sciendo
DOI 10.2478/jazcas-2023-0029

EXPRESSING MEASURE IN CZECH (A CORPUS-BASED STUDY)

MARIE MIKULOVÁ
Institute of Formal and Applied Linguistics, Faculty of Mathematics and Physics, Charles University, Prague, Czech Republic

MIKULOVÁ, Marie: Expressing Measure in Czech (A Corpus-based Study). Journal of Linguistics, 2023, Vol. 74, No 1, pp. 108 – 118.

Abstract: In the contribution, we provide a theory-based and corpus-verified description of expressions for measure in Czech. We demonstrate that the measure expressions may modify quantity of entities (*approximately ten boys*), internal characteristics of events (*he works a lot*), properties (*very big*) and relations (*completely without sound*). We distinguish between the measure expressions that are an answer to the question *To what extent?* (Extent-modifiers) and expressions that modify an answer to the question *How many?* (Quantity-modifiers). The Extent-modifiers are formally, structurally and semantically more diverse than the Quantity-modifiers. For the Quantity-modifiers a list of forms and functions is provided. Theoretical knowledge stemming from the analysis will subsequently be used to improve the annotation in the Prague Dependency Treebanks. It can be also useful for other semantically-oriented descriptions of language.

Keywords: measure modifier, syntax, semantic annotation

1 INTRODUCTION

Semantico-syntactic annotation in the Prague Dependency Treebanks (PDT; Hajič et al. 2020a, 2020b) offers broad coverage of semantic phenomena such as semantic role labeling, modalities, discourse, coreference, information structure. However, there is still need for a fine-grained treatment of many categories. The adverbial category is of a special interest, as it covers a wide range of different meanings (temporal, spatial, measure, etc.). These meanings are captured by the *functor* label. However, it is coarse-grained category and a detailed classification is needed for a more precise description of the meaning.

In our previous work we have presented a detailed description of spatial and temporal meanings (Mikulová – Panevová 2021). At present, we focus on refining the classification of the meanings generally related to measure. In the contribution, we propose a formally, syntactically and semantically based analysis of measure expressions verified on a large number of examples from the PDT corpora. Theoretical knowledge stemming from the analysis will subsequently be used to specify and improve the annotation of measure meanings at the PDT tectogrammatical

layer. This effort is in line with the current trend in the field of computational linguistics – to develop language resources annotated semantically.

2 RELATED WORK

Recently, computational linguistics has become increasingly interested in annotation that aims at an adequate description of the meaning. *Measure* is an interesting phenomenon in that effort and has been studied by logicians, theoretical and computational linguists. An approach that combines ideas from formal semantic theories (Barwise – Cooper 1981; Kamp et al. 2011) has been applied in the development of the annotation scheme **QuantML** (Bunt et al. 2022). Under a similar approach, the **Parallel Meaning Bank** (Abzianidze et al. 2017; Bos 2021) is built. It is a project of semantically annotated multilingual corpus, built on the Combinatory Categorial Grammar (Steedman 2001). In the notation of the corpus, for modified numeral expressions (*about 20*) a set of comparison operators to indicate approximate, lower, or higher values is used, e.g. $X \approx Y$ is for approximately equal to, $X < Y$ for less than.

In the framework of the **Uniform Meaning Representation** (Van Gysel et al. 2021), the annotation of the measure phenomenon is adapted from the **Abstract Meaning Representation** project (Baranescu et al. 2013). A measure expression is captured as a separate concept (node in a graph), e.g. a measure modifier of adverbial character (*less powerful*) is captured as a *degree* concept node. UMR also allows to treat *degree* as an attribute of the property concept. It has three values: *equal*, *intensifier* (*very*, *extremely,* superlative form), and *downtoner* (*somewhat*, *relatively,* comparative form). Except for this case, no generalization is made for expressions of the same meaning.

