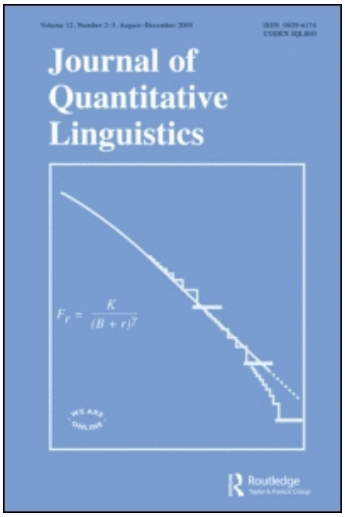

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Full Valency. Verb Valency without Distinguishing Complements and Adjuncts

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Full Valency. Verb Valency without Distinguishing Complements and Adjuncts*

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ABSTRACT

The aim of the article is to introduce a new approach to verb valency analysis. This approach – full valency – observes properties of verbs which occur solely in actual language usage. The term ''full valency'' means that all arguments, without distinguishing *complements* (obligatory arguments governed by the verb) and *adjuncts* (optional arguments directly dependent on the predicate verb), are taken into account. Because of an expectation that full valency reflects some mechanism which governs verb behaviour in a language, hypotheses concerning (1) the distribution of full valency frames, (2) the relationship between the number of valency frames and the frequency of the verb, and (3) the relationship between the number of valency frames and verb length were tested empirically. To test the hypotheses, a Czech syntactically annotated corpus – the Prague Dependency Treebank – was used.

Motto:

> ... the criteria for classifying an argument as a complement or an adjunct are anything but clear.
>
> (Rickheit & Sichelschmidt, 2007)

INTRODUCTION

Verb valency, the property of a verb which plays a central role in the structure of a sentence, has been observed for more than 50 years in linguistics (cf. Mathews, 2007; Tesnière, 1959). Although verb valency has been analysed intensively (e.g. Dixon & Aikhenvald, 2000; Herbst &

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Gotz-Votteler, 2007; Panevová, 1974; Sawicky, 1988; Zhao, 1995) and has become a ''standard'' notion in most branches of linguistics, some fundamental problems have not yet been resolved. One of the most important unsolved problems lies in the absence of clear criteria for distinguishing *complements* (obligatory arguments governed by the verb) and *adjuncts* (optional arguments), despite the fact that this distinction has been essential since the concept of verb valency appeared in linguistics (Comrie, 1993; Heringer, 1993; Rickheit & Sichelschmidt, 2007).

The approach to valency introduced in this article neither clarifies existing criteria for distinguishing complements and adjuncts nor brings new ones. What is proposed is a concept of valency without distinguishing between these two kinds of arguments – *full valency*. Moreover, the article presents a methodology which enables us to test empirically, in Popper's (1959) sense, whether full valency reflects some important language property or mechanism and whether full valency is related to other language properties.

THE TRADITIONAL CONCEPT OF VALENCY VERSUS FULL VALENCY

Valency, in the traditional sense, is usually viewed as a kind of a lexico-syntactic property which ''involves the relationship between, on the one hand, the different subclasses of a word-class (such as a verb) and, on the other, the different structural environments required by the subclasses, these environments varying both in the number and in the type of elements. Valency is thus seen as the capacity a verb has for combining with particular patterns of other sentence constituents'' (Allerton, 2005, p. 4878). In other words, valency ''denotes the property of the verb to claim or to admit, respectively, particular kinds and forms of complements. The verb opens up slots, in which the complements enter as arguments'' (Heringer, 1993, p. 303). Valency thus determines the number, form and meaning of *complements*, which are essential thematic roles and which are necessary to render a sentence grammatical – contrary to *adjuncts*, which are freely appendable (Rickheit & Sichelschmidt, 2007). The distinction between these two kinds of verb arguments plays a fundamental role in the traditional valency approach. More concretely, in sentence (1)

(1) *Peter saw Mary yesterday with Tom*

the words *Peter* and *Mary* are complements, while *yesterday* and *with Tom* are adjuncts.

