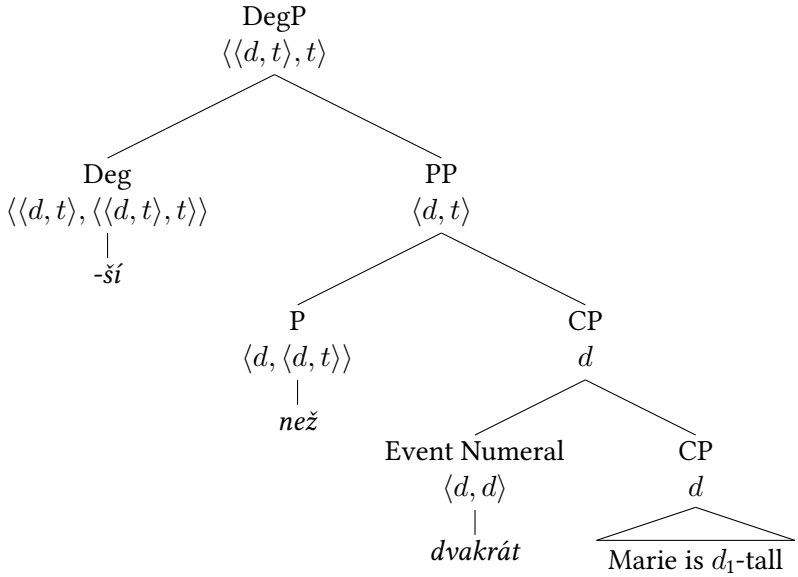
We assume that in comparatives and equatives event numerals are simple operators of type $\langle d, d\rangle$. They take a degree and return a value multiplied by the number corresponding to the numeral root, see (50-a) for the semantics of *dvakrát* and (50-b) for the generalized meaning of event numerals. As a result, they are

less sensitive to a particular structure of a phrase of comparison in which they can appear. We propose that within the DegP event numerals pick CPs as their arguments. We hypothesize that their wider scope follows from that fact.

(50) a. $[\![\textit{dvakrát}]\!] = \lambda d[2 \times d]$ type $\langle d, d\rangle$
b. $[\![\textit{Event Numeral}]\!] = \lambda n \lambda d[n \times d]$ type $\langle n, \langle d, d\rangle\rangle$

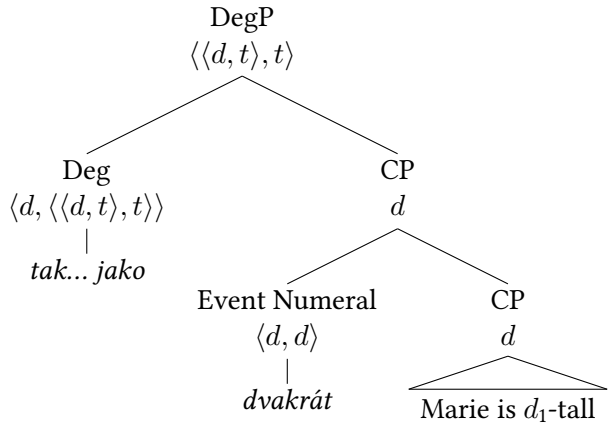
Such a semantics fits nicely both with comparatives and equatives. In (51), the event numeral adjoins to the CP denoting the maximal interval corresponding to the standard of comparison, i.e., Marie's maximal height, before the partitive preposition applies. The event numeral returns the maximal degree to which Marie is tall multiplied by two and it is not until then that *než* yields a set of degrees the maximal degree corresponding to Marie is part of. The resulting $\langle d, t\rangle$ expression is compatible with the input requirement of the comparative marker *-ší*.

(51)



In the case of equatives, see (52), the composition proceeds in a parallel manner the only difference being that there is no partitive preposition to shift the denotation of the CP to $\langle d, t\rangle$. As a result, the equative marker selects the degree provided by the outcome of the multiplication operation introduced by the event numeral.

(52)



Assuming pragmatic enrichment, as discussed in Section 7.1.1, in both cases we obtain the same truth conditions, as specified in (53). This corresponds to an intuition that both sentences are actually equivalent and would be judged true iff the maximal interval to which Petr is tall is equal to the maximal interval to which Marie is tall multiplied by two.

(53) a. $[\![(49)]\!] = \textsc{max}(\lambda d.\mu_{HEIGHT}(Petr) \geq d) \geq 2 \times \mu_{HEIGHT}(Marie)$
b. $\rightsquigarrow [\![(49)]\!] = \textsc{max}(\lambda d.\mu_{HEIGHT}(Petr) \geq d) = 2 \times \mu_{HEIGHT}(Marie)$

Similar to (31-a), the strengthening does not take place in the presence of *aspoň* ('at least'). Therefore, both (54-a) and (54-b) get the $\geq$ interpretation in (53-a).

(54) a. Petr je **aspoň dvakrát** vyšší než Marie.
Petr is at-least twice taller than Marie
'Petr is at least two times taller than Marie.'
b. Petr je **aspoň dvakrát** tak vysoký jako Marie.
Petr is at-least twice so tall as Marie
'Petr is at least twice as tall as Marie.'

The proposed analysis seems to derive the desirable truth conditions and explains different behavior of event and degree numerals in constructions of comparison. Though, our approach does not answer the question why event numerals can be used to both modify degrees and to count eventualities, we would like to speculate that a possible explanation lies in their type requirement. Event numerals seem to be polymorphic operators whose both domain and range consists of expressions of a primitive type d or v which allows then to target degree-denoting free relatives of degrees as well as event-denoting clauses. However, this hypoth-

esis requires careful consideration and we leave this issue for further investigation.

8 Conclusion

In this paper, we have presented novel evidence from Czech concerning the distinction between two classes of adverbs of quantification, i.e., event numerals such as *dvakrát* ('twice/two times') and degree numerals such as *dvojnásobně* ('doubly/twofold'). We have discussed their distribution and examined multiple contrasts in various environments including equatives and modification of count events. According to our proposal degree numerals denote properties of degrees which explains their occurrence in predicate position as well as their ungrammaticality in equatives. On the other hand, event numerals have a more general semantics which results in wider scope as well as the possibility to target both events and degrees. We have hypothesized that event numerals in comparatives and equatives behave as simple operators that yield a multiplied value of an input degree which allows for the compatibility with both comparatives and equatives. Furthermore, we have suggested a treatment for adjectival degree numerals such as *dvojnásobný* ('double/two-time'). Nevertheless, many questions remain open. The exact and systematic representation of the meaning of event and degree numerals poses a challenge for further research. It would be also exciting to pursue a cross-linguistic investigation to explore even more properties of the discussed alternation.

Abbreviations

Syntactic categories: A – adjective, AP – adjectival phrase, Adv – adverb, AdvP – adverbial phrase, COMP – comparative, CP – complementizer phrase, Deg – degree, DegP – degree phrase, Diff – differential, EQ – equative, IP – inflectional phrase, N – noun, NP – noun phrase, P – preposition, PP – prepositional phrase, REFL – reflexive pronoun, VP – verb phrase. Cases: INSTR – Instrumental. Aspect: IPFV – imperfective, PFV – perfective. Others: CNC – Czech National Corpus, LF – Logical Form.

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