3 MEASURE MEANINGS IN PDT

At the tectogrammatical layer in PDT, the tree-like dependency representation is conceived of as a linguistically structured meaning of the sentence. It contains only content words as its nodes. The types of the semantico-syntactic relations are represented by the *functor* attribute attached to all nodes. Functors represent the semantico-syntactic relations in a generalized way, which does not sufficiently capture more detailed meaningful distinctions. Their fine-grained classification into so-called *subfunctors* is assumed from the early stages of the Functional Generative Description theory within which the project is developed (Panevová 1980). In the current stage of PDT representation, different measure modifiers such as *approximately*, *very*, *completely* have the same value *EXT* (extent) and no fine-grained subcategorization is provided. Illustrative examples of subfunctors were given in Panevová (1980) and Mikulová et al. (2006). However, a comprehensive list of subtle categories has not yet been developed.

4 MEASURE MODIFIERS IN CZECH

The term **measure modifiers** covers expressions primarily of an adverbial nature[1] by which measure meanings are expressed. Based on the large volume of examples from PDT corpora easily available through the ForFun database (Mikulová – Bejček 2018), we analyze the measure modifiers from the formal, syntactic, semantic point of view:

(i) What formal means are used to express measure meanings? (formal aspect)

(ii) What function do the measure modifiers have in a dependency structure? (syntactic aspect)

(iii) What meanings do the measure modifiers express? (semantic aspect)

In the following analysis, we will discuss these aspects in detail.

Within the diverse group of measure modifiers, we distinguish between the measure modifiers that are an answer to the question *To what extent?* and modifiers that modify an answer to the question *How many?* and we divide the modifiers into two groups:[2]

Extent-modifiers modify the internal characteristics of events (*hodně pracuje* 'he works a lot'), properties (*hodně velký* 'very big') and relations (*úplně bez zvuku* 'completely without sound').

Quantity-modifiers relate to counting, they modify an (exact) expression of a number/quantity (*přibližně deset chlapců* 'approximately ten boys').

4.1 Formal point of view

The measure modifiers are primarily expressed by adverbs. However, while the group of adverbs for expressing Quantity-modifiers (*přesně* 'exactly', *téměř* 'almost'; cf. (1) and Tab. 1) is limited, the group of adverbs that modify property, event or relation (Extent-modifiers) is much broader. In addition to the core of set of measure adverbs, which are the same for both groups (cf. *téměř* 'almost' in (1) and (2)), a number of other adverbs perform the function of Extent-modifiers (*trochu* 'a little', *značně* 'greatly' (3), *převážně* 'mostly', *napůl* 'half'). The group of measure adverbs include adverbs with a transparent measure meaning as well as adverbs that are homonymous with intensifying particles (*zcela* 'completely', *vůbec* 'at all'; cf. Šindlerová – Štěpánková 2021). Expressively, adverbs of manner (*hrozně* 'terribly'

[1] Note that expressions of quantity after verbs with the meaning "measurement of some physical property" (*it weighs five kilos*) are obligatory arguments of the respective predicates. In our approach, an expression which is an answer to the question *How many?* is not considered as a measure modifier. As a measure modifier, we only understand a modification of the expressed quantity (*approximately five kilos*).

[2] A similar division can be found in other studies on measure and quantification. Gil (1993) or Keenan (2012) divide measure modifiers according to their character as adverbial or nominal-like. Similarly in Czech grammars, quantitative attribute and adverbial of measure are distinguished. Unlike these divisions based on syntactic behavior our distinction also reflects semantics.

