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Recent developments in the theory of valency in the light of the Prague Dependency Treebank*

1. The framework

The Functional Generative Description (FGD, see Sgall, 1967, Sgall et al., 1986) was applied as a general framework for the development of the valency theory (see Panevová, 1974-75, 1980, 1994) as well as for the design of the Czech syntactically annotated corpus (PDT, see Hajič, 1998, Hajičová et al., 2001).

Valency is understood as a lexico-syntactic attribute of a word – more precisely, of a particular lexical sense of the lemma, called here lexis ("lexie" in Czech terminology, see Filipec and Čermák, 1985). More precisely, we can understand a lexis as a pair formed by a lexical unit and one of its meanings.[1] A valency frame (VF) is assigned to every auto-semantic lexical unit (lexis). This, however, may be empty, e.g. with the Czech verb *pršet [to rain]*, with nouns such as *stůl [the table],* adjectives as *hezký [beautiful].* The labels used for the valency slots belong to the underlying structure (tectogrammatics) and, together with the lexical unit (lexis), they constitute a tectogrammatical representation of the lexical entry. With regard to the applied tasks, we include the morphemic counterparts of the particular valency slots as a part of the (complex) frame of the given unit.

Valency is prototypically connected with verbs. We have distinguished two main classes of verbal complements:

(i) inner participants, IP in the sequel (ACT(or), PAT(ient), ADDR(essee), ORIG(in) and EFF(ect)),

(ii) free modifications, FM in the sequel.

The criteria for the distinction between these two classes are given in Panevová (quoted above).

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[1] The formal representation of lexis in FGD has not yet been specified. The surface shape (lemma) of the lexical item is used instead (with a differentiating subscript, if necessary).

Valency frames of lexes are constituted by their respective inner participants (either obligatory or optional) and by their obligatory free modifications.[2]

We share Tesnière's (1959) approach as to the one-argument and two-argument verbs: the first slot is structured as ACT(or) (though it corresponds to different semantic (ontological) roles, such as Bearer, Processor, Stimulus etc.); with two-argument verbs the inner participants are structured as ACT(or) and PAT(ient). The relation between the syntactic arguments and their cognitive roles is called a "shifting of participants", see Panevová, 1980. If the verb has three (or more) valency slots, the semantics of them is taken into account. This strategy agrees with the theory of case meanings, distinguishing between syntactic (grammatical) cases and semantic (concrete) cases (see Kuryłowicz, 1949): the valency slots of ACT and PAT are occupied mostly by syntactic cases (Nominative and Accusative, respectively), while the other participants and free modifications are expressed mostly by cases with concrete (semantic) meanings.

2. An introduction of quasi-valency complements

In section 1 we briefly summarized the basic features of our valency theory of verbs. However, in the course of empirical studies of material, especially in connection with the building of the valency lexicon of verbs VALLEX (see Lopatková, Žabokrtský, 2003 and section 5 below) and with a tectogrammatical annotation of PDT (see Urešová, this volume), some unresolved problems appeared. Firstly, it was necessary to introduce some additional functors (types of syntactic-semantic relations) for newly discovered semantically relevant distinctions (namely OBST(acle) and MED(iator)). In analyzing their semantic and syntactic distribution, we observed that they share partly the features of inner participants, and partly the features of free modifications. Secondly, revisiting the list of verbal complements introduced earlier, we discovered that some complements (namely DIFF(erence) and INT(ent)) also share important features of inner participants (see (i), (ii) and (iii)), although they also have some of the characteristic features of free modifications (see (iv), (v) and (vi)):

(i) they are governed (their morphemic shape is determined) by their verbal heads

(ii) they occur with a limited class of verbs

[2] We prefer this terminology rather than the terminology used in Daneš et al., 1981 and "Mluvnice češtiny 3", 1987. There the term "potenciální" (potential) is used for optional as well as for obligatory positions of VF omitted on the surface. Moreover, the difference between the VF as a part of lexicon and its application for the concrete utterance is not reflected in the terminology common in Czech handbooks.