From the perspective of traditional approaches in linguistics (structuralism, generative grammar), which are focused on language as a prerequisite system (e.g. langue, i-language, competence) enabling real communication (e.g. parole, e-language, performance), the distinction between complements and adjuncts is reasonable, and it corresponds to one's intuition. First, if one observes the properties of an abstract language system (langue, i-language, competence), i.e. the properties of *all possible* grammatically well-formed constructions in the language, it is obscure to speculate about a verb's arguments without distinguishing complements and adjuncts, because every event expressed by a verb happens in some place, at some time, for some purpose, for some reason, in some circumstances, in some conditions, and so on. Clearly, the eventual focus on *all possible* verb arguments in the framework of traditional linguistics makes the exploration of valency both worthless and practically impossible. Moreover, it is evident that some arguments are more closely related with the verb semantics than the others; the complement–adjunct dichotomy seems to reflect this fact.

On the other hand, the absence of clear criteria for distinguishing complements and adjuncts seriously undermines the traditional concept of valency and raises the question why no generally acceptable criteria have been found. In our view, the unsatisfactory state of the art is a consequence of traditional linguistic methodology – which is, of course, closely connected with the general theory of language. Concretely, if one explores *what is possible* (grammatically) in a language, one has to evaluate language data by *introspection* (which is the actual practice of the majority of linguists; cf. Sampson, 2005). The problem is that introspection exhibits a fundamental weakness, as is well known in experimental psychology, namely "the lack of effective means of obtaining interpersonal agreement among scientists on the interpretation of introspective data" (Estes, 2000, p. 21). So, if all tests used for distinguishing complements and adjuncts are based on a methodology which in principle cannot provide interpersonal agreement, it is not surprising that it has not yet been possible to find clear and interpersonally acceptable criteria.

The approach to valency presented in this article, i.e. *full valency*, is based on a different theory of language and methodology. First, the

language dichotomy (langue–parole; competence–performance) is rejected as a metaphysical concept which is empirically unprovable (Čech, 2005, 2007). If this language dichotomy is discarded, the goal of linguistic analyses is not to observe a potentiality of the abstract language system but to model a property of empirically observable language characteristics. Consequently language usage is the only material for linguistic analyses, and introspection is not needed as a method for obtaining linguistic data. In other words, if one adopts empirical methods as a cornerstone of the approach, introspection loses its importance and the language dichotomy loses its sense.

The term "full valency" means that all verb arguments which occur in observed language material are taken into account. A verb argument is an element of the sentence which is directly dependent on the predicate verb. For example, in sentence (2)

(2) *My father gave four books to Mary yesterday evening*

the words *father*, *books*, *to*, *yesterday* are assigned as arguments of the verb *gave* because they are direct dependents of the verb (see Figure 1).

The aim of our study is to explore whether full valency reflects any important language mechanism. Because of our conviction of the usefulness of empirical methodology, empirical tests are used to corroborate the prolificacy of the full valency concept. Specifically, the tested hypotheses concern (1) the regular distribution of full valency frames in a language, (2) the relationship between the number of full valency frames and the verb frequency, and (3) the relationship between the number of full valency frames and the verb length. If these hypotheses are not rejected, it seems reasonable to consider full valency as a linguistically meaningful notion (cf. Altmann, 2005), which could be integrated into the synergetic model of language (Köhler, 1999, 2005a, 2007). Moreover, this would shed new light upon the traditional view of valency.

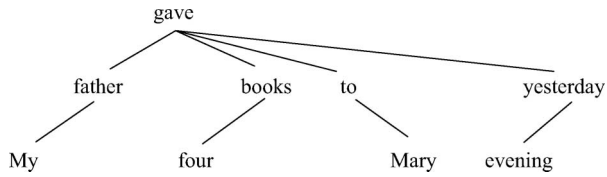

Fig. 1. Syntactic tree of the sentence (2) based on dependency syntax formalism.