(4), *silně* ‘strongly’) are also used to express a large measure; diminutives (*malinko* ‘very little’ (4), *drobet* ‘very little’) are used to express a small measure. Extent-modifiers are further expressed by prepositional phrases with the nouns *míra* ‘measure’ (5), *výše* ‘amount’, *část* ‘part’, etc. Exact measure can be also expressed in percentages or as a part of the whole (6). Some idiomatic phrases also carry measure meanings (*do puntíku* ‘on the dot’ (7), *celým srdcem* ‘wholeheartedly’). Their usage is limited to certain semantic contexts.[3]

(1) *Náklady činily **téměř** miliardu korun.* ‘Payload was **almost** a milliard of crowns.’
(2) *Situace je **téměř** neřešitelná.* ‘The situation is **almost** unsolvable.’
(3) *Firma byla **značně** oslabena.* ‘The firm was **considerably** weakened.’
(4) *Maminka uměla **hrozně malinko** česky.* ‘Mother spoke **terribly little** Czech.’
(5) *Podnikání má zlaté dno jen **do určité míry**.* ‘Making business is a gold-mine only **to a certain extent**.’
(6) *Akcie s hodnotou 0.5 je nestabilní **z poloviny**, s hodnotou 1.5 **ze 30 %**.* ‘The share with the value of 0.5 is not stable **by half**, with 1.5 **by 30%**.’
(7) *Splnili to **do puntíku**.* ‘They fulfilled it **on the dot**.’

One of the differences between Extent-modifiers and Quantity-modifiers is that the Quantity-modifiers are not only expressed lexically (by a content word), but also using preposition (cf. (8) vs. (9)). E.g. an approximate number is expressed using the preposition *kolem*+2 ‘about’ (9), the quantity “less than the given value including the given value” by the preposition *do*+2 ‘up to’ (10). The meaning “less than the given value” and “more than the given value” is also expressed using the phrase with *než* ‘than’ (11).

(8) *Doba čekání je **zhruba** čtyři roky.* ‘The waiting time is **roughly** four years.’
(9) *Doba čekání je **kolem** čtyř let.* ‘The waiting time is **about** four years.’
(10) *cestující **do** 99 let* ‘passengers **up to** 99 years of age’
(11) v*ýsledek **více než** desetileté práce* ‘the result of **more than** ten years of work’

4.2 Syntactic point of view

Measure modifiers are very interesting especially from a syntactic point of view. The Extent-modifiers roughly correspond to the traditional description of adverbials, i.e., adjuncts that may modify (depend on) a verb (3), adjective (2) or adverb (4). However, from our data analysis, it follows that also the entity itself (expressed by a noun) can be modified to some extent, cf. (12)–(13).

(12) *Je to opravdu **téměř** cestopis.* ‘It is really **almost** a book of travels.’
(13) *Jsem jí **víc než** sestra.* ‘I am **more than** a sister to her.’

[3] A measure modification of nominalized events is expressed using adjectives. Cf.:
(a) *Most nebyl **úplně** uzavřen.* ’The bridge has not been **completely** closed.’
(b) *Nedošlo k **úplnému** uzavření mostu.* ’There was no **complete** closure of the bridge.’

Moreover, the various circumstantial relations expressed by prepositions may be modified themselves to some extent. In (14) the temporal relation "since when" is modified, in (15) the spatial relation "outside" and in (16)–(18) other special types of circumstances are modified.[4]

(14) *Vyrůstal jsem zde **skoro** od narození.* 'I grew up here **almost** from birth.'
(15) *To je **úplně** mimo ves.* 'It is **completely** outside the village.'
(16) *Povedlo se to **částečně** kvůli spojenectví.* 'It succeeded partly because of the alliance.'
(17) *Ceny skončily **téměř** beze změn.* 'The price ended **almost** without a change.'
(18) *Pracuji **převážně** podle plánu.* 'I work **mostly** according to the plan.'

The Quantity-modifiers primarily modify the (exact) expression of the number of entities, i.e., the so-called quantitative attribute (Kopečný 1953) expressed by the cardinal numeral in a noun phrases (1). However, the Quantity-modifiers generally modify expressions of various parts of speech that include a number. This means that they modify all types of numerals: ordinal numerals which are of an adjective nature (19), multiplicative numerals of an adverb nature (20). They further modify compound words, one part of which is a number, typically compound adjectives such as *šestiměsíční* 'six-month' (21), and verbs with meaning "to make X-fold" (*zdvojnásobit* 'double' (22)).