(iii) they cannot be repeated,

however

(iv) as to their meaning, they are semantically homogeneous

(v) they do not underlie the "shifting"

(vi) they are mostly optional.

We also reconsidered the complements ADDR, ORIG (and perhaps EFF) from this point of view. The complements ADDR and ORIG undoubtedly fulfill (i), (ii), (iii) characteristics for IP, but also (iv),[3] which is typical of FM ; they do not meet (v) and (vi). The features of EFF shared with quasi-valency complements are limited; (i), (ii) and (iii) are present in EFF, but one of the most important quasi-valency features (iv)is missing here. This is the main reason why we still classify EFF as an inner participant. However, we are still undecided as to whether the ADDR and ORIG should not be classified as quasi-valency complements, too.

2.1 Obstacle

The meaning of OBST(acle) is expressed in Czech by the prepositional group *o + Accusative* with verbs like *zakopnout [to stumble], uhodit se [to strike oneself], bouchnout se [to bump oneself], zranit se [to injure oneself], píchnout se [to prick oneself], bodnout se [to prick oneself]*. Their form is governed by their head verbs. In handbooks on Czech syntax they are classified as Means (Instrument), but they undoubtedly have a special instrumental semantics, see (1), (2) and (3):

(1) Jan zakopl nohou o stůl
[John stumbled over the table with his leg]

(2) Matka se píchla nůžkami
[Mother pricked herself with the scissors]

(3) Růženka se píchla o trn
[Sleeping Beauty pricked herself on a thorn]

In (1) *noha [leg]* is a proper means (Instrument), while the construction *o stůl [about the table]* is not. In (2) *nůžky [scissors]* refers to a device used as an Instrument proper, its semantics includes the semantics of movement with this instrument. In (2) the manipulation with scissors is presumed, while in (3) the noun *trn [thorn]* (with an instrumental semantics)

[3] This statement is valid at least for verbal valency features. As for nouns, see Section 4 below.

is fixed (see also Apresjan, 2001). The feature of an unconscious action is typical of (3), while in (2) the action can be either conscious or unconscious. For the semantics of "fixed" Instrument (expressed by the prepositional group *o* + *Accusative*) the new label Obstacle was proposed (initially in Panevová, 2003). All the verbs listed in this sample imply their unconsciousness. The verbal modification of Obstacle shares the features of the group of inner participants (i), (ii) and (iii), but also all the features listed above as free modification attributes (iv), (v), and (vi)[4].

2.2 Mediator

Also, the Czech prepositional group *za* + *Accusative* is described in syntactic handbooks as a kind of Instrument, see e.g. (4), (5), (6):

(4) Otec přitáhl kluka levou rukou za ucho
[Father has drawn boy's ear by his left hand]
(5) Když jsem odcházel, zatahal mě soused za rukáv
[When I was leaving, the neighbor pulled my sleeve]
(6) Jan přivedl psa za obojek
[John brought the dog by its collar]

Examples (4) to (6) demonstrate that the semantics of this prepositional group is different from the pure Instrument. Pure Instrument is usually used by the Actor of the action directly, while in (4) to (6) the instrument is a part of another entity (the ear belongs to the boy in (4) and as a part of a boy it is used for drawing the boy). In (4) the Instrument proper is present (*ruka [hand]*). The Actor uses his own hand as a means to reach the boy, and he uses the boy's ear as a Mediator for reaching him. Like the Obstacle, the Mediator shares some features of IP and some of the class of FM. Unlike the Obstacle, we have not yet found any verb with an obligatory Mediator.

2.3 Difference

The prepositional group *o* + *Accusative,* although it mostly combines with the comparatives of adjectives or adverbs, can also occur with some verbs (see e.g. (7), (8), (9) for verbs, (10) for an adverb):

[4] Feature (vi) has some exceptions: we have found the verbs *zavadit [to touch], (za)chytit (o něco) [to get caught (on st)]* with obligatory OBST.

(7) Inflace se zvýšila proti roku 2000 o několik procent.