THE FULL VALENCY HYPOTHESES

Regular Distribution of Full Valency

One of the most general processes in language and its evolution is diversification (cf. Altmann, 2005). This process is reflected in a decreasing rank-frequency distribution of particular language classes (e.g. parts of speech, word or sentence length, number of word forms) which always expresses some underlying regularity. Consequently, the observation of rank-frequency distribution is taken as a way of evaluating the advisability of any classification; linguistic classification is judged as ''good'', ''useful'' or ''theoretically prolific'' if the taxa follow a ''nice'' rank-frequency distribution. So if full valency represents the ''theoretically prolific'' class, it should have a regular distribution.

The More Frequent the Verb, the More Full Valency Frames

Relationships between frequency, on the one hand, and other language properties – such as length, polysemy, morphological productivity, morphological status and so on – on the other hand, are well known in synergetic linguistics (Köhler, 2005a; Popescu et al., 2009). The relationship between frequency and valency is also considered analogically (cf. Bybee & Hopper, 2001; Köhler, 2005b; Köhler & Altmann, 2009). The idea is clear: a more frequent verb occurs in more contexts, so it seems reasonable to expect that it should have more full valency frames.

The Shorter the Verb, the More Full Valency Frames

A relationship between the length of the verb and the number of full valency frames of the given verb should be a consequence of the relationship between frequency and length. It has been shown, since Zipf (1935), that length is a function of frequency (Popescu et al., 2009); the hypothesis is therefore based on the following idea: the more frequent a verb, the shorter it is, and consequently the shorter a verb, the more full valency frames it has. This hypothesis has already been tested for the traditional approach to valency (Čech & Mačutek, 2010) and it was not rejected.

LANGUAGE MATERIAL

The Prague Dependency Treebank 2.0 (hereinafter PDT) (Hajič et al., 2006) was used for the testing of the hypothesis. The PDT is a Czech

corpus comprised of articles from newspapers and journals, with interlinked morphological, syntactic, and semantic annotation. For the present purposes, the training data annotated on the analytical layer were used; this part of the PDT contains 4264 documents, 68,495 sentences and about 1.2 million words/tokens. The annotation is based on syntactic dependency formalism.[1]

It was shown above that the full valency concept is focused on the properties of predicate verbs. Because the PDT annotation ascribes the predicate function only to the head-clause, only head-clause predicates are calculated.

METHODOLOGY

The term ''full valency'' means that all verb arguments which occur in the observed language material are taken into account, as was shown above (see Figure 1). For testing the hypotheses, argument properties are determined as follows: *analytical functions* (e.g. subject, object), *morphological cases* (e.g. nominative, genitive), and *lemmas* (only in the case of prepositions) are taken as argument parameters. Particular parameters are assigned to arguments in accordance with the PDT annotation (see the list of parameters in Table 1). As an illustration, the annotation of sentence (2) is shown in Figure 2, and the full valency frame of the lemma GIVE, which is the predicate of sentence (2), is shown in Figure 3.

Detailed information concerning the parsing method is available in the Technical Report (see the website http://www.cechradek.ic.cz/@files/FV_tech_rep.pdf).

In all of the hypotheses, the number of valency frames is considered to be a variable. It should be noted that full valency frames are counted for particular verb lemmas, not word forms, and only formally unique full valency frames are calculated. This means that if the verb/lemma occurs in two or more identical full valency frames in the corpus, only one full valency frame is counted. Concretely, for the lemma COME presented in sentences (3) and (4), only one full valency frame is calculated (see Figure 4).

[1]Full documentation is available on the PDT 2.0 official website: http://ufal.mff.cuni.cz/pdt2.0/.

Table 1. The list of analytical functions and morphological cases.

Analytical function	Description
Pred	Predicate, a node not depending on another node
Sb	Subject
Obj	Object
Adv	Adverbial
Atv	Complement (so-called determining) technically hung on a non-verb. element
AtvV	Complement (so-called determining) hung on a verb, no 2nd gov.node
Atr	Attribute
Pnom	Nominal predicate, or nominal part of predicate with copula *be*
AuxP	Primary preposition
AuxC	Conjunction (subordinate)
AuxO	Redundant or emotional item, "co-referential" pronoun
AuxZ	Emphasizing word
AuxY	Adverbs, particles not classed elsewhere
AtrAtr	An attribute of any of several preceding (syntactic) nouns
AtrAdv	Structural ambiguity between adverbial and adnominal (hung on a name/noun) dependency without a semantic difference
AdvAtr	Ditto with reverse preference
AtrObj	Structural ambiguity between object and adnominal dependency without a semantic difference
ObjAtr	Ditto with reverse preference
Case marking	**Description**
1	Nominative
2	Genitive
3	Dative
4	Accusative
5	Vocative
6	Local
7	Instrumental