(19) *Dostal se tam **zhruba** třetí den.* 'He got there **approximately** the third day.'
(20) *Zvýšil se **více než** desetinásobně.* 'It went up **more than** by ten times.'
(21) ***maximálně** šestiměsíční vězení* '**maximally** a six-month imprisonment'
(22) *Podpora se **téměř** zdvojnásobila.* 'The support has **almost** doubled.'

Consequently, it is difficult to design an adequate syntactic representation of measure modifiers within the traditional dependency syntax. How to capture that measure expressions in (14)–(18) modify the meaning of the preposition (relation) and not the noun (its internal characteristics) within the same prepositional phrase? Similarly, it is difficult to capture the difference between cases in which a measure expression modifies the entire situation expressed by a verb (*vzorky převážně ztmavly* 'samples mostly darkened') and cases in which it modifies only an internal characteristics of the verb (*nepatrně ztmavly* 'samples darkened slightly'). And how to capture a modification of only part of a word as in (20)–(22)?

4.3 Semantic point of view

Our analysis of measure meanings is based on the assumption that there is no one-to-one relation between meaning (represented by the functor-subfunctor

[4] In the domain of temporal and spatial relations, the measure modification of a relation can be expressed very explicitly (*20 days before the loan*). Here, we leave this issue aside. We also do not consider the cases where measure modification is expressed as a consequence (*a profit so big that no one expected it*), by difference (*profit greater by two percent*), or by comparison (*profit greater than last year*).

combination in PDT) and the way it is expressed in the text. One meaning can be expressed by several different means whereas one form can be used to express different functions. Analyzing fine-grained meanings, we apply the principle of substitutability of forms. As for adverbs (a typical means of measure modifiers), it is not very common for them to have different meanings. Only some adverbs express more measure meanings: *docela* carries the meaning "completely" and is substitutable with *zcela*, *naprosto* 'completely' in (23) and it has the measure-certain meaning "to a certain extent" (cf. Vondráček 1999) and is substitutable with *poměrně* 'relatively' in (24).

(23) *Má to **docela** jinou chuť.* 'It has a **completely** different taste.'

(24) *Anglicky umím **docela** dobře.* 'I know English **relatively** well.'

Meaning	**Forms**	**Examples**
exact exactly the given value	*právě akorát* *přesně*	Trvalo mi to ***akorát*** pět minut. 'It took me **just** five minutes.' Do konce mu chyběla ***přesně*** půlhodina. 'He was **exactly** half an hour away from the end.'
approx approximately the given value	okolo+2 kolem+2	***okolo*** 1000 litrů vína '**around** 1,000 litres of wine' Doba čekání je ***kolem*** čtyř let. 'The waiting time is **around** four years.'
	přibližně zhruba asi tak řádově *plus minus nějaký* *cirka cca víceméně*	Jezdím ***tak*** jednou za měsíc. 'I go **about** once a month.' To jsem já ***plus mínus*** před pěti lety. 'This is me **plus minus** five years ago.' Víno dělám ***cirka*** dvacet let. 'I have been making wine for **approximately** twenty years.' Bylo mi ***nějakých*** šest let. 'I was **about** six years old.'
almost the given value	*téměř skoro takřka* *bezmála málem*	Odešli po ***takřka*** pěti desítkách let. 'They left after **almost** five decades.' ***bezmála*** pět metrů dlouhý vůz '**almost** five meter long car'
less than the given value	pod+4	Inflace klesla ***pod*** dvě procenta. 'Inflation fell **below** two percent.'
	méně než	To je ***méně než*** 4.6 %. 'This is **less than** 4.6%.'
more than the given value	nad+4 přes+4	vedra ***nad*** 40 stupňů Celsia 'heat **above** 40 degrees Celsius' Zajel rekordní kolo ***přes*** 228 km/h. 'He drove a record lap of **over** 228 km/h.'
	více než *pryč*	***více než*** dvojnásobný čistý zisk '**more than** double net profit' Bylo mi osmnáct ***pryč***. 'I was eighteen **gone**.'