[The inflation has increased in comparison with 2000 by several percent]

(8) Náš tým zvítězil o dvě branky

[Our team won by two goals]

(9) Jan zvítězil v závodě o prsa

[John won the race by a hair's breadth]

(10) Postupte o dva schody výš

[Move two steps higher]

The modification of DIFF(erence) can be characterized as a kind of extent, but while the general extent expresses nothing more than a high or low degree, the modification of DIFF specifies the extent more precisely. At least two entities are compared here, although one of them is more or less implicit (inflation in the current year and in 2000 are compared in (7), the score of a match of two teams are compared in (8), John's rivals are understood in (9) as the other entity) and the difference between them is explicitly expressed by the Difference modification.

2.4 Intent

The modification of INT(ent) is compatible mainly with the verbs of motion and it differs from the FM of AIM: an actor of the INT is identical with the person that provides the intended action himself/herself (the action can be transformed into a nominalization, see e.g. (12), contrary to (13), where the FM of AIM is expressed). The actor (mother in the case of (13)) only transfers potatoes from one place to another. The difference between INT and AIM could be exemplified by the acceptability of (14a) and unacceptability of (14b).[5]

(11) Jan se šel koupat

[John went to swim]

(12) Helena šla na jahody

[Helen went (to pick) strawberries / *lit.* Helen went on strawberries]

[5] The introduction of the INT complement is supported by the findings presented in Poldauf, 1959. The prototypical expression of an INT is an infinitive; unprototypically, the prepositional expression is used (see (12)); it implies the active participation of the actor in collecting strawberries. This is the reason why (14b) is meaningless (at least in our actual world), somebody else (other than Helen) has collected the strawberries and delivered them to the shop.

(13) Matka šla do sklepa pro brambory

[Mother went to the cellar for potatoes]

(14a) Helena šla do krámu pro jahody

[Helen went to the shop for strawberries]

(14b) *Helena šla do krámu na jahody

[*Helen went to the shop (to pick up) strawberries / *lit.* Helen went to the shop on strawberries]

3. Valency of adjectives

Our analysis of adjective valency was aimed at the verification of two hypotheses:

(i) that the valency slots of adjectives share the roles of verbal complements;

(ii) that the shifting of participants is here valid in the same manner as with verbs (with one natural exception: one of the valency slots is absorbed by the governing noun in noun phrases or by the subject position in the clauses with the copula *být [to be]* so it is excluded from the valency frame of the respective adjective).

In the case of primary adjectives, the position of ACT is absorbed; with deverbal adjectives the absorbed position depends on the type of derivation (with active participles the position of ACT is absorbed as well, with passive participles PAT, ADDR or EFF is absorbed, for details see Panevová, 1998).

Otherwise, the deverbal adjectives share the valency of their source verbs.

The question of the lexical ambiguity of adjectives used for human qualities remains open. This consideration concerns such adjectives as *hrdý [proud], věrný [faithful]* etc. They are used either as the "absolute" attribute of a noun (and they have an empty valency frame), or they are used as relative adjectives with an obligatory PAT *(hrdý na* + Acc*, věrný* + Dat). We have also considered an alternative solution, where we have to deal with a single lexical sense for absolute and relative usage and where the optional PAT enters their valency frame (for more examples, see Panevová, 1998 and Panevová, in prep.).

4. Valency of nouns

The set of valency complements of nouns was extended, as proposed by Piťha, 1981, if compared with the set of valency complements of verbs. We have accepted his proposal as to the complements called there MAT(erial) (as an obligatory or an optional noun participant)