(3) *Mary came early*
(4) *Tom comes late*

The verb length is measured in syllables and the infinitive forms of verbs are considered. As for the overall verb frequency, the number of verb/lemma occurrences in the PDT is taken as a variable.

RESULTS

Distribution of Full Valency Frames

Similarly to the results presented by Čech and Mačutek (2010) (i.e. the number of valency frames applying the traditional approach to valency), also in this case we obtain a very regular distribution of valency frames (see Table 2).

Tentatively we suggest the Good distribution ($P_x = C\frac{p^x}{x^a}$; cf. Wimmer & Altmann, 1999), with the parameters a and p, C being a normalization constant, as a model. The distribution yields a satisfactory fit in terms of the χ^2 goodness of fit test, with $\alpha = 1.3289$, $p = 0.98$ and with the p-value $P = 0.8167$ (99 degrees of freedom).

Relationship Between Verb Frequency and Number of Full Valency Frames

In Table 3, x is the mean of frequencies of verbs which have $f(x)$ valency frames.

The presented data can be modelled by the function $f(x) = cx^{\alpha}$. We obtain the optimized parameter values $c = 1.0226$, $\alpha = 0.6464$, resulting in

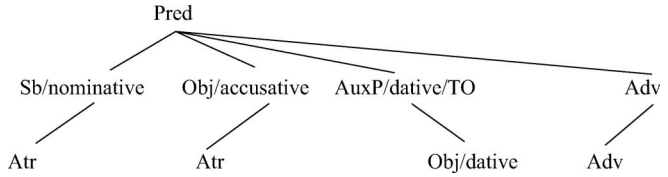

Fig. 2. The PDT annotation of the sentence (2) used for creation of the full valency frame.

GIVE
[Sb/nominative; Obj/accusative; AuxP/dative/TO; Adv]

Fig. 3. Full valency frame of the lemma GIVE, based on sentence (2).

COME
[Sb/nominative; Adv]

Fig. 4. Full valency frame of the lemma COME, based on sentences (3) and (4).

Table 2. Distribution of valency frames (x – number of valency frames, $f(x)$ – number of verbs with x valency frames).

x	$f(x)$	x	$f(x)$	x	$f(x)$	x	$f(x)$	x	$f(x)$	x	$f(x)$	x	$f(x)$	x	$f(x)$
1	1612	13	41	25	14	37	10	49	2	61	1	73	1	125	2
2	649	14	37	26	11	38	4	50	3	62	3	76	1	127	1
3	371	15	37	27	14	39	5	51	3	63	2	77	1	136	1
4	245	16	32	28	2	40	5	52	3	64	2	81	1	137	1
5	160	17	22	29	10	41	4	53	1	65	3	82	2	139	1
6	135	18	24	30	7	42	4	54	1	66	1	91	2	143	1
7	103	19	21	31	9	43	6	55	6	67	1	93	1	162	1
8	79	20	23	32	4	44	2	56	2	68	1	97	1	196	1
9	67	21	15	33	7	45	4	57	1	69	5	100	1	520	1
10	85	22	20	34	3	46	2	58	4	70	1	107	1	966	1
11	52	23	12	35	9	47	2	59	1	71	1	118	1		
12	40	24	9	36	8	48	4	60	2	72	1	122	2		

Table 3. Relationship between verb frequency x and number of valency frames $f(x)$.