Meaning	Forms	Examples
lessincl less than the value incl. the value	(až) do+2 (až) k+3	cestující ***do*** 99 let 'passengers **up to** 99 years of age' Obchody stoupají ***až k*** 145 jenům. 'Deals go **up to** ¥145.'
	maximálně *nejvýše až*	***maximálně*** šestiměsíční vězení '**a maximum of** six months' imprisonment' Je možné převážet ***nejvýše*** dva tisíce korun. 'It is possible to transport **a maximum of** 2,000 crowns.'
moreincl more than the value incl. the value	od+2	Auta jsou k dostání ***od*** 15000 dolarů. 'Cars are available **starting at** $15,000.'
	minimálně *nejméně aspoň* *přinejmenším*	Byl ***minimálně*** dvakrát obětí loupeže. 'He has been robbed **at least** twice.' Je sledován ***přinejmenším*** třemi analytiky. 'He is checked by **at least** three analysts.' Všichni vlastní ***alespoň*** jedno kolo. 'Everyone owns **at least** one bike.'
total	*celkem celkově*	***Celkem*** pětkrát změnili bydliště. 'They changed their place of residence five times **in total**.'
average	*průměrně v průměru*	Stojí to ***průměrně*** 200 korun. 'It costs **an average** of 200 crowns.'
order	*řádově*	průměr jádra je ***řádově*** 10^{-12} cm 'the diameter of the nucleus is **of the order** of 10^{-12} cm' (Cf. Hladiš 1965)

Tab. 1. Measure meanings of Quantity-modifiers

Different formal means and various measure meanings can be also combined and "layered" one on another; cf. (25)–(26).

(25) ***tak asi okolo*** *1000 litrů vína* '**approximately about** 1,000 litres of wine'

(26) *Sehrají* ***minimálně asi*** *dvacet her.* 'They play **minimally about** twenty matches.'

The means that differ stylistically or belonging to a different variety of contemporary Czech (*od – vod* 'from', *velmi* 'very'– *děsně* 'terribly') are considered here as expressions of the same meaning.

Based on the analysis, it is clear that the Extent-modifiers are semantically more diverse than the Quantity-modifiers. Within the Quantity-modifiers, there is a relatively limited repertory of formal means for a limited number of meanings. Particular modifiers place the expressed number on the number line with varying degrees of accuracy. Each partial meaning can be expressed by a set of adverbs, or in the case of a quantified noun phrase, also by means of prepositions. See Tab. 1 for an overview of the measure meanings of Quantity-modifiers.

Meaning	Forms	Examples
large measure	*velmi velice hodně dost moc značně výrazně vysoce hojně ohromně nesmírně mohutně silně mocně notně hrozně příšerně pěkně ve velkém ve velké/značné/hojné míře*	Uveřejňování článků je ***nesmírně*** důležité. 'Article posting is **very** important.' tento ***vysoce*** zajímavý jev 'this **highly** interesting phenomenon' Na staveništi se ***mohutně*** finišovalo. 'They finished **strongly** on the construction site.' Na škole se ***mocně*** krade. 'There is **a lot of** stealing at school.' Je ***pěkně*** vystresovaná. 'She's **pretty** stressed out.' ***V hojné míře*** kouří cigarety. 'He **heavily** smokes cigarettes.'
extreme measure	*krajně extrémně enormně radikálně diametrálně do krajnosti*	Taková věc je ***krajně*** nepříjemná. 'This is **extremely** annoying.' enormně předražené byty '**enormously** overpriced apartments' ***do krajnosti*** vybičovaná inscenace 'a production whipped **to the extreme**'
atmost the largest possible measure	*maximálně nanejvýš úplně zcela naprosto navýsost docela veskrze zhola absolutně totálně nadobro nadevše stoprocentně v plné míře na sto procent*	Situace je ***maximálně*** obtížná. 'The situation is **the most** difficult.' Jezdí se ***nanejvýš*** ohleduplně. 'It is driven with **utmost** consideration.' Žvýkání je činností ***veskrze*** lidskou. 'Chewing is a **completely** human activity.' ***Totálně*** se odvrátila od principů. 'She has **completely** turned away from principles.' ***stoprocentně*** spolehlivé opatření '**100%** reliable measure' Zákrok byl ***v plné míře*** adekvátní. 'The intervention was **fully** adequate.'
oversized measure	*příliš nadměrně nadmíru přes míru přehnaně v nadměrné míře*	Nezkušení kluci ***nadměrně*** riskují. 'Inexperienced guys take **excessive** risks.' Pijí ***přes míru***. 'They drink **excessively**.' Nevystavujte se ***v nadměrné míře*** slunci! 'Do not **over**expose yourself to the sun!'