and APP(urtanance) (as a free noun modification, obligatory with the listed nouns). We have reconsidered his proposal to classify ID(entity) as an optional participant of a noun; it should belong to the class of FM, because any noun can have its name (not only *loď Titanic [boat Titanic],* but also *tužka Koh-i-nor [pencil Koh-i-nor], souprava Julie [set Julia]).*
In the valency frame of many nouns, the same complements occur as in the VF of verbs. This is obvious for deverbal nouns (for details see Novotný, 1980, Karlík, 2000, Panevová, 2000 and esp. Řezníčková-Kolářová, 2003, Kolářová, in prep.). Moreover, the complements (functors) typical of verbs are compatible with a high number of primary nouns (e.g. PAT in *názor na něco [opinion on], příklad na něco/něčeho [example for], kniha o něčem [book on],* ADDR in *dárek někomu [gift to]*, ORIG in *daň z pozemku [tax for]*). In the last two cases, we again perhaps have to do with the absorption of one participant built within the head noun (*dárek* and *daň* are patients themselves, a gift is what was given, tax is what is paid).
The functor called ORIG(in) has a special position among noun complements. Although it has its counterpart within verbal inner participants, with nouns it typically behaves as a free modification: it is compatible with any primary noun and it can be repeated (š*aty ze lnu od starší sestry [a dress from linen from my elder sister], nábytek ze dřeva od našeho hlavního dodavatele [furniture from wood from our main provider]).* The interpretation of the inanimate noun expressing an Origin is material, while an animate name (and its equivalents as the names of institutions, human collectives etc.) corresponds to the source. A re-classification of Origin as a FM noun complement – proposed here for the first time within our framework – is based on its syntactic behaviour with nouns (different from its behaviour with verbs, where it cannot be repeated and it is not compatible with every verb).

5. The building of a valency lexicon based on the theory described

A description of valency is impossible without a good syntactically based framework, and – since valency differs from one lexical item to another – it cannot be described by general rules. Therefore a valency lexicon belongs among the basic language resources indispensable for any rules-based task of NLP (Natural Language Processing). Here we refer to the valency lexicon VALLEX, which has been created in connection with the annotation of PDT.[6]

[6] Besides VALLEX, a larger valency lexicon (called PDT-VALLEX, see e.g. Hajič et al., 2003, Urešová, this volume) has been created during the annotation of PDT. PDT-VALLEX contains more verbs (5200 verbs), but with only those of their senses that occurred in PDT, whereas in VALLEX the verbs are analyzed in their full complexity, in all their senses. In addition, richer information is assigned to particular valency frames in VALLEX, and stress is laid on the consistency and completeness of annotation.

The Valency Lexicon of Czech Verbs, Version 1.0 (VALLEX 1.0, http://ckl.mff.cuni.cz/zabokrtsky/vallex/1.0/) is a collection of linguistically annotated data and documentation, resulting from the attempt at formal description of the valency frames of Czech verbs. VALLEX 1.0 contains roughly 1400 verbs in all their senses (app. 4000 frame entries / senses). VALLEX is designed both for human readers and for application tasks in NLP as e.g. machine translation or information retrieval.