x	$f(x)$	x	$f(x)$	x	$f(x)$	x	$f(x)$
39,922.00	966.00	637.00	66.00	348.00	46.00	151.52	20.00
13,372.00	520.00	595.00	59.00	337.00	45.00	145.92	23.00
6430.00	196.00	592.00	77.00	326.00	47.00	144.00	22.00
3144.00	136.00	591.67	65.00	310.50	44.00	140.95	17.00
2345.00	162.00	586.00	69.00	304.67	52.00	128.71	19.00
1849.00	100.00	544.00	70.00	295.25	32.00	119.96	18.00
1684.50	122.00	535.00	60.00	291.00	37.00	102.16	16.00
1556.00	139.00	531.00	54.00	288.38	36.00	97.11	15.00
1425.00	118.00	524.00	68.00	286.29	33.00	89.05	14.00
1363.00	137.00	520.00	61.00	282.00	34.00	85.49	13.00
1359.00	107.00	509.00	67.00	268.67	35.00	85.35	12.00
1356.00	125.00	502.50	63.00	257.50	38.00	71.67	11.00
1030.00	143.00	484.00	72.00	255.20	39.00	62.57	6.00
964.00	127.00	481.67	62.00	253.75	42.00	62.06	10.00
947.50	91.00	477.00	57.00	242.71	30.00	55.46	9.00
906.00	93.00	447.67	55.00	240.00	40.00	45.86	8.00
870.00	64.00	440.00	71.00	234.40	29.00	41.84	7.00
845.00	76.00	436.50	48.00	224.78	31.00	28.51	5.00
754.00	73.00	423.00	56.00	202.21	27.00	21.43	4.00
741.50	82.00	412.00	50.00	201.07	25.00	14.82	3.00
735.50	49.00	409.00	53.00	187.73	26.00	9.81	2.00
695.00	97.00	386.25	41.00	174.50	28.00	4.59	1.00
641.00	81.00	384.33	51.00	173.67	24.00		
638.50	58.00	352.17	43.00	155.47	21.00		

the determination coefficient $R^2 = 0.9778$. One can see that also in this case the fit is satisfactory.

Relationship Between Verb Length and Number of Full Valency Frames

The data presented in Table 4 are pooled so that there are at least 20 verbs in each category.

The data can be fitted by the function $f(x) = cx^{\alpha}e^{-bx}$, x being the mean verb length and $f(x)$ the mean number of valency frames in respective categories. One obtains the determination coefficient $R^2 = 0.8806$ and the optimized parameter values $c = 14809.2914$, $\alpha = 7.0135$, and $b = 4.7975$. The determination coefficient clearly attains a lower value than in the previous section, but still there is no reason to reject the model. The fit could possibly be better if one took the mean length of all verb forms which appear in the analyzed texts. We note that Čech and Mačutek (2010) investigated this phenomenon from the opposite "direction", i.e. they modelled verb length as a function of the number of valency frames.

CONCLUSION AND FURTHER RESEARCH

The present study is the first attempt, to our knowledge, to observe and test empirically full valency verb properties. Consequently, although none of the hypotheses were rejected for the Czech language and it seems reasonable to consider full valency as an important property of language, the approach is still at an embryonic stage and further analyses should be done. First, the observation of other languages is necessary. Naturally, the research presented here is just a first step and it

Table 4. Relationship between number of valency frames (VF) and mean verb length (VL).

VF	VL	VF	VL	VF	VL	VF	VL
185.85	1.60	28.30	2.73	16	3.19	8	3.13
71.25	2.58	25.44	2.76	15	3.05	7	3.18
58.57	2.75	23.43	3.19	14	2.92	6	3.27
49.62	2.86	21.57	3.06	13	2.83	5	3.28
42.90	2.90	20.00	3.09	12	2.90	4	3.19
38.21	2.96	19.00	3.00	11	3.17	3	3.22
35.25	2.50	18.00	2.79	10	3.08	2	3.27
31.90	2.70	17.00	3.09	9	3.04	1	3.28

is questionable whether the models fit data from other languages. If not, one will have to modify or generalize the models, or to find other ones. It goes without saying that one of the future tasks is also to interpret the parameters of the models. Second, hypotheses predicating relationships between full valency and other language properties (e.g. synonymy, polysemy, polytextuality, complexity; cf. Köhler & Altmann, 2009) have to be tested.

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