Tab. 2. Selected meanings of Extent-modifiers

A comprehensive description of the meanings within the group of Extent-modifiers is difficult. Even leaving aside the modification of circumstantial relations ((14)–(18) above), we are still dealing with a wide variety of formal means and diverse meanings; cf. (27)–(29).

(27) *Jsou vypouštěny **stoupající měrou**.* 'They are released **in an increasing extent**.'

(28) *Pracovali **na 83.7 % kapacity**.* 'They worked **at 83,7% of capacity**.'

(29) *Pijí **přes míru**.* 'They drink **beyond measure**.'

In our analysis, we have focused on the modifiers expressed by an adverb. A detailed list with forms and examples for the selected meanings is given in Tab. 2. An overall overview of the basic set of Extent-modifiers meanings is summarized in Tab. 3.

5 CONCLUSION

In the contribution, we propose a formally, syntactically, and semantically based fine-grained classification of measure expressions verified on the analysis of a large number of examples from the Prague Dependency Treebanks. The analysis of the material reveals the diversity of structures and their relative difficulty in classification. We demonstrate that the measure modifiers involve modifying the quantity of entities (*about ten boys*), extent of property expressed by adjectives (*very big*), adverbs (*very slowly*), verbs (*work a lot*), nouns (*more than sister*), and extent of relation expressed by preposition (*almost without sound*). Within this diverse group, we distinguish between the measure modifiers that are an answer to the question *To what extent* (Extent-modifiers) and modifiers that modify an answer to the question *How many* (Quantity-modifiers). The Extent-modifiers are formally, structurally and semantically more diverse than the Quantity-modifiers. For the Quantity-modifiers the comprehensive description of their meanings and forms is provided.

Meaning		**Examples**
exact	exact measure	***akorát*** úspěšný '**just** successful'
approx	approximate measure	***víceméně*** úspěšný '**more or less** successful'
large	large measure	***velmi*** úspěšný '**very** successful'
extreme	extreme measure	***extrémně*** úspěšný '**extremely** successful'
small	small measure	***trochu*** úspěšný '**slightly** successful'
atmost	the largest possible measure	***maximálně*** úspěšný '**maximally** successful'
atleast	the smallest possible measure	***minimálně*** úspěšný '**at least** successful'
over	oversized measure	***nadmíru*** úspěšný '**overly** successful'
approp	appropriate measure	***přiměřeně*** úspěšný '**adequately** successful'
nonapp	non-appropriate measure	***nepřiměřeně*** úspěšný '**disproportionately** successful'
almost	almost appropriate measure	***skoro*** úspěšný '**almost** successful'
prev	prevailing measure	***vesměs*** úspěšný **'mostly successful'**
part	partial measure	***částečně*** úspěšný '**partially** successful'
enough	sufficient measure	***dostatečně*** úspěšný 'successful **enough**'

Meaning		Examples
notenough	insufficient measure	***nedostatečně*** úspěšný '**insufficiently** successful'
relat	relative measure	***relativně*** úspěšný '**relatively** successful'
half	half measure	***napůl*** úspěšný '**half** successful'
medium	medium measure	***středně*** úspěšný '**moderately** successful'
total	total measure	***celkově*** úspěšný '**overall** successful'
average	average measure	***průměrně*** úspěšný '**averagely** successful'
X-multiple	X-multiple measure	***mnohonásobně*** úspěšný '**many times** successful'

Tab. 3. Measure meanings of Extent-modifiers (a preliminary proposal)

ACKNOWLEDGEMENTS

The research has been supported by the Czech Science Foundation under the project GA23-05238S. This research also has used language resources and tools developed and/or stored and/or distributed by the LINDAT/CLARIAH-CZ project of the Ministry of Education, Youth and Sports of the Czech Republic (LM2023062).