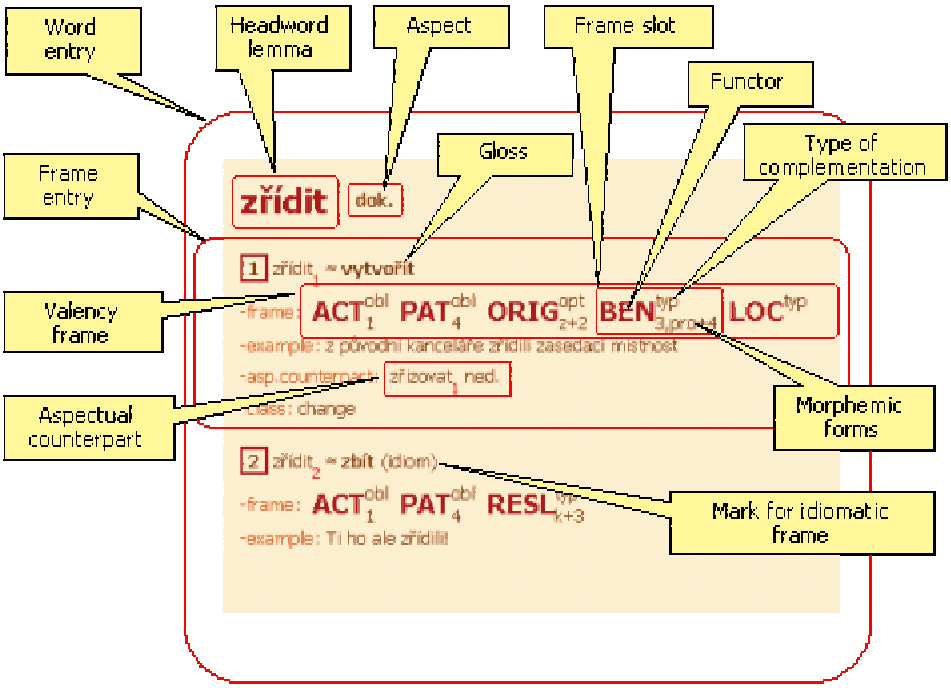

Figure 1: Word entry in VALLEX

A Czech verb as a whole, a verb lexeme (word entry in VALLEX) is an abstract unit made up by all the senses of a particular verb. A word entry consists of a (non-empty) sequence of frame entries, each of which corresponds to a single sense ("lexis", see above). Each frame entry describes the valency frame itself, the specification of a sense in question (by gloss(es) and example(s)), and additional information (as e.g. aspect, type of reflexivity, control, (preliminary) semantic class). A valency frame itself is a sequence of frame slots corresponding to (either required or specifically permitted) complements of a given verb. Each valency slot is characterized by its functor, i.e. the name of the syntactic-semantic relation (labels of underlying roles), and the possible morphemic form(s) (specification of morphemic case, prepositional group, infinitive or subordinated verbal construction).

A word entry in VALLEX corresponds to the whole lexeme; it consists of a (non-empty)

sequence of frame entries corresponding to a single sense.

We have formulated the following principles and functional criteria for distinguishing particular senses adopted that are connected with their valency. The principles can be characterized by two statements:

A. any change in valency frame (either in functor, in the combination of functors, or possible form(s) of functor) justifies an introduction of a new frame entry;

B. any significant change in sense justifies the introduction of a new frame entry.

These fundamental principles imply the following rules.

(i) The difference in the sense is a necessary but not sufficient condition for a postulation of two (or more) valency frames – a (slight) difference in the sense is ignored if lexical units do not differ syntactically.

(15) *hýbat$_1$ [to move]*[7] … ACT(1;obl) PAT(Instr,s+Instr;obl)
hýbat rukou; hýbat (s) křeslem
[to move (with) sb`s hand, to move an armchair]

In Czech lexicons "Slovník spisovného jazyka českého" [The dictionary of Standard Czech] (1964) as well as in "Slovesa pro praxi" [Verbs for Practice] (1997) two distinct senses are distinguished – "uvádět něco v pohyb, pohybovat" [to set st in movement, to move st] and "měnit polohu" [to change position (of st)]. In VALLEX, these two usages of the verb *hýbat* in (15) are described in a single valency frame – the difference in the senses is not taken into account, their syntactic behaviour being the same. The decision to ignore this type of difference is based on the fact that such a "fine-grained" distinction of senses is not reflected in the syntactic behaviour of the given lexical units and they are often not perceived, even by a human reader in real texts.

(ii) Two different senses can have an identical valency frame.

(16a) *chovat$_1$ [to cradle]* … ACT (1;obl) PAT(4;obl)
chovat dítě (v náručí)
[to cradle a child (in one`s arms)]

[7] The lower numeral index attached to the lemma denotes a particular frame entry in VALLEX notation.

(16b) *chovat$_2$ [to keep]* … ACT (1;obl) PAT(4;obl)
chovat prasata (na farmě)
[to keep pigs (on a farm)]

The indisputable different senses of the verb *chovat* have the same valency frame consisting of two inner participants, Actor and Patient with the same morphemic forms; however, the difference of the sense has to be reflected by distinguishing two different frame entries in VALLEX.

(iii) The change in morphemic realization signalizes the possibility of different senses.