References

Abzianidze, L. et al. (2017). The Parallel Meaning Bank: Towards a Multilingual Corpus of Translations Annotated with Compositional Meaning Representations. In Proceedings of the 15th Conference of the European Chapter of the Association for Computational Linguistics, Valencia, pages 242–247.

Baranescu, L. et al. (2013). Abstract Meaning Representation for Sembanking. In Proceedings of the 7th Linguistic Annotation Workshop, Sophia, pages 178–186.

Barwise, J., and Cooper, R. (1981). Generalized Quantifiers and Natural Language. Linguistics and Philosophy, 4, pages 159–219.

Bos, J. (2021): Quantification Annotation in Discourse Representation. In The 17th Joint ACL – ISO Workshop on Interoperable Semantic Annotation, Groningen.

Bunt, H. et al. (2022). Quantification Annotation in ISO 24617-12. In Proceedings of the 13th Language Resources and Evaluation Conference, Marseille, pages 3407–3416.

Gil, D. (1993). Nominal and verbal quantification. Sprachtypologie und Universalienforschung, 46.4, Berlin: Walter de Gruyter, pages 275–317.

Gysel van, J. E. L. et al. (2021). Designing a Uniform Meaning Representation for Natural Language Processing. Künstl Intell 35, Springer-Verlag, pages 343–360.

Hajič, J. et al. (2020a). Prague Dependency Treebank – Consolidated 1.0. In Proceedings of the 12th International Conference on Language Resources and Evaluation, Marseille, pages 5208–5218.

Hajič, J. et al. (2020b). Prague Dependency Treebank – Consolidated 1.0. LINDAT-CLARIAH, Prague: Charles University. Accessible at: http://hdl.handle.net/11234/1-3185.

Hladiš, F. (1956). K významu a užití příslovce řádově. Naše řeč, 48(4), pages 254–256.

Kamp, H. et al. (2011). Discourse Representation Theory. In Handbook of Philosophical Logic, 15, Elsevier, MIT, pages 125–394.

Keenan, E. L. (2012). The Quantifier Questionnaire. In Handbook of Quantifiers in Natural Language. Studies in Linguistics and Philosophy, 90, Dordrecht: Springer.

Kopečný, F. (1953). Kvantitativní přívlastek a určení míry. Slovo a slovesnost, 14(3), pages 115–121.

Mikulová, M. et al. (2006). Annotation on the tectogrammatical level in the Prague Dependency Treebank. Annotation manual. Technical report, 2006/30, Prague: Charles University.

Mikulová, M., and Bejček E. (2017). Prague Database of Forms and Functions 1.0. LINDAT/CLARIAH-CZ, Prague: Charles University. Accessible at: http://hdl.handle.net/11234/1-2542.

Mikulová, M., and Panevová, J. (2021). Formy a funkce okolnostních určení v češtině. Určení prostorová a časová. Prague: Charles University.

Panevová, J. (1980). Formy a funkce ve stavbě české věty. Prague: Academia.

Steedman, M. (2001). The Syntactic Process. Cambridge: The MIT Press.

Šindlerová, J., and Štěpánková, B. (2021). Between Adverbs and Particles: A Corpus Study of Selected Intensifiers. Jazykovedný časopis, 72(2), pages 444–453.

Vondráček, M. (1999). Příslovce a částice – hranice slovního druhu. Naše řeč, 82(2), pages 72–78.