(17a) *hlásit se$_2$ [to be counted among sb*] … ACT(1;obl) PAT(k+3;obl)
hlásit se ke komunistům
[to be counted among communists]
(17b) *hlásit se$_4$ [to apply for st]* … ACT(1;obl) PAT(o+4;obl)
hlásit se o svá práva
[to apply for own rights]

The change in morphemic realization signalizes different senses and thus two lexical items *hlásit se*$_2$ and *hlásit se*$_4$ are distinguished.

(iv)On the other hand, a particular complement in a valency frame can have morphemic variants (if they differ stylistically, rather than in their semantics).

(18) *učit$_1$ [to teach]* … ACT(1;obl) ADDR(4;obl) PAT(3,4,inf,že,zda,aby,jak;obl)
Učitel učí žáky matematice / matematiku / pracovat / ...
[Teacher teaches his pupils mathematics$_{Dat}$ / mathematics$_{Acc}$ / to work / ...]

With this lexical unit there is more than a single possibility to express the obligatory Patient.

(v) A change in valency frame is connected with a change of sense – two valency frames cannot share their senses.

(19a) *postavit$_1$ [to raise]* … ACT(1;obl) PAT(4;obl)

postavit sloup

[to raise a column]

(19b) *postavit$_2$ [to build]* … ACT(1;obl) PAT(4;obl) ORIG(z+2;opt)

postavit budovu; postavit model letadla z balzy

[to build up a building; to construct a model of a plane from balsa wood]

(20a) *poslat$_1$ [to send]* … ACT(1;obl) ADDR(3;obl) PAT(4;obl)

poslat matce dárek k narozeninám.

[to send sb`s mother a birthday gift]

(20b) *poslat$_2$ [to send]* … ACT(1;obl) PAT(4;obl) DIR3(;obl)

poslat zásilku do Konga

[to send a consignment to Congo]

The valency frames in (19a) and (19b) differ in the presence of an optional inner participant ORIG(in) – *postavit$_1$ [to raise]* cannot be modified by this complement. This distinction entails a clear distinction in the senses of *postavit$_1$* and *postavit$_2$* (reflected also by different translation equivalents, *to raise* and *to build*).

With some groups of verbs this principle is not obvious at first sight – they have two valency frames and their sense is rather close, e.g. *poslat* in (20a) and (20b). However, the detailed analysis of syntactic and semantic properties of some of these groups given in Benešová, 2004 shows clear syntactic and semantic distinctions in sense between them.

(vi)Different valency frames can reflect a primary and a secondary (figurative) usage of a given verb.

(20a) *dopadnout$_1$ [to fall (down)]* … ACT(1;obl) DIR3(;obl)

dopadnout na zem

[to fall down to the ground]

(20b) *dopadnout$_2$ [to strike]* … ACT(1;obl) PAT(na+4;obl)

Dopadly na ně starosti.

[Troubles have fallen on them]

Directionality proper and directionality in a metaphorical sense are met in (20a) and (20b). Despite the same morphemic realizations, different functors, namely DIR3 (direction – to where) and PAT, are assigned to the second complement. This distinction is justified by

different syntactic-semantic features (*dopadnout*$_1$ belongs to the "verbs of motion", unlike *dopadnout*$_2$).

Distinguishing the particular senses of a single verb lexeme is amongst the most complicated problems in the domain of constructing a lexicon. We have tried to discuss and exemplify the criteria connected with the valency behaviour of verbs.

6. Conclusion

The Czech data analyzed during the development of the PDT present some new issues not yet solved within the theoretical background. In confronting these issues, we have made some modifications in the framework: we have introduced new types of functors (syntactic-semantic relations) and we have shifted some functors into another class of valency complements. We have presented here several examples illustrating the methodology used in building up the valency lexicon (VALLEX 1.0). The relations between the lexical meanings of verbal units and their valency frames are illustrated in Section 5. We can conclude, however, that the changes to the framework resulting from the annotation of relatively large data are not substantial, although they have brought some refinements of the theory of FGD.

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